Use of Guidelines and Decision Support Systems within EHR Applications in Family Practice – Croatian Experience

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Abstract— **The aim of this survey was to evaluate the state of implementation of guidelines and decision support systems within the EHR applications in Croatian family practice. The survey was conducted using electronic and paper based questionnaires which were formed in accordance to European best practice. Obtained survey results are showing number of improvement areas, which relate to both existing applications, as well as doctors' knowledge about qualities and possibilities of the guideline-based decision support systems. What we see as the foundation in this process is implementation of open standards such as HL7 in combination with open source technologies, which could significantly improve the overall situation. Continuous education of doctors and health authorities about the possibilities and needs for use of those systems is essential in the adoption process.**

Keywords— **guidelines, decision support systems, electronic health records, family practice, HL7 and open source.**

I. Introduction

Croatian primary health care (PHC) information system (IS) launched in late November 2007 currently includes the central part that contains all the essential services and the system registries, the information system of the Croatian Institute for Health Insurance (CIHI), an information system of the Croatian Institute for Public Health (CIPH), and family doctors' (FD) professional solutions [1,2]. Due to CIHIs implementation policy Croatia achieved almost 100% use of computers and electronic health record (EHR) applications in 2356 FD offices [3,7]. In the following stages of development the system will also encompass pharmacies, laboratories, integration to hospital information systems, other PHC practices and patient access as separate, but integrated components. The integration of all these system parts is enabled by using of HL7v3 and HRN ENV 13606 standards (the latter is Croatian translated version of CEN/TC ENV 13606 standard) [1]. Establishment of a central EHR repository, which will be synchronized with EHR applications in FD offices, is planned. In this way the strategy aims to ensure the secondary uses of data collected in FD offices and efficient health system management. Such system organization sets appropriate conditions on completeness and accuracy of the EHRs collected in FD offices. By using of the working guidelines and the guideline-based decision support systems (DSS), improvement and evaluation of the doctors' work, as well as completeness and accuracy of the EHRs, can be assured. After more than two years of running period and continuous improvement of EHR applications we were compelled to evaluate the acceptance and adoption of working guidelines and DSSs implementation within these applications, with the idea to try to measure the benefits that FD offices experience by system introduction. What is important to emphasize that our choice of survey method is based on European and other good practices in the world, which enables us to efficiently compare the outcome and suggest further steps.

II. Methods

A. Conducting of Survey

Survey was conducted in late December 2009.The questionnaire consisted of questions about: (a) general information about the doctor and office (gender, age, experience, type and autonomy of the office, the EHR application), (b) using the working guidelines (clinical, pharmacological, administrative) in EHR application, (c) existence of visual indicators of the doctors' work quality and (d) existence of DSSs within the EHR application (diagnosis, prescriptions); was made. It 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 lists to approximately 1100 FDs, 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 106 complete and correctly filled questionnaire forms were collected (85 in electronic and 21 in paper form).

B. Papers and WEB Contents Analysis

The analysis of available papers and WEB contents was conducted in order to gain insight into the history of

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development, the current stage of development and availability of working guidelines in health care, as well as their impact on development of the DSSs. Obtained survey results were compared with the relevant European statistics.

C. Insight into EHR Applications Possibilities

Croatian FDs can choose among 11 applications offered on the market [2]. Applications' properties are determined by their manufacturers, not by recommendations of MHSW and other subjects. Because of that, we conducted a short insight in real possibilities for a few EHR applications which are, based on survey results, showed as the most represented in the Croatian FD offices.

III. Results

By conducting the survey, 106 complete and correct filled questionnaire forms were collected. Table 1 shows the sample characteristics.

Table 1 Sample characteristics

	Median	Interquartile range	
Age	49	44 - 51	
	Median	Interquartile range	
Years of working	23	18 - 26	
	Male	Female	
Gender	23,6 %	76,4 %	
	Yes	No	
Specialization	66 %	34 %	
	Health centre	Under lease	Private
FD office autonomy	18.9 %	69,8 %	11,3 %
	Urban	Rural	Insular
FD office type	64,1 %	32,1 %	3,8 %

By comparison of data from well-known official Croatian health statistical publications [5], and data known from some previous analyzed works [3, 4], it can be concluded that the sample is representative enough to draw conclusions from the study.

Table 2 Survey results

Item	%	Satisfaction (0-1)
Inbuilt working guidelines	41,5	---
Inbuilt visual working quality indicators	51,9	---
Inbuilt DSS for diagnosis	8,5	0,78
Use of external DSS for diagnosis	9,4	---
Inbuilt DSS for prescribing	24,5	0,71
Use of any kind of DSS	25,5	---

The results obtained in the effective part of the questionnaire are shown in Table 2. Examining the survey forms we noted that different users with the same applications categorized their features on different ways. We interpret this again by reflecting to the early stages of the overall system implementation – i.e. we foresee several years of active usage before some best practices start to be dominant and pervasive.

Furthermore, in examining features of few EHR applications which are, according to the survey results, the most common in Croatian FD offices, it was found to be mainly "lighter" forms of user helping features. We can classify them as follows hereafter.

A. Clinical Guidelines

Some applications have built-in the Ministry of Health and Social Welfare's (MHSW) recommended clinical guidelines presented in HTML format. In addition to these internal facilities FD applications offer external links to clinical experts' proven and recommended Web addresses:

- http://iskra.bfm.hr/hrv/Guidlines.aspx [13]
- http://www.cardionet.hr/cardionetHeart/casopis/SmjerniceSadrzaj.asp [15]
- http://www.plivamed.net [16]

All of the above sources of clinical guidelines are well systematized, but are written in the form of free text and not encoded. The content of these guidelines does not cover all of the domain specialties. Access to these contents takes too much time FDs.

B. Pharmacological Guidelines

Similarly as in the case of clinical guidelines in addition to built-in pharmacological guidelines in HTML format, recommended by MHSW, there are also external links:

- http://www.plivamed.net [16]
- http://www.tg.com.au [17]

Time required to access and manner of access to pharmacological guidelines are completely the same as in the case of clinical guidelines.

C. Visual Working Quality Indicators

As is evident from Table 2, 52.9% of FDs use EHR applications that contain some visual indicators or gauges for assessment of FDs' working quality according to CIHI administrative guidelines which are implicit implemented in EHR applications. For now, in this way only three elements are followed:

- financial index for diagnostic-therapeutic procedures
- financial index for drug prescribing
- the rate of sick leave

Based on these three elements CIHI monitors the work of FDs, regardless of their visualization in the application [2].

D. DSS for Diagnosis

Considered applications have the following diagnostic helping features:

- monitoring and signaling of chronic diseases (~73% of used applications)
- monitoring and signaling of allergies (~75% of used applications)
- monitoring and presentation of earlier patient's diagnosis during the following diagnosis (~50% of used applications)

We can see that these features are, in principle, very simple but very useful helping elements, especially monitoring and presentation of earlier diagnosis.

E. External DSS for Diagnosis Processes

Considering the externally available diagnosis support systems, Croatian FDs are in most cases using an advanced system for diabetes monitoring named CroDiab NET [14] developed at the University Clinic "Vuk Vrhovec" in Zagreb. The system is based on the world-known guidelines for diabetes and ICD-10 coding system. It allows managing of disease registry, automatic generation of clinical discharge summaries (only for clinic use) and automatic creation of medical histories for each patient, based on data collected in the registry. The system can operate as an autonomous application on FD's computer or as a web application. FDs can enter patients' data into central registry, get printed clinical discharge summaries from clinic and print out ambulatory medical histories from the system.

F. DSS for Prescribing

These systems contain a slightly higher number of useful elements than the previously mentioned helping systems. Mostly are used automated therapy prescription for chronic diseases, control of the prescribed dose, the control of the prescribed medication according to ICD-10 diagnosis and helping FDs to choose drugs from CIHI's list. The systems are based on implicit administrative and professional guidelines and in 24.5% of cases are built-in in the Croatian EHR applications. Monitoring the interactions between certain medications and patient's allergic reactions to certain drugs, would further increase the quality of the systems.

IV. Discussion

Authors of the pilot study "Pilot on e-Health Indicators" (Empirica, 2007) [6] in analysis of the availability of DSS in European countries indicate that this term encompasses a wide range of different applications that can be used to denote different things depending on the understanding of the responding FD. This fact further suggests that we should access very carefully to the interpretation of survey results. Modified chart in Figure 1 was taken from the study [6] and shows the availability of DSS in European FD offices parallel with the results of our survey.

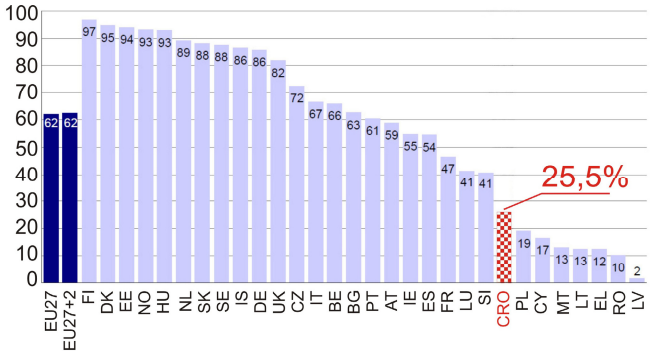

Fig. 1 Availability of DSS in EU and Croatia (Empirica, 2007) [6]

Table 1 shows that population of Croatian family/general practitioners is generally middle-aged (median is 49 years). A majority of 18.9% doctors that are employees of health centers (not self-employed practitioners with CIHI contract) have been using computer based EHR systems for only two years. Their understanding of the DSS is significantly different from the actual definition. Deeper analysis shows that in EU DSS for diagnosis make 59% compared to 32% of support for prescribing [6], while according to our results, Croatia currently measures support for diagnosis in 9.4% of cases, compared to 24.5% of support for prescribing. This is probably a consequence of CIHI's strict drug prescribing policy, especially in the case of chronic diseases [2]. However, if we compare the available helping elements in Croatian EHR applications with Gartner generation model [8] we see that applications are currently matching the second generation model (the Documentor) from the 90s, while the model for 2009 predicts the emergence of advanced fourth generation (the Colleague), which suggest large room for improvement.

In the past fifteen years a wide range of research projects were conducted under the European research and development program AIM (Advanced Informatics in Medicine), with subjects of the research including, for instance, problems of definition and implementation of guidelines in

European health care [9], implementation of guidelines in quality assurance of physicians' work in PHC in the Netherlands [10] or knowledge engineering for drug prescribing guidelines in the UK [11]. Based on the experience gained in these projects, in last 5-10 years the experts have developed some advanced PHC information systems. Thanks to equitable support in implementation of clinical and business guidelines the British National Health System (NHS) successfully uses over 130 indicators for evaluation of FDs work quality and pay-for-performance policy [12].

As previously mentioned, the Croatian health care system, except to the domestic sources, usually refers to the world-known sources of clinical guidelines such as National Guideline Clearinghouse (USA) [18] and the NHS Clinical Knowledge Summaries (UK) [19], while for the pharmacological guidelines commonly refers to Therapeutic Guidelines Limited (Australia) [17]. Considered EHR applications also refer to these sources. To create the DSS on the basis of these guidelines, they need to be localized with respect to the functional model of FD offices and current classifications of diseases and procedures, it is necessary to make the formalization of the guidelines presentation, and to make an adjustment of logical system for use within existing EHR applications [22]. In the case of EHR applications in Croatian FD offices, solution should be sought in the further implementation of HL7 open standards [20, 21]. By applying of service-oriented communication architecture and knowledge base consisting of rules written as Arden Syntax Medical Logic Modules (MLMs) is possible to create DSS oriented to specific health problems of each patient within existing EHR applications. Emerging of the development systems based on free and open source enabling technologies has significantly improved progress and spreading of guideline-based DSS [22].

V. Conclusions

Good properties of computerization within the Croatian FD offices, as a part of primary health care, certainly are: application of HL7v3 communication standard and a high degree of implementation of EHR applications. We see some encouraging first results in applying of the working guidelines and guideline-based DSS, but also significant areas of further improvement. Also, what we find to be essential is permanent education of doctors and health authorities with the aim of understanding capabilities of these systems and the needs for their use. Use of these systems guarantees the completeness and accuracy of the data in the EHRs, and thus the safety of the patient in the health care system. Solution for efficient and financially cost effective implementation should be sought in the further implementation of HL7 open standards and products developed using the free and open source enabling technologies.

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