eHealth: Patient- Centric eHealth Services

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Evgeniy Krastev
Faculty of Mathematics and Informatics
Sofia University St. Kliment Ohridsky
Sofia, Bulgaria
e-mail: eck@fmi.uni-sofia.bg

Dimitar Tcharaktchiev
Department of Medical Informatics
Medical University
Sofia, Bulgaria
e-mail: dimitardt@gmail.com

Abstract—**This special track is dedicated to research in the rapidly developing subject area of eHealth with an emphasis on patient-centric services. Continuity of care has considerable impact on the quality of such services most of which essentially require some kind of interoperability. Therefore some of the major topics in the submitted papers are related to the implementation of the existing standards and technical specifications in health informatics governing the exchange of clinical data. Special attention is devoted to the design of clinical concepts in terms of the Archetype paradigm and the implementation of the obtained models in software applications. Realistic use case are selected from national healthcare practice and real-life functional requirements are satisfied in the proposed solutions. For example such requirements are satisfied in the proposed approach for choosing the appropriate Picture Archiving and Communication System subject to the needs of a group of healthcare service providers The software demonstrations include management of medicinal prescriptions in electronic format as well as reports with clinical data about services and procedures completed in a hospital during the treatment of a patient. All the submissions make significant scientific and applied contributions in developing cost-efficient solutions that add value to existing patient-centric services in eHealth.**

Keywords-health informatics; semantic interoperability; PACS; ePrescription; openEHR

I. INTRODUCTION

Electronic health (eHealth) aims at improving the quality of healthcare through a synergy of medical informatics, business and public health services employing modern information and communications technologies. Interoperability both technically and semantically is essential to the provision of better and more tailored healthcare that is closer to the needs of the patient [1]. For example, the European commission has approved a set of standards in health informatics for enabling semantic interoperability in cross- border exchange of clinical data in the International Patient Summary [2] [3]. At the same time the implementation of such standards in eHealth applications remains one of the greatest challenges nowadays in eHealth [4]. The patient-centric perspective in digital innovations employing business intelligence and modern information technologies is acknowledged to be imperative for their successful integration in healthcare services.

The scope of this special track comprises a broad set of topics that represent major issues in modern eHealth. Research work related to these topics considers implementations of standards in health informatics for exchange of heterogeneous clinical data and interdisciplinary studies on using business intelligence with modern information technologies for delivering top quality patient-centric healthcare services. Most of the contributions report research work exploring the application of the European standard EN 13606 [5] [6] and openEHR [7] [8] specifications for modeling and management of the Electronic Health Record(EHR) in realistic use cases of Health Information Systems(HIS) [9] [10] [11]. The development of a cost efficient Picture Archiving and Communication Systems (PACS) [12] [13] [14] offering improved quality of the medical images is another important topic of discussion [15]. Most of the contributions provide prerecorded video demonstrations of fully functional software implementation of the proposed theoretical models. In the following Section we summarize briefly the scientific and application contributions of the research work reported in this special track.

II. SUBMISSIONS

The main topics of the eHealth special track comprise a list of the most important research directions in the existing literature. The four papers accepted after strict reviewing in the final program are relevant to some of them that appear to be most challenging in terms of practical implementation. Such directions are topics related to creating applications based on standards in health informatics, modeling electronic records in selected use cases and improving the quality of patient-centric services. A common feature of these papers is that they present results obtained by extending related research work reported in previous editions of IARIA conferences. In the following paragraphs we will outline the most important contributions of these papers in thew order they appear in the conference program.

The first paper is entitled "Semantic Interoperability of Medical Information Systems and Scientific Repositories" [9]. This paper extends results in related research work, where the authors consistently apply the EN ISO 13606 European standard modeling of EHR Extract [16] [3]. Unlike existing

approaches that implement this standard with semantic web technologies [17] the authors have succeeded in applying the Archetype paradigm for the purpose of transferring clinical data between the national Register for rare endocrine diseases and international repositories. Besides, the data structures are compatible with the latest International patient Summary standard introduced in 2019 [3] [18]. For this purpose the ICD-10 codes [19] are mapped to the Orphanet nomenclature of rare diseases [20] and respective ORPHA codes [21]. In conjunction with XML technologies and relational database management the authors prove the ability utilize the EN ISO 13606 reference model for achieving semantic interoperability in a real scenario of clinical data exchange.

The following two papers in the program of the eHealth track also explore the application of the Archetype paradigm in use cases motivated by the needs of national healthcare. Both papers propose working solutions from the perspective of a reference information model built according to openEHR specifications.

One of these papers is entitled "Management of Clinical Concepts in Bulgarian Healthcare Using openEHR Specifications" [10]. This paper considers the use case of processing reports sent by hospitals. The reports describe the procedures and the services that have been applied during the treatment of a patient. These reports are collected by the National Health Insurance Fund (NHIF). They are referred to as clinical path documents and contain valuable clinical data. The exchange of such data by preserving its original semantic context is major functional requirement of this use case. The authors build an openEHR template of the clinical path document by means of reusable archetype models corresponding to major clinical concepts in the that document. One of the main contributions in this research is the development of a fully functional multitier web application that allows management of instances of the clinical path document on an openEHR platform [22] [23]. Video demonstration illustrates [24] the execution of basic operations with such documents. This demonstration additionally shows transformation of such documents prepared in proprietary information models into the Archetype object model [8] of openEHR. The proposed architecture of the web application enables exchange of clinical data in such documents between openEHR platforms.

The next paper considers the implementation of ePrescriptions in national healthcare by means of openEHR technologies. It is entitled "Modelling and Management of ePrescriptions on openEHR Platform in Bulgarian eHealth" [11]. This is another novel approach to implement an important and useful patient-centric service in national healthcare. The authors exploit the reusability of archetypes to create an INSTRUCTION archetype of a medical prescription in electronic format. A video demonstrates the implementation of the archetype model in a multitier web application [11]. The architecture of the web application for processing ePrescriptions is identical with the one used in the previously discussed research work for processing clinical path documents. This way both papers demonstrate the advantages of the Archetype paradigm where reusability can be exploited both at the level of modeling and at the stage of software implementation of the archetype model. Moreover, the Archetype paradigm enables semantic interoperability in the exchange of clinical data across the same software architecture.

The fourth paper in the eHealth special track proposes an approach for choosing the appropriate PACS in accordance with the needs of group of healthcare service providers organizations such as a group of hospitals for instance. This paper is entitled "Medical Requirements for Selecting Local Picture Archiving and Communications Systems Influences from Information Technologies and Business Models" [15]. This paper extends results in a related research work [25]. It introduces techniques for improving the quality of medical images which is a very important feature in PACS related patient-centric eHealth services [26]. It is noteworthy to mention that the proposed PACS is the first such regional system deployed in the Bulgarian healthcare.

III. CONCLUSION

This special track provided the unique opportunity to meet research workers and discuss recent success stories, good practices and existing challenges in eHealth as well as new perspectives in global health. The presenters reported research results in application domains of eHealth from perspectives that are rather unexplored in the existing literature. Modeling and management of EHR by means of European standard EN ISO 13606 and openEHR specifications remain a real challenge in practice. The same is valid for the development of a PACS and its deployment in a given HIS.

It is rather difficult to find reports in the existing literature for practical implementation in concrete use cases of the reference information model introduced by EN ISO 13606, openEHR and related to them technical specifications. Therefore, the scientific and application contributions of papers like those presented in this special track are significant and novel. Unlike other research wok these papers provide details about both an Archetype design of an EHR in a specific application domain and a practicable software implementation of the model allowing management of clinical documents employing the selected design. The deployment of regional PACS system, the openEHR implementations of clinical path and ePrescription documents and achieving semantic interoperability in medical information systems and the register for rare endocrine diseases are new results in scope of Bulgarian healthcare. Their importance is not limited to national healthcare because they are built on models, technology and practices that are reusable in similar use cases and application domains.

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