

A Methodology to Assess Experiences in Implementing e-Health Solutions in Croatian Family Medicine

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Abstract. The central information system of primary health care of the Republic of Croatia is in an early stage of implementation which for now covers integration of all family doctors' offices into a single comprehensive eHealth network connecting their software solutions with the national payer institute and public health authority. Measuring the quality and efficiency of information systems at an early stage of development is a very difficult task. The main goal of this work is establishing the foundation for a formal methodology to measure and quantify the experience of family doctors in the current use of this system. A questionnaire has been created to support the work which, on one side carefully follows our assumptions for quality criteria, and on the other collects valuable input from the users of the technology and solutions implemented. Our work is closely aligned with worldwide accepted standards and recommendations carefully analyzed and localized to reflect the current environment and health policy. This paper presents some preliminary results based on the survey conducted with family doctors on the field.

Keywords. Experiences based assessment methodology, e-Health, family doctor offices, electronic health records, reliability, certification criteria

Introduction

The process of implementation of the national e-Health infrastructure in the Croatian public health care system started in 2006 by introduction of the Croatian primary health care information system (PHCIS or CEZIH in Croatian language) [1]. The first areas of the system implementation includes the integration of family doctor's offices (FDO) into a comprehensive system, that includes the integration of various types of FDO specialized solutions with national infrastructure, Croatian Institute for Health Insurance and Public Health Authority. The system is generally tested "in vivo" i.e. real production conditions and real patient data, and without comprehensive feasibility study performed on the field. The central part of the information system was delivered by a renowned company specialized in this kind of projects, as a very stable and quality system based on well defined business processes, legal and semantic rules, and communication and messaging standards such as ENV 13606 and HL7v3 [2]. Design

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of the applications for managing the electronic healthcare records (EHR) in FDO was left to a number of small IT companies competing on the Croatian market, which had to undergo certification process defined by the Ministry of Health and Social Welfare (MHSW). Certification currently includes communication and basic data exchange with the central part of the system only, which are hardly single quality criteria for such solutions, especially from the perspective of final end users – doctors and nurses. The concept and functionality of these applications has been left to the manufacturers of these applications [3].

With such situation in place, it seems very difficult to measure the quality and effectiveness of an information system which is in the early stage of development. For those reasons, our motivation was to establish a methodology to quantify and qualify overall quality criteria. The performed actions can be summarized in the following steps: analysis of previous surveys and field researches on e-Health implementation among general practitioners' (GPs') and family doctors' (FDs') offices; analysis of known e-Health assessment models; analysis of European pilot studies among GPs/FDs; analysis of known standards, industrial initiatives and certification criteria in the world; construction of the formal assessment tool; survey with qualified sample of GPs/FDs; assessment of reliability, validity and accuracy of the tool; and, finally, drawing conclusions on acquired results i.e. point out the problems and propose specific changes.

1. Relevant Work in Assessing e-Health Implementation Experience

One of the earliest frameworks for assessing community readiness for eHealth solutions refers to "Framework for rural and remote readiness in telehealth" that was conducted in 2002 by Canada's advanced research and innovation network CANARIE [4]. This paper describes the basic assumptions that derive from the theory of change and stages of change. The next interesting example can be found in association of the Aga Khan University in Pakistan and the University of Calgary in Canada [5]. The subject of the project was development of tools for e-Health readiness assessment in developing countries. Project has proposed methods for validation and reliability testing of the tool for e-Health readiness assessment. A third interesting example is found in the study "e-Health Readiness framework from Electronic Health Records Perspective" conducted on the University of New South Wales in Australia [6]. However, all the models referenced above are based on an analysis of isolated cases ("in vitro") by gathering the elements to assess the readiness of a small part of health system for the introduction of e-Health concept, while our framework requires experiences assessment in large scale deployment with very limited prior analysis ("in vivo"), which leaves us with highly challenging environment that requires careful assessment and offers less change maneuver space. For this reason this work takes more recommendations from some more recent works, including European EuroRec EHR-Q TN project, EuroRec EHR Quality Seal Level 1 and Level 2 [7], and American ONC Meaningful Use of EHR Stage 1 certification project [8]. The contents of European studies that were conducted by Empirica [9] and Health Consumer Powerhouse [10] were also of great help in the making process of the framework.

Based on these foundations we made a rather comprehensive questionnaire. The questionnaire consists of seven main units. While the first unit contains general questions about the FDO, the remaining six modules measure major dimensions which

our work has identified as needed (see Table 1). In total there are 118 questions of which 103 issues have been defined for assessment. These 103 questions for the assessment consist of 32 multiple choice questions in a Likert scale of 1-5, 54 questions with dichotomous answers (YES-NO i.e. 1 or 0), and 17 questions with offered answers that should be marked. The range of quantitative ratings for each question is from 0-1, so the total predicted mean quantitative score for the entire questionnaire is less than or equal to 1. The time allocated for completing the questionnaire was estimated at 20 minutes.

Table 1. Structure of the questionnaire with general description of its categories.

A) BASIC	B) TECHNOLOGICAL	C) ENGAGEMENT
<ul style="list-style-type: none"> • Attitude about use of computers in FDO; • Organization of work on computer support; • Impact assessment of use of computers to work process; • Attitude about basic elements of e-Health. 	<ul style="list-style-type: none"> • Problems with hardware and network support in FDO; • Quality and reliability of EHR applications in FDO; • Readiness of diagnostic equipment for use in e-Health; • Data protection and patient safety. 	<ul style="list-style-type: none"> • Self-assessment of the IT and medical domain knowledge; • FD engagement in process of new system implementation; • Use of EHR for evaluation of doctor's work and research; • Care about the safety and security of the EHR.
D) DOMAIN	E) ORGANIZATIONAL	F) SOCIETAL
<ul style="list-style-type: none"> • Domain usability and functionality of EHR applications; • Structuring and encoding of information in EHR application; • Implementation of advanced decision support systems; • Monitoring and quality of work assessment according to working guidelines; • Overall satisfaction with the EHR applications from the domain view. 	<ul style="list-style-type: none"> • Use of e-mail communication with other health institutions; • Possibilities of migration to a paperless business; • Elements of e-business integrated into EHR application; • Forms of electronic reporting built in existing application support; • Interoperability and compatibility of EHR applications with current diagnostic systems. 	<ul style="list-style-type: none"> • The impact of use of computers and EHR applications on patients' satisfaction; • The impact of health contents available on the Internet on behavior of patients in FDO; • Forms of electronic communication between doctors and patients.

2. Analysis of Survey Process and Data Collected

The survey was conducted during the period from mid-December 2009 until the end of January 2010. Questionnaire was made in electronic PDF/FDF form with the ability to automatically return to the sender via e-mail, and in the classical paper form. The questionnaires in electronic form were offered via dedicated mailing list, which has approximately 1100 formal users (assuming that the number of active users is much smaller), while about 70 questionnaires were distributed in paper form at the professional meetings and collected on spot or received by post. Random sample selection depended on FDs' free will to fill the questionnaire.

A total of 115 complete and correctly filled questionnaire forms were collected (87 or 75.7% of 115 in electronic and 28 or 24.3% of 115 in paper form). Therefore, we included approximately 4.7% of total 2450 Croatian FDs. By analysis of general data about the respondents and their offices, we got the structure of the analyzed sample, which is showed in Table 2. By comparison of data from well-known official Croatian health statistical publications [11], and data known from some previous analyzed works [3] with data showed in Table 2, it can be concluded that analyzed sample is representative enough to draw conclusions from the study.

Table 2. Characteristics of tested sample of the Croatian family doctors and their offices.

Category	Characteristics		
Age	Median: 49	Interquartile range: 44 – 51	
Years of working	Median: 23	Interquartile range: 18 – 26	
Gender	Male: 23,6 %	Female: 76,4 %	
Specialization	Yes: 66 %	No: 34 %	
FD office autonomy	Health center: 18,9 %	Under lease: 69,8 %	Private: 11,3 %
FD office type	Urban: 64,1 %	Rural: 32,1 %	Insular: 3,8 %

3. Results Analysis and Discussion

The results of qualitative and quantitative analysis of the categories and total experience are shown in Table 3. Due to limited space, the qualitative ratings are summarized for the most important elements, while the quantitative rates provide fairly realistic overall scores on a scale from 0 to 1.

Table 3. Major qualitative results, average quantitative results and reliability coefficients of experiences assessment presented by categories.

Category	Results		
A	<ul style="list-style-type: none"> -40% of FDs believe that the new system and EHR applications slow down their work; -In 4.3% of FDOs nurses write medical information in the EHR, while in 10.4% of FDOs the doctor updates the administrative and demographic data of patients; -34% of FDs do not support e-prescribing, while 35% do not support e-referral; -50% of FDs are mainly against the secondary use of medical data; -66% of FDs do not believe in the security and confidentiality of data in a central EHR; 		
	Mean rate: 0.696	Items: 12	Cronbach α : 0.667
B	<ul style="list-style-type: none"> -All contracting FDOs are equipped with the necessary ICT equipment; -Automatic remote software update is provided for all EHR applications; -All EHR applications use the same formal structured and coded lists of health registers and nomenclatures that are automatically updated on a regular basis; -All EHR applications have authorized access and role specific access rights; -41% of FDs have some diagnostic devices that provides results in an electronic format suitable for inserting in EHR; -Transfer to another EHR application is rather difficult due to portability and "data lock" issues => EHR is not longitudinal in its most important part; 		
	Mean rate: 0.555	Items: 24	Cronbach α : 0.694
C	<ul style="list-style-type: none"> -13% of FDs believed to be overloaded with unnecessary knowledge of IT technologies; -26% FDs attended IT schools or courses in the past 5 years; -17% of FDs assess their IT knowledge as very high; -57% of FDs use the data from their EHR applications for quality evaluation of their work; -75% FDs give to their replacement doctors to work on their user account (security risk); -Only 60% of FDs make daily backup their data (EHR); 		
	Mean rate: 0.427	Items: 18	Cronbach α : 0.722
D	<ul style="list-style-type: none"> -In 61% of EHR applications is possible atomized (structured) input of the physical status; -All applications contain regularly maintained classifications and nomenclatures; -In 72.6% and 75.4% cases EHR applications offer support for chronic disease and allergies monitoring, respectively -Decision support systems are in their beginnings as a simpler forms of work assistance; -In 41.5% cases EHR applications have built-in clinical and pharmacological guidelines; 		

Table 3. Continued

Category	Results
D	-In 51.9% cases EHR applications have built-in visual indicators for the financial indexes for diagnostic-therapeutic procedures, drug prescribing and the rate of sick leave; -35.7% of FDs are very satisfied with the overall domain properties of their EHR application;
	Mean rate: 0.430 Items: 23 Cronbach α : 0.822
E	-All EHR applications are capable for e-prescribing and e-referral -All EHR applications have the ability to add scanned paper-based diagnostic test results into the EHR, but only 22.6% of FDs use this feature; -EHR applications support some forms of electronic reporting; -All EHR applications are capable to remotely check the patient's health insurance status;
	Mean rate: 0.324 Items: 17 Cronbach α : 0.689
F	-In 23.5% cases patients are satisfied with the implementation of the new information system; -EHR applications currently do not provide patients with reports on their health status; -Only 27% of FDs communicate with patients via e-mail and other electronic media; -Only 9.6% FDs collect information about chronic diseases of their patients via e-mail.
	Mean rate: 0.446 Items: 9 Cronbach α : 0.541
Overall	Mean rate: 0.48 Items: 103 Cronbach α : 0.886

To determine and prove the reliability of our measurement tool, we used a calculation of the Cronbach α coefficient of correlation for each of categories [12]. The recommended amount of this coefficient for a high degree of reliability, i.e. internal consistency of questionnaire, is ≥ 0.7 . Before calculating of the coefficient, we conducted verification of the required sample size with Bonett's formula [13] using null hypothesis value of 0.7 and estimated value of 0.8 (two-sided, $\alpha=0.05$, $\beta=0.2$, $N=103$). We calculated a minimum sample size of 41, which is significantly less than our 115. Our population sample was not previously prepared for the testing. For this type of testing are common slightly smaller amounts of the Cronbach α than in controlled or clinical conditions. As we see from Table 3, the lowest Cronbach α has a category of social experience (5.41), however, it is a common occurrence in the questionnaires that have fewer than ten questions. So called face validity and content validity [5] of our measurement tool were confirmed through interviews and commentaries of the doctors. Comments were positive, and confirm the relevance of all categories in over 75% of cases. To determine accuracy, it would be necessary to carry out additional field researches. We see this as the subject of further research.

As we see from the results presented in Table 3, categories A, C and partly F reflect the doctors' views about essential objectives of the e-Health concepts and doctors' engagement in achieving these goals. From the results of all other categories we can see how EHR applications meet the current worldwide certification criteria. Based on identified system performance, and current Croatian certification criteria [1], we can conclude that Croatian EHR applications would be able to almost entirely meet the criteria of EuroRec EHR-Q Seal 1 and in some parts even the Seal 2 criteria, which is subject to more detailed analysis. However, in domain functionality, which is better covered by ONC Meaningful Use of EHR, is still necessary to significantly improve the functionality. Furthermore, we see some encouraging first results in applying of the working guidelines, guideline-based decision support systems and monitoring of chronic diseases and allergies [14]. A similar situation is with monitoring and indication of the quality of doctor's work. These are definitely significant areas of further improvement.

4. Conclusion

In this paper we have presented some preliminary results of what is envisioned to be a comprehensive methodology and criteria to measure quality of EHR system implementations at FD's offices. The focus of this paper is a measuring tool which is the basis for data analysis that serves to identify some key areas of quality to measure. Croatian certification criteria are still mainly based on the local requirements and needs of current developments and do not draw direct reference to some of the internationally recognized quality indicators and frameworks or take into account clinical protocols, experts practice, and expectations on readiness and experience by users. Since the certification of EHR applications is performed in successive stages of development, we expect to be relatively easy to fully comply with worldwide technical criteria, however it remains to be seen what additional requirements we will identify as important or how would international certification processes apply to localized environments and large scale deployment. The preliminary results give us confidence that our assessment methodology could be used as the potential tool for monitoring of further improvements of Croatian certification criteria, also in respect to forthcoming development phases of the Croatian healthcare information system.

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