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Using an Iconic Language to Improve Access to Electronic Medical Records in General Medicine

Christian SIMON [a,1], Sylvain HASSLER [b], Marie-Catherine BEUSCART—ZEPHIR [b], Madeleine FAVRE [c,d], Alain VENOT [a], Catherine DUCLOS [a], Jean-Baptiste LAMY [a]
[a] *LIMICS (INSERM UMRS 1142), Université Paris 13, Sorbonne Paris Cité, 93017 Bobigny, France, UPMC Université Paris 6, Sorbonne Universités, Paris*
[b] *EVALAB, Lille, France*
[c] *Université Paris Descartes, Paris, France*
[d] *Société de Formation Thérapeutique du Généraliste (SFTG), Paris, France*

Abstract. Physicians have difficulties to access and analyse information in a medical record. In a previous work on drug databanks, we have shown that with an iconic language as VCM, an icon-based presentation can help physicians to access medical information. Our objective, herein, is to study whether VCM can be used in an electronic medical record for facilitating physician access in general practice. We identify the data and the functionalities of an electronic medical record that could benefit from VCM icons representing clinical findings, patient history, etc. We also present a preliminary evaluation of this new icon-focused interface. We conclude by discussing the results like the assessment of the user's satisfaction and pointing out the importance of coding data.

Keywords. Electronic Medical Record, Family medicine, Icon-based language

Introduction

The use of electronic medical records in general practice is increasing [1] and has become vital for patient follow-up. This is generally done over a long period and involves the management of acute conditions, repeated episodic outbreaks and chronic diseases, thus requiring the coordination of healthcare programmes. The records can often be complex due to the plethora of conditions that can affect different organs or functions, and the wealth of patient information (patient examination, minutes, prescription, etc.).

Furthermore, care management makes it incumbent on the medical practitioner to work as a member of a team [2]. For instance, a doctor may need to refer to a record that he or she had not drafted. It must therefore be possible for a doctor, who may not necessarily be the case manager, to quickly find all the relevant information on a patient from the electronic medical record. However, given the complexity and diverse

[1] Corresponding Author. Christian Simon, E-mail: simonc@neuf.fr

nature of the data and data sources, a joint analysis of the record by the doctor and others is often difficult.

To address this problem and thus facilitate the analysis of patient record, several graphical solutions with interface capabilities have been evaluated in the context of their benefits and limitations (lifeline [3], visualisation methods [4], etc...).

The research laboratory LIM & BIO/LIMICS has developed an icon-based language called VCM (Visualisation of Medical Concepts) [5]. VCM icons can represent disorders, physiological states, patient history, risks, drug and non-drug treatments, follow-up procedures, health professionals, etc. This icon-focused approach has been successfully applied to the SPCs (Summaries of Product Characteristics) of medical drugs, leading to faster analysis and synthesis of information [6].VCM is different from previous approaches insofar that it describes medical information and can be integrated with existing interfaces to enhance their effectiveness rather than replace them.

Our study seeks to establish whether VCM can be adapted for use in an electronic medical record, e.g. for representing patient disorders, with the view to improving the overall management of the process while enhancing response times and quality in the selection of information and documentation during a consultation process [7].

This study was conducted in the framework of L3IM project by a consortium of several research laboratories, industrial firms and a learned society in general practice. As a first step, it was vital to identify the functionalities of a general medicine software that would benefit from icon-based representation. The next challenge was to implement these functionalities in an electronic medical record. Then we present the results of the evaluation in terms of time for reading patient records, the amount of relevant information found in the records and perceived user-satisfaction. We conclude by discussing perspectives for icon-based representations in health records.

1. Methods

The VCM language consists of icons depicting medical concepts and associated information from a combination of different basic concepts. Each icon consists of a colour that represents the temporality of the information (history, current problem or risk), a basic shape indicating the status as either "normal/physiological" or "abnormal/pathological", a main pictogram indicating the organ or the function involved, and optionally shape modifiers to specify a problem as a viral infection, a haemorrhage, etc.. M. VCM is an interactive interface that can present summarised information by organising VCM icons according to anatomy and aetiology on a graphical representation of a human body. More information is available on the VCM web site: http://vcm.univ-paris13.fr.

éO Médecin is a French medical software that captures all the information produced or collected by a doctor, and is used to structure information with SOAP contacts flagged up as problems. Within SOAP (Subjective, Objective, Assessment, Plan), each problem encountered during consultation is apportioned across four categories: the reasons given for the visit by the patient in narrative form, the objective and traceable facts identified by the practitioner, the conclusions or diagnoses and what the health care provider has done to treat the patient in terms of procedures and prescriptions.

1.1. The identification of areas of information suitable for graphical visualisation

Several steps have been taken to identify the information that may benefit from VCM graphical visualisation.

First, a focus group was organised by the Evalab laboratory involving doctors from SFTG, a general practice learned society. Six doctors worked on two clinical cases including 2 paper-based patient records (8 and 20 pages) and on one computerised record with the view to solving medical problems. The Evalab team provided the impetus for the production of results in order to highlight the key areas on which the doctors focus their attention, for helping in the articulation of the difficulties related to information management, and for recording the exchanges with respect to navigation within the record [8]. Finally, the doctors stuck VCM icons on parts of the record that they viewed as suitable candidates for visualisation and drew some VCM summaries. These iconised records and summaries were analysed by ergonomists.

Second, the éO software was analysed and stress-tested over several sessions with the help of the General Practitioners, with the view to identifying the functionalities of the software that could be enhanced by the use of icons and would meet users' expectations. The list of functionalities that would benefit from VCM was used to identify both the data that need to be represented by icons and the medical terminologies that can be used for coding these data.

1.2. User-centered assessment

A representative sample by age and by sex of 20 GPs was established with users at their doctors' offices using the éO software (without VCM icons).

Two anonymous medical records were extracted from a General Practitioner's database. Physicians were asked to read the records in éO, either with or without VCM functionalities, and to identify the important information items to prepare care management for the patient. Several parameters were assessed: (1) the number of items identified by the physician, (2) the relevance of these items assessed against a list drawn up by the doctors from the consortium and corresponding to relevant information to establish a diagnosis or a prescription for this patient, (3) the time taken by the GP to consult and analyse the record and (4) the time per item ratio.

After using the system, each GP completed a usability scale questionnaire with the aim of measuring the perceived usability of the system. The SUS (Standard Usability Scale[9]) questionnaire, consisting of 10 questions to be rated on a scale of 1 to 5 corresponding to "Strongly disagree" to "Strongly agree", was used.

Finally, the GPs had the opportunity to discuss freely the positive or negative aspects of the use of VCM and its incorporation within the software.

2. Results

The focus groups highlighted the challenges faced by the GPs when consulting and analysing patient records.

This study has enabled the identification of the key functionalities and information in a patient record that would benefit from VCM; these include: the patient's current disorders, history (Figure. 1), reasons for and diagnoses from consultations, medical specialties associated to medical reports, prescription drugs, dashboard summaries as

well as VCM pictograms to filter the information or to illustrate an interactive patient timeline. The study has highlighted that the lack of structured information [10] and common language is a limitations when implementing a support system. In a previous work, ICD-10, one of the most used terminologies [11], has been mapped to VCM. Furthermore, we used mapping between ICPC-2 and ICD-10 to perform transcoding of ICPC-2 and VCM. In addition, we have extended VCM with new icons to respond to GP requirements, such as illustrating the impact of social factors on health.

During evaluation, the number of relevant information items retrieved by GPs in both test records is a little higher without VCM functionalities. However, the Wilcoxon test does not demonstrate statistically significant differences (P = 0.54 and 0.73). For the first record, GPs took less time using VCM but this difference is not significant. For the second record, we found that the GPs took significantly more time when using VCM (439 secs without VCM on average against 675 secs with VCM, p=0.0312). The subjective evaluation in the SUS questionnaire returned a 65 out of 100 satisfaction score, thus demonstrating a positive assessment of this implementation. To improve this SUS result, a majority of users suggested they needed more time to explore and practice all the VCM-based functions. However, they believe that these functions have not been complicated by VCM and are in fact easy to use but should be further simplified. With no additional training, they would be well-placed to take over the system. The users are comfortable with the information displayed by the VCM icons and, in the main, have expressed the desire to use it. They appreciate the ability to filter information by clicking on an icon, and the M. VCM visual summary which provide "a quick overview of the patient case" and the highlighting of key information.

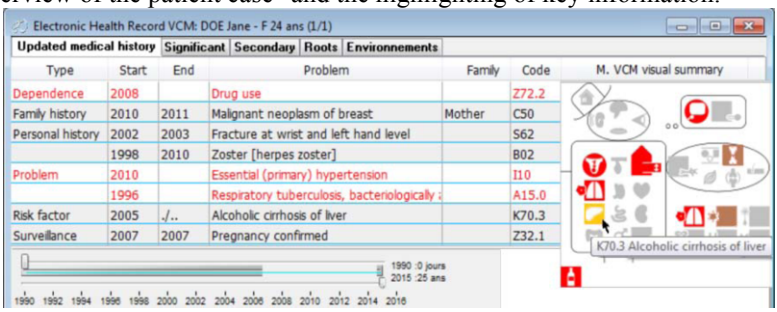

Figure 1. M. VCM based on patient history and problems

3. Discussion

In this study, we have shown that icons representing disorders, drug treatments, procedure, etc., can be used to enhance medical records. This study has highlighted the system's benefits to users, particularly with respect to complex records of multi-pathological patients followed up over a long period of time. The evaluation provided contradictory results on the impact of VCM on consultation time. This may be due to the complexity of the second record changing the behaviour of the GPs via a two-fold discovery of the record: in the first instance, they seem to return to their old habits without paying much attention to VCM; in the second instance during the record's journey, they seem to focus their attention on the information displayed by the VCM icons. This can probably be explained by the GPs discovering the VCM language, with

their attention focused on the analysis of the icons and the instruction on how to use the language. This focus on the use of the icons may have diverted their attention to other cognitive tasks. The sample size of GP-evaluators was reduced. It would be interesting to conduct a more extensive evaluation to remove the effects of playful discovery and of learning the VCM language while analysing factors such as the complexity of a record that can influence the behaviour of medicines and the impact of results.

The coding of medical information is necessary to enable the display of the information in iconic form. However, the actual practice shows that very few medical data are encoded in France. Further work is needed to improve the interfaces for data entry and to propose new methods of capturing standardised information (structured and coded information based on recognised terminology and classification) with minimal user intervention. This led us to start a new research project, SiFaDo (*Saisie Facile des Données Médicales*, Easy Entry of Medical Data).

After a phase of improved processes, VCM in éO can be handed over to users for evaluation at the doctor's office. This will provide an evaluation of user acceptance and of the benefits delivered in the context of a more sustained ownership. It will enable the assessment of the benefits delivered to other medicine stakeholders such as trainees and locum replacements who do not have as full a picture of the patient's history.

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References

[1] Xierali IM, Hsiao CJ, Puffer JC, Green LA, Rinaldo JCB, Bazemore AW, et al. The Rise of Electronic Health Record Adoption Among Family Physicians. Ann Fam Med. 2013 Jan-Feb;11:14-19.
[2] Gill JM. EMRs for Improving Quality of Care: Promise and Pitfalls. Fam Med. 2009 Jul-Aug;41(7):513-51.
[3] Plaisant C, Milash B, Rose A, Widoff S, Shneiderman B. LifeLines: visualizing personal histories. Proceedings of the SIGCHI conference on Human Factors in Computing Systems; 1996 apr 13-18; Vancouver:Canada.
[4] Kosara R, Miksch S. Visualization methods for data analysis and planning in medical applications. Int J Med Inform. 2002 Dec 18;68(1):141-153.
[5] Lamy JB, Duclos C, Bar-Hen A, Ouvrard P, Venot A. An iconic language for the graphical representation of medical concepts. BMC Med Inform Decis Mak. 2008 Apr 24;8:16.
[6] Lamy JB, Venot A, Bar-Hen A, Ouvrard P, Duclos C. Design of a graphical and interactive interface for facilitating access to drug contraindications, cautions for use, interactions and adverse effects. BMC Med Inform Decis Mak. 2008 Jun 2; 8:21.
[7] Poissant L, Pereira J, Tamblyn R, Kawasumi Y. The impact of electronic health records on time efficiency of physicians and nurses: a systematic review. J Am Med Inform Assoc. 2005 Sep-Oct;12(5):505-516.
[8] Beuscart-Zéphir MC, Elkin P, Pelayo S, Beuscart R. The Human Factors Engineering approach to biomedical informatics projects: state of the art, results, benefits and challenges. Yearb Med Inform. 2007;109-27.
[9] Bangor A, Kortum P, Miller J. Determining What Individual SUS Scores Mean: Adding an Adjective Rating Scale. Journal of usability studies. 2009 May; 4(3):114-123
[10] Tate AR, Martin AGR, Ali A, Cassell JA. Using free text information to explore how and when GPs code a diagnosis of ovarian cancer: an observational study using primary care records of patients with ovarian cancer. BMJ Open. 2011 Feb 23;1(1):e000025.
[11] Ahmadian L, van Engen-Verheul M, Bakhshi-Raiez F, Peek N, Cornet R, de Keinser N. The role of standardized data and terminological systems in computerized clinical decision support systems: Litterature review and survey. Int J Med Inform. 2011 Feb;80(2): 81-93.