The Use of Open Source and Web2.0 in Developing an Integrated EHR and E-learning System for the Greek Smoking Cessation Network

Stathis Th. KONSTANTINIDIS [a], Evdokimos KONSTANTINIDIS [a],
Maria M. NIKOLAIDOU [a], Afroditi K. BOUTOU [b], Nikos HAVOUZIS [b],
Paraskevi ARGYROPOULOU [b], Panagiotis D. BAMIDIS [a,1]
[a] *Medical Informatics Laboratory, School of Medicine,*
Aristotle University of Thessaloniki, Greece
[b] *Respiratory Failure Unit, 3rd University Pulmonary Clinic of Papanikolaou Hospital,*
School of Medicine, Aristotle University of Thessaloniki, Greece

Abstract. Technologies of information and communication are incrementally integrated with all facets of healthcare practice and education. Although Electronic Health Records (EHRs) have long been used in healthcare the introduction of open source tools has empowered their further expansion of use. Simultaneously the use of Web 2.0 tools has opened up new ways of enhancing both healthcare practice and education. In this paper, we describe our approach towards the development of an integrated system supporting the smoking cessation network initiatives in the Greek public hospitals. The system combines the availability of an open source, web based EHR subsystem, with a Web 2.0 facilitated e-learning component for supporting continuing medical education and promoting public awareness.

Keywords. electronic health records, open source, SCORM, healthcare LOM, collaborative learning, social networking, continuing medical education, public awareness

1. Introduction

Information and communication technologies are integrated incrementally with all facets of Healthcare [1]. Health-related information on the web and, more specific, web portals containing information about healthy life styles and everyday habits are increasingly becoming available, since the Internet is a widely accessible delivery channel that has great potential to reach millions of smokers with evidence-based treatments [2]. At the same time, there is an on-going explosion of online health-related Education by facilitating the use of e-learning environments, educational standards and web-based collaborative learning. In this notion, the increased use of social web tools under the general jargon "Web2.0" is becoming a beacon, since it facilitates encouragement and psychological support (for patients), as well as, the exchange of cases and healthcare practice (caregivers and academics). Moreover, the availability of

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[1] Corresponding Author: P.D. Bamidis, Lab of Medical Informatics, Medical School, Aristotle University of Thessaloniki, Greece, PO Box 323, 54124, Thessaloniki, Greece; E-mail: bamidis@med.auth.gr.

web-based medical databases or Electronic Health Records (EHRs) is of key importance if one wanted to be lead to associations between disease parameters, extraction of health care indicators and in general to improvements of healthcare quality [3].

It is also true that smoking is still one of the most important problems for public health, the hazard-diagnosis and prevention of which relies strongly on the availability of Health Records and the promotion of Health Education. There are currently over 1.1 billion smokers worldwide and this number is expected to increase to 1.6 billion until the year 2025. Studying smokers' attitudes towards smoking cessation usually reveals that 2 out of 3 seriously think or intend to quit smoking [4]. Therefore, there is an increasing demand for networks providing the underlying support and mechanisms for smoking cessation. However, there is a lack of systems that would combine and integrate the use of the required EHR for such a healthcare network, with that of an e-learning platform for continuing medical education of caregivers on one hand, and the promotion of public health for smokers on the other. So, the aim of this paper is to present the undertaken development towards a system that would (i) allow distributed healthcare practitioners to securely store and process patient health data; (ii) facilitate web-based training for health professionals and the public; and (iii) spawn the dynamic creation and provision of user-generated online content via Web2.0 artifacts that would further promote health education and awareness through the collaborative exchange and sharing of experiences, opinions, comments and practices between patients, patients' support and caregivers.

2. Related Work

Within the last decade, a number of applications emerged aiming to patient support for Smoking Cessation. Initially, the use of traditional telephones and then mobile phones with multimedia capacities [4] were in the centre of interest. With fast internet still expanding, most applications are nowadays turned to be web-based. At the same time, recent survey findings indicate that smokers are interested in receiving online smoking cessation support, in addition to other forms of treatment [5]. To this extent, the notion of web-based blended treatment applications has emerged [2].

But, for healthcare professionals to able to provide adequate and contemporary treatment schemes and treatment guidelines, it is necessary to equip them with continuing medical education. Numerous recent works urge for the use of international standards for content delivery in online Medical Education [6, 7]. The latter is currently shifting towards dynamic services and communication tools that emphasize on peer-to-peer collaboration, contributing, sharing, usually known under the collective term Web 2.0 [8]. To exploit the actual power of Web 2.0 with respect to participation one needs to focus not on content provision, but on the mechanisms for this dynamic content creation, via peer participation and collaboration, in order to systematically allow for the creation and fertilisation of new knowledge. This holds true also in communication among patients; see for example the emergence of "Patients Like Me", (*www.patientslikeme.com*) as a great paradigm for patient problem and experience sharing, answer and advice finding, as well as, (shared common) knowledge supporting and symptom and treatment monitoring. Such paradigms may be particularly useful in the case of smokers and any initiatives towards smoking cessation.

3. System Aim and Implementation Requirements

The aim of the proposed system is to join the aforementioned needs through the new trends of ICT and Medical Education Informatics. To ascertain these needs the system is divided into three subsystems; the "Stop Smoking" system, responsible for storing and processing patient data, the "e-learning environment" providing the appropriate tools for collaborative peer-training and the "forum", which is the public place for patient support, exchange of opinions and answer seeking.

Four types of users are defined in the "Stop Smoking" subsystem: Physician, Admin-Physician, Patient and Administrator. All these users relate to different access levels. For instance, a "Physician" is responsible for inserting, editing, her own patient data;. "Admin-Physician" is a role that can be assigned to a Physician that assumes accumulated/advanced rights for viewing and processing all patient data stored in the database system, but without any access to sensitive demographic data. This role can create/delete new/existing Physician or Admin Physician users. The "Patient" role allows a patient to view information saved in his/her own EHR, having the right to change only the demographic data part. Finally, the "Administrator" is responsible for maintaining the system, assigning roles and adding/deleting new capabilities (e.g., queries) following specific analysis requirements. Moreover, the e-learning environment maintains three main roles: the "Teacher", who is responsible for the creation and accreditation of a course, the "Student", or else the trainee, and the "Administrator" for usual system maintenance. Finally, the forum subsystem has two roles. The "Patient", capable of discussing with others and the "Physician", who may interfere in patient discussions to clarify misconceptions, or start-up a new discussion with other peers only.

A significant step during the design was the proper definition of the medical data to be stored in the EHR database. Such data relate to epidemiological parameters, as well as, to the level of dependence for each smoker, e.g., the Fagerstrom Test of Nicotine Dependence (FTND) [9]. To this extent, nicotine withdrawal symptoms should be recorded, using the DSM-IV diagnostic criteria [10]. Psychological parameters of patients should also be recorded using the depression scale of Zung [11].

Regarding the "e-learning environment" subsystem, requirements analysis followed the educational process described in [12]. It starts with the design of the module (or course or seminar) itself, continues with the selection of teaching methods or strategies that will accommodate the design requirements, as well as, the development of the content itself, and finishes with the evaluation (of the teachers and the students in general) [8]. International educational standards (e.g., SCORM, LOM) are used to fulfil requirements such as Interoperability, Accessibility, Reusability, Durability, Maintainability and Adaptability. To this extent web-based collaboration-ware (Web 2.0 tools: wikis, blogs and podcasts) may be used in the training and learning procedures [13].

The user interface, as one of the most important components of a Web system which is addressed to a large number of users, was kept as simple as possible, while efficiency and interoperability of the system were carefully designed, taking much into account the security of data. To this extent, a first step in providing access control is authentication, involving the usual user validation via username and password login. Dedicated web services and a SOAP architecture with cryptography algorithms and data encryption by means of SSL/TLS protocols assure that data transfer and database will be visible only by authorized users.

Last but not least, the cost of the system should be low, so that it becomes affordable for every "Smoking Cessation (Public) Health Unit". Therefore, open source tools were used in the development and the only infrastructure required by a unit is an internet-connected PC or PDA.

4. System Architecture and Development

As mentioned above, the system is comprised of 3 subsystems: "Stop Smoking", "e-learning environment", "Forum". The "Stop Smoking" subsystem was built for both slow and fast internet connections. For slow connections a solution with PHP and Web Services was implemented and for faster connections a solution with SilverLight and Web Services was developed. The system uses MySQL6 database, Apache server for PHP and Silverlight and IIS6 for Web services. Regarding the "e-learning environment" subsystem, there are numerous e-learning platforms that fulfil the aforementioned requirements, but one of the most competitive and highly evolved open source ones is Moodle, which was the choice herein. The "Forum" subsystem was chosen to be phpB because of its easy-to-use administration panel and its user friendly environment.

5. Scenarios of Use

In the first scenario we assume that a Physician examines a new patient in a "Smoking Cessation Health Unit". The physician logs into the system by his/her PC or PDA and selects to insert a new patient. He first inserts some demographic data and then a set of forms appears in the screen; these have to be filled in after patient interviews or by inserting biosignal data (e.g., spirometer results). At the end of the procedure the next appointment is electronically arranged following customized parameters, while a reminder of this appointment is sent to both patient and physician 3 days before the next meeting. When the patient has left the health unit, he can visit online the e-learning environment and find useful information about quitting tobacco, tobacco effects in health etc. He can choose to take pre-arranged courses about healthy living styles and participate in collaborative learning through Web 2.0 instruments, having created an account and logged in into the "Forum" (a virtual place to share experiences with similar people trying to quit smoking). The Patient can exchange views regarding smoking cessation and "chat" to a specialist about everyday problems while receiving treatment. The patient can also log into the "Stop Smoking" subsystem and view his/her personal medical data.

In a second scenario we assume that a Physician with no specific training on smoking cessation wants to acquire some scientific knowledge on the topic. He has to register to the e-learning environment and follow some courses. If the non-expert physician successfully finishes the course he is accredited proper CME credits and the theoretical capacity of becoming an expert (receives equivalent certification). The physician has to take a hands-on seminar in pre-defined time at a "Smoking Cessation Health Unit". When the physician successfully finishes it, he/she can become a part of "Smoking Cessation Health Network" by getting an account of the "Stop Smoking" subsystem. The e-learning environment allows any physician that wants to extend his/her medical knowledge to participate.

6. Conclusions

In this paper a first attempt towards the development of an open source Smoking Cessation Network of Public Hospitals in Greece was presented. An integrated approach was followed in the sense that care was taken to address long term needs of such a medical community, thereby facilitating the availability of a secured EHR system, with that of an e-learning environment and the notion of social networking. The envisaged advantages from such a system are important as it will allow for epidemiological research, data processing and statistical analysis "at a click of a button"; in the long term, the "Stop Smoking database" could lead to a fully personalized health treatment [14]. As numerous diseases associate directly with smoking, proper exploitation of the system could reduce health treatment cost and improve the quality of life. On the other hand, as training of health professionals in Greece in smoking cessation is provided only at postgraduate level and in nursing schools, it is vital to allow for ICT enabled life-long learning through knowledge sharing, peer-to-peer collaboration and physician-patient interaction. Moreover, the aimed increase of public awareness regarding smoking cessation and associated supporting techniques not only compose a strategic objective for any Health Ministry, but also moves much along revolutionary recent approaches of patient social networking sites. Although the system is now under a country-wide pilot running, the overall intention is to target a pan-European one.

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