A Physiotherapy EHR Specification Based on a User-Centered Approach in the Context of Public Health

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Abstract

Considering that disabilities are increasing, well supported rehabilitation team activities directed towards the population’s health are necessary. Physiotherapy rehabilitation activities are well established and some studies report the use of EHR for physiotherapy. However, such EHR are related to hospital and clinic environments, and no EHR for public health physiotherapy services have been reported. Moreover, difficulties occur in developing EHR, due to not enough end-users participating during system development. The aim of this study is to describe a physiotherapy EHR system specification for public health care in Brazil, based on a user-centered approach. This approach is comprised of five phases, including observation of physiotherapists’ activities, requirements specification, prototype development, usability tests and object-oriented modeling. As a result of this user-centered approach application, it is possible to reduce development problems, meet users’ needs and improve the integration of the development team with end-users.

Introduction

Disabilities are defined as the relationship between an individual’s health condition and personal and external factors. Disabilities are treated by a rehabilitation team comprised of many health professionals, including physiotherapists. Due to the increasing number of disabilities, the rehabilitation team needs tools that allow data organization, recovery and storage. Furthermore, the World Health Organization (WHO) in its “Disability and Rehabilitation WHO action plan 2006-2011”, reported on the need to collect, analyse and disseminate disability-related data and information. An important tool for meeting these needs is the use of a Health Information System (HIS), such as Electronic Health Records (EHR). The implementation of EHR in health institutions has allowed improved collection of information on patients, as well as health care quality. EHR is also essential for public health services, where information about population characteristics and problems are necessary. As physiotherapists are part of the rehabilitation team, EHR are essential for guiding their activities, as well as for enabling surveillance analyses.

Despite all this evidence, the development of such a system is not an easy task. Thus, most rehabilitation teams do not have an EHR, leading to a reduction in health care quality, and insufficient participation of end-users during system development. Development problems lead to unusable systems. This was detected by US General Accounting Office, which reported that 98% of their systems were abandoned. On the other hand, in 1994 Sitting found the same problem in clinical information systems (around 60%). Furthermore, in 2004 Larman reported that 37% of problems with systems development occur in the requirements analysis phase. Considering that requirements analysis is a critical specification phase of system development, user-centered methodologies should be considered when performing it. A user-centered approach can integrate software engineering concepts with end-users’ participation and their needs.

The aim of this study is to describe a case study of an EHR specification for physiotherapy in public health. This EHR specification is based on a user-centered methodology. The first section of the paper provides some background on physiotherapy EHR evidence. The case study is then described and finally some previous results are presented and discussed.

Physiotherapy EHR

In a literature review published in 2006, Vreeman described the benefits, barriers, and key factors for success in implementing physiotherapy EHR systems, based on 13 systems’ studies from 1968 to 2004. The more recent studies of this work (from 1999 to 2004), and another from 2006 are compared here. Table 1 compares where these EHR systems are located (clinic or hospital), the approaches used in their development, and who the end-users are. As shown in Table 1, two studies report a specific system for physiotherapy, and none of them were developed.
using a user-centered approach, nor do they have emphasis on public health. As reported by Vreeman, in 2006 a small percentage of EHR studies described a specific health information system for physiotherapy in hospitals and clinics. Moreover, none of them is related to physiotherapy in public health services. The most important difference is that in public health services patients’ information must be aggregated, in order to enable the planning of specific health activities for a set of people (citizens). Apart from these studies, there are more recent ones focusing on physiotherapy in hospital health care, but also reporting the importance of EHR in primary care.

The user-centered approach for physiotherapy EHR specification presented in this paper associates other techniques to The Bridge, called UMEHRS (User centered methodology for electronic health record specification). This is necessary due to the specific HIS characteristics and the health professionals’ working conditions. The UMEHRS has five phases, comprised of the observation of physiotherapists’ activities; application of the adapted Bridge method, prototype development; usability testing, and object-oriented modeling. In the first phase, the software engineer observes the health professionals’ activities. As a result of this observation, an “Attributes Analysis of Use Context” document is elaborated, based on ISO 92141-1:1998. This document is essential to understand the system environment (such as operating systems requirements, hardware platform, etc.).

The second phase is an adaptation of The Bridge method. The adaptation is due to health professionals’ working conditions and their availability to participate in the system specification process. The results of this phase are the physiotherapy EHR requirements specification and the Graphical User Interface (GUI). To carry out this phase, the software engineer meets with five physiotherapists who identify work actions and elaborate a poster, called the Big Picture. In the next step, the physiotherapists elaborate a kind of workflow for each identified action. Then, they identify the nouns that appear on the workflows, and these nouns are called action objects. After that, it is possible to create the GUIs, mapping action objects to GUI objects. More details about this adaptation may be found in Borges (2006, in Portuguese).

<table>
<thead>
<tr>
<th>Study</th>
<th>Approach</th>
<th>Location</th>
<th>End users</th>
</tr>
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<tr>
<td>Eiseman, 1999</td>
<td>Not described</td>
<td>H</td>
<td>RT</td>
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<tr>
<td>Mazzoni-Maddigan, 2000</td>
<td>Not described</td>
<td>C</td>
<td>P</td>
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<tr>
<td>Kaur, 2004</td>
<td>Data modeling, design in Microsoft Access</td>
<td>H</td>
<td>RT</td>
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<tr>
<td>Barry, 2006</td>
<td>Not described</td>
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<td>P</td>
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Table 1. Studies relating EHR for physiotherapy. Legend: RT = rehabilitation team / P = physiotherapy / H = hospital / C = clinic

EHR development functionalities depend on the reality and characteristics of the application area. As the Brazilian health system includes physiotherapists as part of the multidisciplinary team, the EHR must be suited to the physiotherapists’ activities. In the next section, a case study is presented for the specification of physiotherapy EHR, considering Brazilian public health care.

A case study

In Brazil, some cities’ public health systems have an EHR. In general, no specific information relating to physiotherapy is collected or stored. An example of a public health EHR is the case of Curitiba, located in southern Brazil, with approximately two million inhabitants. In Curitiba, physiotherapists perform three different activities: patient evaluation, health care for collective groups with similar illness, and home care. In the public health system, physiotherapists have 15 minutes to provide care to each patient. The only information relating to physiotherapy in Curitiba’s EHR is the rehabilitation request and the care description, without any kind of standardization. Because of this, it is difficult to know if the physiotherapy session really takes place and what kind of interventions are carried out. The use of EHR allows data standardization, as well as bringing some benefits relating to information storage and recovery. Better EHR benefits may be possible if user-centered approaches are applied to EHR development. User-centered approach is an approach for systems development with an early focus on users and their tasks. In 1998, Dayton presented a user-centered approach for system development with end-user participation, called The Bridge. This method meets the users’ mental model, their requests and software engineering principles, resulting in Graphical User Interface (GUI).
Figure 1. Evolution of phase 2

The third phase is the development of a prototype, which is based on the GUI created during the second phase. The GUI enables the carrying out of usability tests by end-users. The usability test is the fourth phase, the result of which is prototype efficiency, effectiveness and user satisfaction with it. The fifth phase is the object-oriented modeling, based on the Unified Modeling Language (UML). The purpose of the UML diagrams is to provide a simplified vision of the work of the physiotherapists, facilitating the developers team communication with the end-users. In this case study, the software engineer is a physiotherapist and the research participants are physiotherapists in Curitiba.

Figure 2. Requirements for GUI prototype

Results

The first result is the presentation of requirements specification using paper charts; followed by the GUI presented as a prototype; and then the UML diagrams. Figure 1 illustrates the evolution of phase 2, obtained through the application of the adapted Bridge method. This figure is divided into three parts: a, b and c. Part (a) illustrates the Big Picture, elaborated together with professionals, where actions are identified by the professionals themselves. Part (b) shows the action flow action constructed based on the actions of the Big Picture. Part (c) shows the action objects identified in action flows. Figure 1 illustrates an example, although the steps of the adapted Bridge method are carried out with all actions. Figure 2 illustrates the mapping of the requirements specification to the GUIs. This is useful for the prototype implementation. The number of GUIs may not correspond to the number of action objects, which depends on how the end-users organize their service. The fifth phase, UML diagrams, is based on the steps of the second phase. The actions of the Big Picture (figure 1, part a) were used to elaborate the use cases diagrams. The action workflow (figure 1, part b) supports the construction of the activities diagrams and the sequence diagrams. The action objects poster was used for the construction of the class diagram. Figure 3 presents part of the created class diagram showing the mapping from the action objects (Patient) to the class, action objects attributes (name, address, phone number).
number, age, sex, birth date, filiations, and occupation) to class diagram attributes, and actions of action objects (enter data, search, print and save) to methods.

Figure 3. Action objects mapped to class diagram

Discussion

The control of a person’s state of health is important for the person and also for ensuring good health for the whole population\(^1\), \(^2\), \(^6\), \(^7\). Among the benefits offered by the EHR are the data storage capacities, improvement of health professionals’ communication and integration, and time reduction for filling in patient records\(^5\), \(^12\). As health public services involve disease prevention, health promotion, diagnosis, treatment, rehabilitation, policies and research\(^1\), \(^4\), HIS needs to becomes useful for health professional teams and also to be customized to take into consideration specific information about each one of professional. Unfortunately, HIS are still constructed from the administrative and financial point of view, and the population’s health problems are left in second place. As shown in the review of the literature, there is no specific EHR for physiotherapy in public health services\(^1\), \(^2\). In the specific case of physiotherapy as part of public health care in Curitiba city, the needs of the service not supported by an EHR, or by manual records. The approach presented in this paper contributes towards the identification and understanding of health professionals’ activities, so as to enable improved practice and quality of EHR development. Another contribution is the ease of creating the UML diagrams from the posters produced during the requirements specification phase. The UMEHRS has reflected the integration of the development team with the end-users, allowing better communication between them and, consequently, improved users’ satisfaction. Users’ satisfaction was verified in the prototype usability evaluation with fifteen physiotherapists from Curitiba. Physiotherapists’ satisfaction with the prototype was 82%. Some authors have described usability evaluation after system construction. This also leads to identification of causes of problem, such as user interface or terminology contents\(^2\). However, one of the advantages of applying usability tests at the requirements specification phase is the identification of usability problems prior to the implementation phase.

Conclusion

EHR are becoming essential for health professionals to perform their activities. However, it is difficult to develop EHR\(^5\), \(^6\), and problems relating to their development may reduce health care quality\(^5\). Moreover, performing activities specific to a given population depends on the availability of high quality clinical information\(^2\). This high quality information may change health professionals’ management of clinical information and can be made accessible through the use of EHR\(^1\). Assuming that information and information systems are the backbone of the effective provision of public health care\(^1\), \(^6\), EHR must be developed to meet the needs of health professionals. This can be possible using a user-centered approach\(^6\), which in this study is applied to developing physiotherapy EHR. Some functions of this EHR, such as providing rehabilitation health care more effectively and supporting population problems are expected with the implementation of such a system.

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