Developing an Online Web Application for Disability Evaluation on a Medical, Social and Computerized Level

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Abstract
Using informatics solutions in medicine is not news, but creating a disability data base that has the purpose to evaluate disability on all its levels is imposed, considering the ascending trend of the number of population living with different categories and different levels of disability. A multidisciplinary team decided to focus efforts in designing a new online web application, able to respond to most of the specifications of an ideal disability survey tool. The aim is to develop a valuable instrument, worthy of being adopted as a national IT solution for disability degree evaluation.

Keywords: Rehabilitation Medicine; Web application; Disability evaluation

Introduction

After scientists had promoted the first digital computers in the 1940's, society was told that these new tools would soon be used on a daily basis as cognitive aids assisting with calculation and search for information.

Health Information Technology (IT) has the potential to improve the health of individuals and the performance of suppliers, leading to improved quality, lower costs and better patient engagement in modern healthcare systems. Information Systems (IS) are designed to manage the cost and improve the quality of medical care. In addition to the present role of information technology (IT) in clinical and diagnosis equipment, IS are uniquely positioned to measure, secure, store, process, save and communicate real time information to people with decision-making power, for a better coordination of healthcare at both the individual and population levels, which will lead to better outcomes [1,2]. What does the future hold for the IS in the field of health care? Considering how IT develops these days, it should not wait too long to find out.

Disability is a generic term that is covering a large scale of impairments, from impairments in body functions or structures to limitations in activity and/or restrictions in participation in specific activities. Since the disability does not affect the person only from the functional perspective but also from the viewpoint of integration into the society, the International Classification of Functioning (ICF) also included here environmental and personal factors [3].

Over a billion people live with some form of disability. This corresponds to about 15% of the

world's population. 110 million to 190 million adults have very significant difficulties in functioning. Rates of disability are increasing, due to population ageing and the global increase in chronic health conditions [4]. In Romania, according to the report given in September 2014 by Ministry of Labor, Family and Social Protection, there are more than 720.000 people with a form of disability, it can be said that 3.5% of the Romanian population has a disability and more than 40% among them have a physical chronic impairment.

Having all these numbers in mind one must remember also that Rehabilitation Medicine holds a distinctive place. It is a disciplinary crossroads which deals with many diseases and impairments and aims to alleviate the consequences of illness for the individual, minimizing disablement and improving the patient's ability to fulfill functions and obligations [5], and World Health Organization puts International society of Physical and Rehabilitation Medicine first in the field of managing disability.

Creation the Disability Survey

An online application that standardize the measurements and evaluation procedures in order to improve evidence-based rehabilitation and quality of practice, to define shared working methods, to unify professional perspectives, and to enhance the rigors of research in rehabilitation medicine has been designed and developed. This application is meant to rate the population who is disabled by major diseases of the neurological and muscle-joint-bone systems, in order to quantify the personal and societal burden of disability and to guide the efforts to solve these issues in an optimal manner and to improve the quality of life of the persons with disability. The quality of the instrument derives from the quality of its development process. It is also recognized that some practical issues have also to be considered, such as the acceptability of an instrument (respondent burden) and its ease of administering and processing (administrative burden). The app is being projected as a multilevel model:

- **Section 1**: looks like a web site that will contain some informational material on disability as well as useful instructions for the persons bearing the burden of disability (Figure 1).
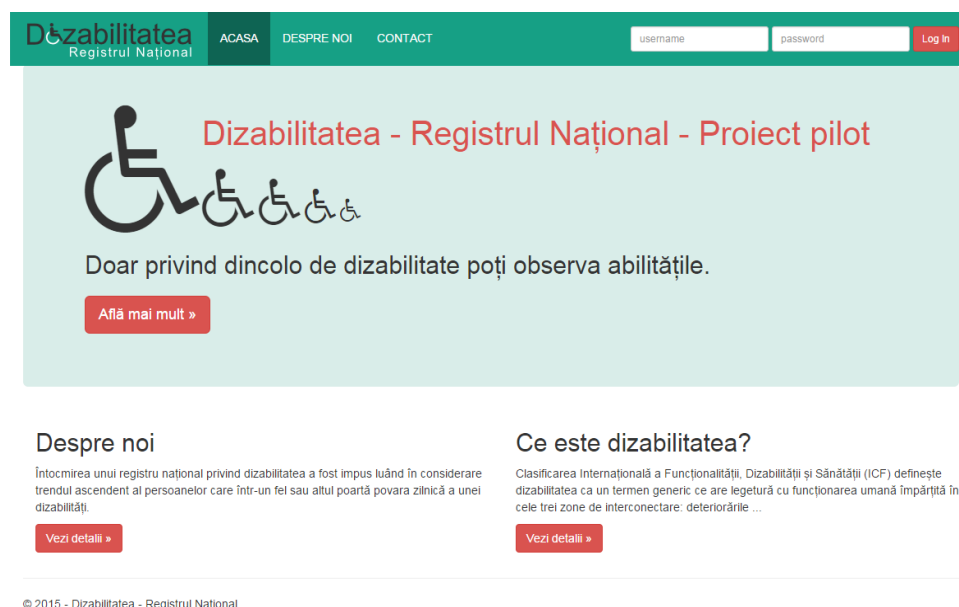
Figure 1. Section 1 of the application for disability evaluation

- **Section 2**: it will be a private section to which only authorized persons have access via a user name and password.

In the beginning, 4 medical centers considered the biggest and the most important Medical Rehabilitation Centers in Romania will be enrolled. Each medical center will be able to assign an infinite number of users that can enter patient data.

Section 2 comprises two areas:

- *Measure of Activity and Participation.* The Participation area of section 2 identifies the extent that the individual's participation has been restricted in the daily activities due to the impairments associated to the patient's health condition: education and training, employment or job seeking, community life (civic/political activity, volunteering, neighborhoods watch), family life, socializing, shopping, living with dignity, leisure/cultural activities, sports or physical recreation, religion and health services. The barriers and challenges section highlights social and environmental factors that potentially contribute to the participation restrictions of people with disabilities in society. These barriers and challenges include: physical environment (access to buildings, public footpaths and personal accommodation), services and supports (personal assistant, home help and physiotherapy), access to information, people's attitudes, transport (accessible transport), laws [3]. This evaluation form will be completed by the patient.

- *A standard interview and an evaluation form completed by the physician* that will include: the diagnosis focused on the main involved impairment, patient's level of ambulation, devices and aids, the patient's cognitive status (by using Mini-mental State Examination), environmental facilitators and barriers (using ICF core sets), evaluation of the severity of the patient's disability and the results of physical and rehabilitation medicine evaluation in "a uniform way", by comparing the results concerning the activities of daily living (ADL) between the Functional Independence Measure (FIM instrument) and the Barthel Index, in order to determine the validity and usability of these two instruments for the Romanian population [6] (Figure 2).
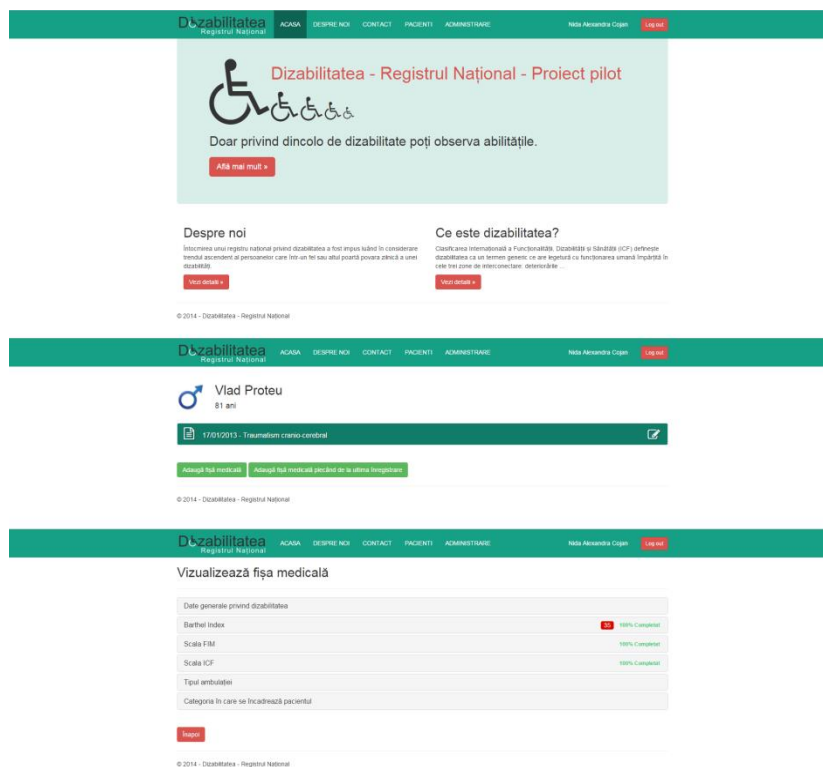

Figure 2. Second section of the application

- **Section 3**: Since 1989, every 2 year the International Conference on Rehabilitation Robotics takes place. The Robot-Assisted Therapy (RT) is aimed for the management of the neurological disorders, in order to improve the recovery process and to facilitate the restoration of functionality. Including RT in the rehabilitation programs has been one of the most positive aspects of evaluating the movement due to the exact measurements through the sensors on the

device. The last challenge of the application is to be able to load the results given by motion captures device applied directly on the patient how wears robot equipment or not. All the results will be transmitted and stored in to the application, analyzed, and then the involved physicians will be able to report the best decision about the patient's recovery protocol.

In the end, it is important to evaluate the applicability of an instrument, how well its content matches the purposes and the specificity of the targets to address (objectives, patient decision, intervention, etc.). Furthermore, it is crucial to establish acceptable levels of reliability, validity and responsiveness as final goal. Still it can be said that this web application, by using two kinds of measurements - observational/examination by a PRM physician and a patient's report using a specially designed self-administered questionnaire - gives hope that the application will be validated as gold standard tool and method for disability evaluation in Rehabilitation Medicine [7].

The Implications of Creating the Web Application

Although most people think of the Internet as a recent development, its roots go back over four decades. The expansion of the Internet in the last decade made it the major method of communication. The most important development in the last few years has been the explosion of activity on the world wide web. The Internet is already supporting several medical applications, and the web is providing a rich environment for development of sophisticated information access tools [8,9].

The most exciting topics in health refer to the designing and adoption of the information and communication technology solutions in health system by putting into action new applications, which demonstrate their usefulness and effectiveness. The "human element" is critical in developing IT apps.

Internet is the best suitable way in developing the project because: the number of Internet users is continuously increasing, the costs are continuously dropping down, the increasing Internet speed will make the information easier to access and to distribute. In medicine, the Internet can be able of efficiently sharing medical records, and gives the possibility to the users to access the data from anywhere if they have an internet connection. Furthermore, the information can be adapted to be displayed in a friendly and intuitive for a wide range of devices (from smartphone to tablet), it also gives the opportunity to have an accurate reporting, producing a fast and accurate report [10].

Different attempts for the digital computerization of the Romanian health care system, in order to improve its efficiency, are already in use [11].

Designing a web application was the correct ant the obvious solution due to the benefits listed above. In order to accomplish this goal it was decided to use the tools provided by Microsoft who gave a large range of options. The web application was developed using ASP.NET MVC framework. It was tried to adopt three-tier architecture for this solution composed from the well-known presentation tier, the domain logic tier and the data storage tier. This is a common software architecture pattern which is intended to allow that any of the three layers to be upgraded or replaced independently as a response to changes in requirements and technology. The ambition was to "deliver" a user and device friendly application, so it was tried to provide an application with an adaptive interface to different devices and also to be very intuitive and easy to use even by inexperienced users.

Security and privacy should be considered when an application is developed. Because one of the main concerns when working with sensitive data is security, it was tried to achieve this by hosting the application on a dedicated server hosting and to make all the communication between clients and server through a secured http connection (Hypertext Transfer Protocol Secure - communications protocol for secure communication over the Internet). The patient confidential data can be access only by users who are authenticated and who are authorized to see the data.

The final step was to acquire a domain name in order to host the application on a web server. The chosen URL was picked to be self descriptive, to contain relevant keywords, to have an acceptable length and to be easily correlated with the content. The URL is www.registru-dizabilitate.info

Discussions

The concept of developing a disability survey has been applied in European Union countries such as Italy, France, Ireland, Spain, Portugal, and United Kingdom (Table 1). A search on MEDLINE and Repository of Disability Surveys and Censuses has been done, by using the following keywords: disability, evaluation, rehabilitation medicine, neurological and muscle-joint-bone systems, the result of this search is that an application which evaluates the population who is disabled by major diseases of neurological and muscle-joint systems has not been done yet [12].

Table 1. Disability surveys in European Union

County	Name of survey	Year	Link
Italy	Living Conditions Survey	2007	http://www.istat.it/en/
France	Health and Disability Survey - Ordinary Household	2008	http://www.insee.fr/en/methodes/default.asp?page=sources/ope-enq-handicap-sante-menages-hsm.htm
Ireland	National Disability Survey	2006	http://disabilitysurvey.checkdesign.de/EURO_Ireland_NDS.htm
Spain	National Survey of Public Health "Health on equal terms"	2010	http://disabilitysurvey.checkdesign.de/EURO_Spain_data%20extraction_EDAD2008%20individual.htm
Portugal	National Health Survey	1999	http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_publicacoes&PUBLICACOESpub_boui=69444907&PUBLICACOESmodo=2
United Kingdom	Survey of disability	1988	http://www.leeds.ac.uk/disability-studies/archiveuk/disablement%20income%20group/opcs%20survey.pdf

After a preliminary version of the application had been developed, a focus group meeting has been made, to gather feedback on the application. Twelve impartial members have been recruited and divided into three subcategories: three web developers, three physicians in field of PRM, and four patients (two under fifty years old and two over fifty years). All members ware invited to browse the web site and to answer a set of questions. After answering the focus group questionnaire, the conclusions were:
- The web site was easy to navigate;
- The information was accurate and useful to the patient and to the medical doctors;
- The graphics are appropriate and complement the text;
- The survey gives a complete assessment data, medically relevant reports about the patient disability and the approaching ways for rehabilitation;
- The fact that the completion of data took too much led us to the idea of a brief form in order to avoid abandoning the completion of the form;
- The patients over 50 years old had difficulties in using the computer.

Having gathered this report, the developers' team decided to eliminate the first three sections of ICF core sets and to keep only environmental facilitators and barriers. It has also been given the possibility of downloading/printing the self-administered questionnaire to the patients with low experience in computer usage.

The Internet is becoming omnipresent, playing an important role in research, education, and popular entertainment. Physicians are starting to use the Internet as an assistance to clinical and basic research, to collaborate with colleagues, and for patient education. There is no doubt that the internet will continue to play an even more important part in medicine.

It can be said that along with other fields of application, rehabilitation can also benefit from the advantages of using an IT application. A preliminary version of the system is fully implemented and after a brief training, the users will start introducing data. This technology will assist medical practitioners/researchers by enabling efficient management and sharing of the medical data within

or across a community without being subject to geographical restrictions and without creating problems of inconsistent and fragmented medical data. In the end it is expected that this program will be a decision support tool and also will allow the clinicians, to have standards that will constitute evident based arguments for the political decision makers to improve quality of life to the people with disability according the document that the Romania Government has signed with EU and WHO.

Considering that the IT solution is at this moment in its final stage of drafting, a future article with the obtained results will be published.

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgements

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