eHealth Beyond the Horizon – Get IT There
S.K. Andersen et al. (Eds.)
IOS Press, 2008

Use Of Super-Concepts To Customize Electronic Medical Records Data Display

P. MASSARI[a], S. PEREIRA[a], B. THIRION[a], A. DERVILLE[b], SJ. DARMONI[a]
[a] *CISMeF, Rouen.University Hospital & GCSIS, LITIS EA 4108, Institute of Biomedical Research, University of Rouen, France*
[b] *IS@S Company. Paris. France*

Abstract. Patient medical record systems (MRS) merely offer static applications, in which mostly unstructured text is linked to coded data. In these applications the more common presentation is a time oriented one, which does not allow easily for data and information retrieval. Concept oriented views based on supper-concepts (metaterms) initially defined in CISMeF to optimize Web medical search, was implemented in our MRS as specialties views. This work shows that these terminological tools are able to facilitate information retrieval.

Keywords. Medical Records Systems, Computerized, Data Display, Information Storage and Retrieval, Abstracting and Indexing

Introduction

The architecture of patient medical record systems often respect the European standard HISA [1]. In these systems, Electronic Health Records (EHR) are structured to a certain degree, according to patient record system used, and most of the EHR contain a majority of unstructured texts [2], these texts being linked to contacts[1] and procedures[2] as described in HISA [1]. These entities, contacts and procedures are also associated with respective ICD10 and procedure codes.

The most common presentation of these data in the MRS is a time related presentation, referring the dates and periods of care. In this model information retrieval can be difficult when patients have a long medical history. To optimize information retrieval in EHR, the problem-oriented medical record was introduced as a concept in 1968 [3]. It does not yet have a wide spread because of the requirement on structuring patient-data entries [4].

Another way is to implement appropriate views, using terminological tools. The CISMeF metaterms [5] are super-concepts which were initially defined to draw together MeSH terms from the MeSH thesaurus [6]. CISMeF's metaterms correspond to medical specialties (e.g. cardiology), types of medical procedures (e.g. surgery) or

[1] HISA definition of contact : event during which the clinical state of a subject of care is under the active consideration of healthcare agent.
[2] Procedures included office visits.

health topics (e.g. diagnosis, therapy). Creating metaterm (or super-concepts) came up initially to optimize information retrieval in the CISMeF catalogue, in particular to maximize the recall [7]. We have decided to reuse the super-concepts in a different environment (MRS) using different health terminologies. ICD 10 for coding diagnosis and several health procedure classifications in use in France : CCAM [8] (since September 2005) and CDAM (before 2005) for therapeutic and diagnosis procedures and ADICAP for pathological exams. CISMEF metaterms embedded in the EHR could offer to clinicians customized views of the EHR elements, that could be more efficient than the classical time-oriented presentation.

The aim of this study is to describe and evaluate individual medical records sorted by typology of elements and by medical specialties based on terminological tools, using CISMeF super-concepts.

1. Material and Methods

1.1. Patient medical record system of the Rouen University Hospital

EHR was introduced in 1992 in the Rouen University Hospital [9] and took into account medical contacts, laboratory results, discharge ICD codes, medical procedures codes, medical procedures reports and discharged medical reports. Between 1992 and the end of 1999, the medical record system was implemented on a mainframe system, while since the end of 1999 a new medical record system working on an Oracle data base has been in use, allowing to take into account the same data and specific structured data. Currently EHR includes all the computerized data from 1992 until now, corresponding to 1.2 million patient records, 8.6 million contacts, 9.34 million medical procedures, 1.2 million discharge reports and 3.1 million medical procedure reports.

1.2. CISMeF metaterms and MeSH

CISMeF ([French] acronym for Catalog and Index of French Language Health Resources on the Internet) [1] is a quality-controlled health gateway. It was designed to catalog and index the most important and quality-controlled sources of institutional health information in French in order to allow end-users to search them quickly and precisely (N=36,589). Its URLs are http://www.chu-rouen.fr/cismef or http://www.cismef.org. CISMeF uses two standard tools for organizing information : the MeSH thesaurus [6] from the US National Library of Medicine and several metadata element sets, in particular the Dublin Core metadata format (URL:http://www.dublincore.org) [10]. However, the MeSH thesaurus was originally intended to index scientific articles for the Index Medicus and for the MEDLINE database. In order to customize it to the broader field of health Internet resources, we have been developing several enhancements [1] to the MeSH thesaurus, with the introduction of two new concepts, respectively metaterms (MT) and resource types (RT). CISMeF RT are an extension of the publication types of MEDLINE. Creating metaterms were firstly designed to optimize information retrieval in CISMeF and cope with the relatively restrictive nature of these medical specialties as MeSH (keywords) descriptors. The MeSH thesaurus does not allow to have a global vision of a medical specialty. Therefore, in the CISMeF terminology, metaterms can be considered as

"meta-concepts". Metaterms have been manually selected by the chief medical librarian (BT). The semantic links between metaterms and MeSH terms, MeSH subheadings and CISMeF resource types are based on his know-how and expertise of medical specialists of the RUH. There is a 0 to N relations between CISMeF metaterms and MeSH terms, MeSH subheadings and CISMeF resource types. In September 2007, the number of metaterms in the CISMeF terminology was 123. The comprehensive list of metaterms is available at the following URL : http://doccismef.chu-rouen.fr/liste_des_meta_termes_anglais.html.

1.3. CISMEF metaterms and ICD10, CCAM, CDAM and ADICAP classifications

A clinician (PM) and the chief medical librarian (BT) reviewed the list of CISMeF metaterms to be reused in this context (N= 66 out of 123, 54 %). Semantic links were manually created between super-concepts and each code of ICD 10, CCAM, CDAM, ADICAP classifications (see Table 1). As for MeSH thesaurus there is a 0 to N relations between CISMeF metaterms and codes of ICD10, CCAM, CDAM, ADICAP classifications. As an example, the metaterm Cardiology is semantically linked with the ICD 10 code I50.0-Congestive Heart Failure, the CCAM code "DZQM006-Échographie-doppler transthoracique du coeur et des gros vaisseaux" (Echocardiography, transthoracic) and the ADICAP code "BHCZ-Biopsie endomyocardique" (Endomyocardial biopsy).

Classification	Number of codes	Number of semantic links	Min-Max by codes
ICD10	10,505	13,650	1-3
CCAM	7,389	12,538	1-5
CDAM	7,699	13,508	1-4
ADICAP*	279	372	0-3

Table 1 : Semantic links between super-concepts and classifications in use in France

* A simplified ADICAP nomenclature is used in Rouen University Hospital

Using metaterms to make queries on clinical consultations requires the indexation of consultation service points. A partial evaluation of the manual semantic links between super-concepts and CCAM codes was performed by automated indexing tools [11].

1.4. EHR views using super-concept

To filter data of one or more medical specialties, customized views using metaterms have been implemented in our MRS. Codes and associated metaterms taken into account are : ICD10 discharge codes of hospitalization, CCAM and CDAM (before 2005) for technical medical procedures, ADICAP for pathological exams. These queries allow to make containers of data, classified by type of EHR elements (stays, diagnosis, surgical procedures…) and filtered by medical specialties.

1.5. Evaluation

The potential advantage of specialty-oriented views of EHR as compared to the "more classical" time related views, depends on the number of elements contained in the patient records. Because they have a potential interest for complex patient records with multiple reports, a preliminary evaluation needs to study the distribution of patients records size. We have studied the size of patient records taken in charge during the first trimester 2006. It was performed by cardiologists, lung specialists and gastroenterologists.

2. Results

2.1. Size of the health records

Between 1 January-31March 2006, 81,471 patients came to the Rouen University Hospital for hospitalization or consultation. 33.46% of the medical records contain more than 20 medical contacts, and 34.01% more than 20 medical procedures.

2.2. Time oriented view versus specialties views

Illustrations of time oriented and specialty views a shown on figure 2.

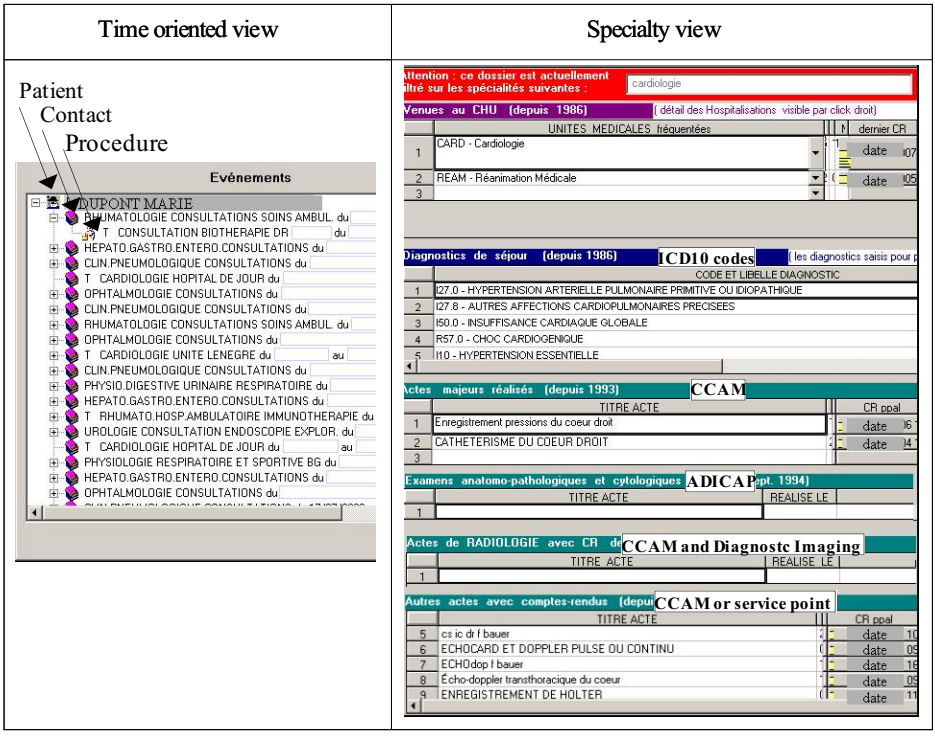

Figure 2 : Time oriented vs specialties views in Rouen EHR

The EHR used to illustrate these views is the one of a patient who has a four years medical history in RUV (see figure 2). It takes into account 62 outpatient contacts and 41 inpatient ones. The time oriented view shows in a three levels treeview including patient, contacts, and medical procedures. Linked data (codes, reports…) are accessible after selecting the element. To review the cardiological problems of this patient by the time oriented view, a clinician would have to search contacts and procedures linkable to heart disease and to read the linked data. The specialty view only displays the contacts and procedures linked with the metaterm cardiology. Seven inpatient contacts are retrieved out of 41, 5 in cardiology units, 2 in the intensive care unit (Réanimation Médicale). For these 7 contacts one or more ICD10 discharge codes are linked with the metaterm cardiology (I50.0-Congestive Heart Failure, I27.0-Primary Pulmonary Hypertension, R57.0-Cardiogenic Shock). The numbers of this EHR elements filtered by the metaterms cardiology and pneumology are shown in table 2.

Type of data	Number of elements in the whole record	Number of elements filtered by "cardiology"	Number of elements filtered by "pneumology"
Contacts	18	7	12
ICD10 discharge codes	38	6	6
Major procedures	16	2	8
Pathological reports	6	0	3
Radiological procedures	24	0	3

Table 2 : Distribution of the elements of the medical record

2.3. Comparison of the two view types of in information retrieval

A clinician in care of this patient would want to see all the cardiologic informations or only the reports of a chosen procedure, for example reports of echocardiographies. In this EHR there are 3 echocardiographies, if the clinician (or the patient) do not know when these procedures were performed, without specific tools finding these 3 reports is nearly impossible. Knowing them, the user will have to select the contact, unfold the treenode and open each report, it takes less than 5 minutes to do it. Using the specialties view, no matter if the end-user knows the procedures dates or not, the three echocardiography records can be found in less than 2 minutes.

The evaluation of specialties views based on CISMeF metaterms in EHR was considered as satisfying by the CISMeF team and the RUH, therefore we have decided to implement this specialty view tool in the real environment of the RUH EHR .

3. Discussion

This paper presents another use of the CISMeF metaterms, originally developed for the optimization of information retrieval and categorization. The CISMeF metaterms are now semantically linked with different medical terminologies (ICD 10, CCAM, CDAM and ADICAP) in order to provide the clinicians customized views of EHR elements. This semantic links are manually established. Therefore, the quality of the CISMeF metaterms relies on the know-how of this manual indexing. Fortunately, the

CISMeF team includes the chief medical librarian (BT) who has 12 years of experience in manual indexing using health terminologies. The fifteen years history of EHR in RUH [9] means that a significant part of patients records in the data base contains a large number of recorded events. The information and data retrieval in these records is difficult, and need specific tools [10]. Improving information retrieval can be done by different types of views, the effectiveness of concept-oriented views was reported by several authors [13] [14]. More recently, a second generation of these tools, using ontologies to define fundamental concepts, their properties, and interrelationships within a particular domain, have been described [15].

4. Conclusion

EMR display data and retrieval information can be optimized by specialties views. Super-concepts initially designed for medical Web search can be reused to create these views. These super-concepts could make possible in the future the creation of problem-oriented views, without the requirement of structuring patient data entries.

5. References

[1] Healthcare Information System Architecture (HISA) : prENV 12967-1; CEN/ TC251, [Online] [cited 2008 Feb 22] 1997; URL : http://www.tc251wgiv.nhs.uk/pages/hisa.asp
[2] Bayegan E, Nytro O. A problem-oriented, knowledge-based patient record system. Stud Health Technol Inform. 2002;90:272-6.
[3] Weed LL. Medical records that guide and teach. The New England Journal of Medicine, 278(12), March 21, 1968.
[4] Lundsgaarde HP, Fischer PJ, Steele DJ. Human problems in computerized medicine, University of Kansas Publications is Anthropology Number 12, Lawrence, Kansas, 1981.
[5] Douyère M, Soualmia LF, Névéol A, Rogozan A, Dahamna B, Leroy JP, Thirion B, Darmoni SJ: Enhancing the MeSH thesaurus to retrieve French online health resources in a quality-controlled gateway. Health Info Libr J 2004: 21(4):253-61.
[6] Nelson SJ, Johnson WD, Humphreys BL: Relationships in Medical Subject Headings in Relationships in the organization of knowledge. In Bean and Green, eds. Kluwer Academic Publishers, 2001. p. 171-84.
[7] Gehanno JF, Thirion B, Darmoni SJ. Evaluation of meta-concepts for information retrieval in a quality-controlled health gateway. Proc AMIA Symp. 2007:269-73
[8] Rodrigues JM, Trombert-Paviot B, Baud R, Wagner J, Rusch P, Meusnier F. Galen-In-Use: an EU Project applied to the development of a new national coding system for surgical procedures: NCAM. Stud Health Technol Inform. 1997;43 Pt B:897-901.
[9] Massari P, Smuraga I, Froment L, Boudehent S, Czernichow P, Streiff J, Baldenweck M, Hecketsweiler P. Application de gestion des dossiers informatisé du CHU de Rouen. Cinquièmes Journées Francophone d'Informatique Médicale. Genève 9-10 juin 1994.
[10] Dekkers M, Weibel S: State of the Dublin Core Metadata Initiative. D-Lib Magazine April 2003: vol 9. Number 40.
[11] Pereira S, Massari P, Joubert M, Darmoni S. Utilisation de métatermes pour la recherche d'information dans les dossiers médicaux. JFIM 2007, Bamako, Mali, Janvier 2007
[12] Powsner SM, Tufte ER. Graphical summary of patient status. Lancet 1994; 344:386-9.
[13] Dore L, Lavril M, Jean FC, Degoulet P. An object oriented computer-based patient record reference model. Proc Annu Symp Comput Appl Med Care. 1995;377-81.
[14] Zeng Q, Cimino JJ. Evaluation of a system to identify relevant patient information and its impact on clinical information retrieval.Proc AMIA Symp. 1999;642-6.
[15] Elisabeth B, Oystein N, Anders G. Ontologies for Knowledge Representation in a Computer-Based Patient Record 14th IEEE International Conference on Tools with Artificial Intelligence (ICTAI'02). 2002. p. 114.