EMBEDDING ON-LINE TRAINING IN AN E-PRESCRIBING SERVICE

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Abstract: As the number of prescriptions rising nationally each year, Electronic Prescribing (ePrescribing) has been described as the solution to improved patient safety and reduced medication costs. Web-based technology should be fully embraced in the pharmacy industry as an aid to improve not only effectiveness and efficiency but also quality of health services, by reducing the number of errors that may be incurred with hand-written prescriptions. Healthcare information systems are facing the challenge of attempting to satisfy the needs of both novice and expert users, focusing on a high likelihood of physician adoption of ePrescribing. An ePrescribing service that premises a reusable, flexible, agile and adaptable training content with the objective to enable healthcare professionals instil their knowledge and expertise in the ePrescribing process, it may conduct to ePrescribing adoption. To this end, an online training embedded within the ePrescribing service could be used as it offers an intuitive, clear, how-to instruction on performing each action that the system provides to the user. In this paper the training content is provided as a system embedded within the ePrescribing service, using a learning management system (LMS) and to this end, the online training system acts as a collective online memory containing training material, contributing to the adoption of the ePrescribing service.

1 INTRODUCTION

Healthcare has registered unsatisfactory performance in both costs and quality over many years. The drive in healthcare to reduce cost and improve quality requires enhanced cooperation and collaboration among disparate healthcare units. Hence, considerable attention has been paid on developing healthcare information systems that support intra- and inter-organizational healthcare processes, focusing on reducing (or eliminating) medical errors, containing costs and improving quality of care (Makris et al, 2009); (Wieringa et al, 2003).

Healthcare providers face the challenge to incorporate technology solutions as part of their cost containment strategy. Thus, ePrescribing has been described as an opportunity to improve the quality of health services, while reducing medication and adverse drug events (Lapane, 2010; Siemens Medical Solutions USA, 2009, Devine et al, 2008). Moreover, an evolving focus on ePrescribing, may present the best opportunity to successfully introduce acceptable, valuable technology into the broader physician community. Success in this manageable area could open the door to broader adoption of e-Health services (Siemens Medical Solutions USA, 2009); (Devine et al, 2008).

It is estimated that thousands of deaths occur each year worldwide due to medication errors. These errors are predominately due to hand-writing illegibility, wrong dosing, missed drug-drug or drug-allergy reactions (Lapane, 2010; Siemens Medical Solutions USA, 2009, Devine et al, 2008).

The execution and management of value-added ePrescribing processes requires extensive and continuing education of healthcare professionals, mainly prescribing physicians and pharmacists, in order to gain user acceptance, as healthcare professionals acceptance is often the pivotal factor determining the success or failure of a healthcare information system. Properly designed user training material should enable users understand process-oriented healthcare delivery, visualize the cross-organizational ePrescribing process, assimilate the logic underlying existing processes and identify areas where redesigning existing processes is required in order to adapt to today's dynamic

healthcare environment (Lenz and Kuhn, 2004); (Makris et al, 2009); (Wieringa et al, 2003). The knowledge that these intra- and inter-organizational ePrescribing processes contain (e.g., flow of activities, resources involved, physical location) and the data content must be made explicit through training so that healthcare professionals understand the requirements of the environment. For example, contextual constraints may dictate that ambulatory care physicians should not sent prescriptions directly to pharmacies but the pharmacy choice is left to patients. This paper focuses on the objective of empowering users interaction, being particularly concerned with designing and developing relevant training material for healthcare professionals, regarding ePrescribing procedures.

Along these lines, the ePrescribing service adoption is a two-level process that firstly should provide a user-friendly environment to foster active user participation and secondly should grant online training content, at the point of care, on an as-needed, just-in-time basis.

In particular, to enable users understand ePrescribing concepts, so that may instil their knowledge and expertise in the definition and execution of ePrescribing processes while paying due regard to culture, we propose an online training system into an ePrescribing service. The online training content should offer a task-oriented, clear, how-to instruction on performing each action that the ePrescribing service provides to the user. Thus, the knowledge provided by the ePrescribing service will have great potential to reduce and facilitate healthcare professionals work, provided that they typically want to execute their work, devoting limited attention to learning new systems.

To this end, this paper is concerned with the development of an online training system that is embedded within an ePrescribing service with the objective to assist healthcare professionals (e.g. physicians and pharmacists) in understanding the ePrescribing processes and their roles in it and possible drug interactions and also in using the ePrescribing service within the context, framed by the current legislation and medical advances.

2 BACKGROUND

ePrescribing enables healthcare providers to electronically generate and submit prescriptions to a pharmacist. ePrescribing has the potential to empower both prescribers and pharmacists to deliver higher quality care and improve workflow

efficiencies. An ePrescribing service allows providers to evaluate a patient's medication history, allergies, possible drug interactions and drug coverage information. Pharmacies can also communicate with physicians through ePrescribing services to clarify prescription orders and process renewal requests (Goldman et al, 2010); (Lapane et al, 2010); (NGA Center for Best Practices, 2009); (Devine et al, 2008).

ePrescribing is a promising approach as healthcare costs augmentation and poor quality impact are major concerns. Evidence today suggests that the use of ePrescribing can result in (Lapane, 2010); (Siemens Medical Solutions USA, 2009); (Devine et al, 2008):

• reduction in healthcare and legal costs and also in fraud through drug pricing information

• improved patient safety, decreasing the risk of medication errors, reducing oral miscommunications regarding prescriptions and providing warning and alert systems at the point of prescribing (drug-drug interactions, drug-allergy interactions, drug appropriateness etc)

• complete patient medication history

• improved coordination of care through real-time communications between doctors, pharmacies and patients

• healthcare professional work efficiency

• administrative efficiencies (Lapane et al, 2010; NGA Center for Best Practices, 2009).

However, regional interconnectivity to ensure prompt transfer of patient information has become a critical issue as the patients increasingly travel across countries. Hence, besides the obvious advantages of reducing medication errors and saving upon time and money, ePrescribing is building path for a global healthcare structure and this is an issue to which this approach should give considerable attention.

Healthcare systems have been slower to adopt ePrescribing standards (Siemens Medical Solutions USA, 2009. Differences in adoption are not only seen between countries, but also between primary and secondary care to a large extend. ePrescribing in primary and secondary care are very different in terms of its application, being more successful in primary care, due to the standardization of products and coherent user group (eHealthInitiative, 2006).

ePrescribing is expected to have a steady penetration in the coming years with the encouragement from physicians and pharmacies to adopt the technology and also with the appropriate acts from governments (Smith, 2006; State Alliance

Call to Action for NGA, 2009). All these efforts would set this technology to find its acceptance for a broader use in the global healthcare. With contributing factors such as increased mobility, changing lifestyles and the increasing ageing population worldwide, the market for ePrescribing is expected to grow (Smith, 2006). It should be mentioned that ePrescribing must be understood in the context of the whole medicines use process. Beyond central stakeholders (e.g. doctors, nurses and pharmacists) are many other healthcare professionals who are potential users of ePrescribing if and when they need to review a patient's medication, like staff of insurance agencies and hospital staff (Lohr et al, 2010; Trend Micro, 2010).

The motivation of individual healthcare professionals to use ePrescribing is a critical issue. Healthcare professionals beyond using ePrescribing service need to understand the overall vision of a more robust medicines use practice and the change that accompanies an ePrescribing implementation. To this end they should be motivated by a user-friendly and task-oriented ePrescribing service that helps them accomplish their own tasks. Training can be considered as part of a solution to the persistent problem of ePrescribing service adoption. The aim of training is to get staff up to speed with basic ePrescribing functions, so they can perform their tasks effectively, quickly and with minor effort. Training can also build up confidence, reveal concerns and pick up important bugs or problems within a system (eHealthInitiative, 2006).

How can we enforce healthcare professionals to be open to change and adopt ePrescribing service? Training may be an answer to these questions, as it could be used to convince healthcare staff that ePrescribing is a focal point of the health information technology (HIT) industry, which will contribute to improve the safety, quality and efficiency of patient care. Unfortunately, no much focus has been given on prescriber training. Nevertheless, for a successful ePrescribing implementation to occur, healthcare professionals will need to focus on necessary decisions and changes, meaning that they should allocate extra time for training. Also, all healthcare stakeholders should collaborate to encourage widespread adoption and optimal use of standards-based ePrescribing through collaborative development and delivery of education resources, training, and support (eHealthInitiative, 2006).

Several efforts have been made, as concerns the adoption and use of ePrescribing services. Blue Cross Blue Shield of Massachusetts (BCBSMA) has developed a pay-for-performance program for participating primary care providers in training. Also, Blue Cross Blue Shield of Tennessee and West Virginia Bureau for Medical Services (WVeSCRIPT) (http://www.wvescript.com) provide training materials to healthcare professionals. Furthermore, the U.S Department of Health and Human Resources and Centers for Medicare and Medicaid Services (CMS; https://www.cms.gov) provide to healthcare professionals educating resources, in the context of E-prescribing Incentive Program. As concerns Europe, the England NHS Foundation Trust Electronic Prescribing On-line Training Web Site (http://ep-training.co.uk/) provide training through course categories (e.g. for pharmacists, anaesthetists, doctors, nurses). All training materials described are part of a support process, focusing on educating healthcare professionals to use the ePrescribing service.

However, a training material embedded in the ePrescribing service may be a motivation for adopting and efficiently using the system, as this type of training requires less effort and time and also it serves healthcare professionals need for a task-oriented training content, thus what they need, when they need it. An online training is always available, providing quick access to contents and full search functionality, by making information easy to find. Figure 1 shows the adoption process of the ePrescribing service, as it is described in this approach. The development of an online training as a training material, into the boundaries of the ePrescribing service can be a remarkable incentive for healthcare professionals to adopt ePrescribing concepts and ensure consequently the high quality of healthcare provided.

3 MOTIVATING SCENARIO

Recent years have seen considerable attention on designing new healthcare processes or redesigning existing ones according to current requirements (Lenz and Kuhn, 2004); (Makris et al, 2009); (Wheeler and Wheeler, 2009). In particular, ePrescribing processes are required to be designed through active user participation so that users' knowledge and expertise is incorporated into their definitions. In turn, this facilitates a user awareness activity on ePrescribing process management concepts which calls for a suitable and adaptable training content to be made available to users anytime and from anywhere.
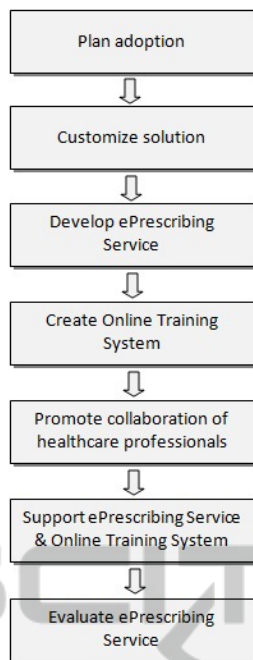
Figure 1: The ePrescribing process adoption.

To illustrate the main principles of the training approach proposed, consider an ePrescribing service. The benefits accrued from the implementation of an ePrescribing service are manifold: for example, the service puts eligibility, insurances and formulary information at the physician's fingertips at the time of prescribing. This enables physicians to select medications that are on formulary and are covered by the patient's drug insurance. It also informs physicians of lower cost alternatives such as generic drugs. In addition, physicians can access a timely and clinically sound view of a patient's medication history at the point of care, decreasing the risk of preventable medication errors (Bratsas et al, 2009).

This scenario shows an example implementation of an ePrescribing service that involves physicians, pharmacists, patients and the insurance organizations:

• The physician diagnoses a patient using the computer or a PDA.

• The physician uses his/her computer or PDA to access an ePrescribing application which is interfaced to an EMR (Electronic Medical Record) system.

• The physician reads the summary record of his/her current patient and selects one or more drugs from the Insurance Organization's formulary based on information regarding eligibility status and ID numbers of the medication list covered.

• Upon selection of one or more drugs by the

physician, the ePrescribing service can check for appropriate dosing, therapeutic duplication, drug-drug and also drug-allergy interactions, and formulary status.

• The ePrescribing service alerts the physician if the prescription needs to be changed, so he selects an alternative medication.

• In case of a clear prescription, the prescription is stored, as pending, in the medication profile area of the insurance organization's designated data center.

• A pharmacist connects to the insurance organization's cloud infrastructure, selects the patient's prescription and executes it.

• The pharmacist dispenses the medication with minimal time spent on verifying the formulary status of the medication.

• The pharmacist counsels the patient.

• The patient or a delegated person thereof collects the prescribed drugs from a pharmacy of his/her choice (Puustjärvi and Puustjärvi, 2006).

The system structure regarding the ePrescription for a patient is represented at the class diagram of figure 2 that conducts to the corresponding ontology. The ontology may include for example the following information (Puustjärvi and Puustjärvi, 2006):

• ePrescription is prescribed by a physician and it is targeted at a patient.

• An ePrescription of a patient may precede other ePrescription of the patient.

• Each ePrescription includes a drug.

• Each drug has a price, and it may have one or more substitutable drugs.

• Each drug corresponds to a medicinal product.

• Each drug belongs to a product group.

• Each electronic patient record (EPR) is associated with a patient and it is written by a physician.

The benefits of using the ontology are:

• To obtain formal specifications of learning scenarios oriented to their automation

• To catalogue learning scenarios

• To validate the behavior of new scenarios

• To personalize learning scenarios

• To monitor the behavior of the learning scenarios within a Learning Management System (LMS) (Rius et al, 2008).

Design or redesign of the ePrescribing process model can be performed by manipulating already defined objects, providing flexibility, agility and reusability of the training material designed.

4 AN ONLINE TRAINING WITHIN AN EPRESCRIBING SERVICE

Healthcare professionals should be adequately motivated to change their behaviour and to accept new technological efforts in the healthcare domain, as ePrescribing, being aware of their superiority. Nevertheless, these conditions require that healthcare professionals should have a clear picture of the new technological effort, opportunities to practice it with a sequence of appropriate materials and also continuing reinforcement of it.

The need for providing training material for ePrescribing process management concepts requires a training environment so that users not only acquire knowledge about the training/learning objects but also learn the relations between them.

LMS as a program that manages the administration of complete on-line education provides authoring, sequencing, and aggregation tools that structure the content to facilitate the learning process. An LMS integrates educational resources, the learners and support tools (Díaz-Antón and Pérez, 2006), (Rius et al, 2008).

The LCMS is one of the sub components in LMS which promotes a complete integration of eLearning system. While a LMS is used to deliver, manage, and track content over the Internet or a connected network, a LCMS is used to author and edit the content (Díaz-Antón and Pérez, 2006).

A LCMS is an environment where developers can create, store, reuse, manage, and deliver learning content from a central object repository, usually a database. LCMSs generally work with content that is based on a learning object model (Srimathi, 2010). These systems usually have good search capabilities, allowing developers to quickly find the text or media needed to build training content. Learning content management systems often strive to achieve a separation of content – which is often tagged in XML – from presentation (Hall, 2003).

Ontologies can also enhance the management, distribution and retrieval of the learning material within a LMS and therefore play a relevant role in eLearning procedure.The objective of a LMS and a LCMS is different: the primary objective of a LMS is to manage learners, keeping track of their progress and performance across all types of training activities (Hall, 2003; Srimathi, 2010). On the other hand, the main focus of LCMSs is on achieving personalized learning on demand (LOD) to drive performance in an organization by delivering content to learners to solve business problems (Díaz-Antón and Pérez, 2006).

The prototype learning system consists of an LMS system called Docebo LMS (www.docebo.org) which is an open - source LMS and LCMS that offers several capabilities:

- It provides a "multi-model didactic" approach that can be configured for different environments that use didactic modes.

- It makes extremely easy to construct the didactic content of lessons.

- Trainers are free to reuse files that they already have.

- It has a comprehensive user management system that lets an administrator manage user in groups or in hierarchical fashion.

- It provides web 2.0 features, such as wiki, forum and chat, allowing for collaborative knowledge.

The training content implemented includes Docebo LMS and behaves as an online training, embedded into the ePrescribing service, accessible from the authorized users that can access also the ePrescribing service. The ePrescribing service is hosted onto the Amazon cloud infrastructure, which is a flexible, scalable and low-cost and secure cloud computing platform. The architecture of the approach proposed is represented in figure 3.
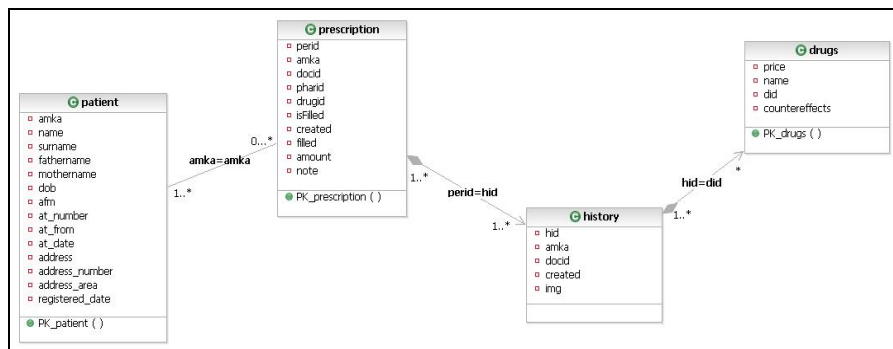

Figure 2: The class diagram of the ePrescribing process.

5 RESULTS

The approach proposed in this paper is concerned with capturing the knowledge existing in ePrescribing processes and in structuring this knowledge through a LMS that operates as an online training, developed into the boundaries of an ePrescribing service. Thus, the training content enables users to search through the LMS for learning objects/ontology constructs, understand their meaning and usage with the help of the supportive text and media and navigate to associated constructs.

In this way, an in-depth understanding of each healthcare process of the ePrescribing procedure is ensured. From the trainee's point of view, the main advantages of the proposed model are knowledge or conceptual navigation and knowledge dissemination and ease of use without further education and training through the ePrescribing service, simply by pressing the online training button into the ePrescribing service.

The cloud solution to host the training content of the ePrescribing service has significant advantages to healthcare organizations such as cost saving, accelerated time to delivery, offloaded maintenance and management to the cloud, elastic resources, redundancy and scalability. More importantly, due to the information sharing capability, healthcare professionals can share standardized and best practice medical protocols thus improving the quality of care provided.

6 CONCLUDING REMARKS

Healthcare is an increasingly collaborative enterprise involving a variety of activities (administrative, paramedical, nursing and medical) that are interconnected into healthcare processes in a manifold manner and are performed within and outside healthcare organizations.

This paper takes the stance that implementing an ePrescribing service may contribute to cost containment, quality improvement and rapid adoption from healthcare professionals that is necessary and that to facilitate adoption there is a need for an effective training aid embedded into the ePrescribing service. Thus, a prototype approach to providing and structuring training content in ePrescribing processes is proposed.

The approach is based on a LMS embedded on the ePrescribing service, behaving as an online training system. The ePrescribing service should be available anytime and from anywhere to authorized users and to this end it is hosted on a cloud environment. Thus, the main concept of this paper is a process to implement a successful ePrescribing system that will be adopted from healthcare professionals. To this end, after implementing the ePrescribing service, it defines a general ontology, refines the general ontology by adding all learning objects/ontology constructs required, implements the LMS infrastructure into the system and store the ePrescribing service in a virtual private cloud.
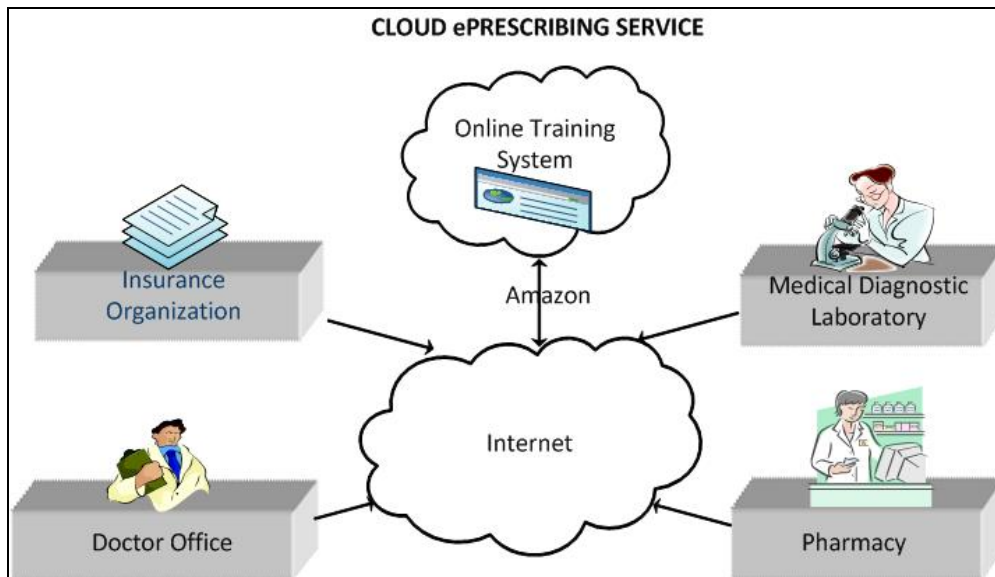

Figure 3: The architecture of the online training of the ePrescribing service.

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