MEDINFO 2007
K. Kuhn et al. (Eds)
IOS Press, 2007

Creation and Evaluation of a Terminology Server for the Interactive Coding of Discharge Summaries

Hernán Navas, Alejandro Lopez Osornio, Analía Baum, Adrian Gomez, Daniel Luna, Fernan Gonzalez Bernaldo de Quiros

Department of Medical Informatics, Hospital Italiano de Buenos Aires, Argentina

Abstract

Free text entry versus structured data has been proposed as models in data entry in health information systems. A new user interface was developed with the objective of improving data capture. It also implemented a modification of the discharge summary data entry user interface that allowed the selection of already coded terms from a local terminology in the context of an inpatient electronic medical record. This software interacts online with a terminology server to provide feedback on data entry to clinical users in order to automatically code data. To evaluate the impact of this new software, we measured user satisfaction and the impact on autocodification rate. The new system had good acceptance from the users who ranked it high using QUIS (Questionnaire for User Interaction Satisfaction) and the auto codification rate improved from 61.5% to 88.39%.

Keywords:

automatic data processing, user-computer interface, computerized medical record

Introduction

For a long time there has been a discussion regarding the use of free text versus structured text for data entry that later must be codified [1]. Free text has the advantage of allowing physicians to express themselves freely, but the disadvantage is the need for a laborious codification process to allow data analysis. Structured text allows a quick codification process but has the disadvantage of being time-consuming for the physician and constrains expression to the level of detail of the selected entry terminology.

Since 2000, physicians at the Hospital Italiano of Buenos Aires have used an inpatient electronic medical record for creating the discharge summary using free text. The discharge summary is a structured abstract of the hospitalization episode where data are registered for caring and management purposes [2].

This paper describes our experience when introducing a more restrictive user interface that will require users to select terms from an existing list. The new system should have functions that can facilitate migration from the previous unconstrained text entry model and author kit is designed to assist in preparing the submission. It is an exact representation of the format expected by the editor.

Objectives

The objectives are to:

- Develop and implement a modification of the discharge summary data entry user interface that allows the selection of already coded terms from a local terminology
- Measure the usability of the new software prior to its implementation will be measured
- Assess the impact automatic codification rate after implementation.

Methods

Information contained in discharge summary is structured in several domains. This structure has the purpose of collecting all the necessary information to group episodes using diagnostic related groups (DRG). The different domains are shown in Table 1.

In each of these fields, the physician entered free text descriptions. The previous version of the discharge summary software tried to automatically code the entered text using the terminology server. If the term did not match an existing entry in the local terminology, it was addressed to the terminology team for secondary manual codification. The terminology team reviewed all the discharge summaries, assigned ICD-9CM codes and manually grouped them into a DRG [3].

The Terminology Server (TS) [4] is software composed of a local interface vocabulary (thesaurus) mapped to a reference vocabulary, SNOMED CT. The thesaurus is a list of terms created from almost 2 million free text inputs extracted from the clinical data repository. The terms included in the thesaurus are divided into concepts (real clinical entities) and descriptions (different ways of naming these clinical entities). The TS also has capabilities to reject invalid terms already flagged as not appropriate for the intended use.

The TS was used for several months in the background without interacting with the users, coding exact matches and ignoring invalid and new terms [5].

Table 1 - Description of discharge summary fields

Domain	Description
Principal diagnosis	Syndrome or disease that best explains the patient's condition on admission to hospital
Other diagnosis	Diagnosis made during hospitalization not related to the principal diagnosis or not caused by it
Clinical history	Diseases suffered by the patient prior to, and not related to, the current hospitalization
Surgical history	Procedures experienced by the patient prior to, and not related to, the current hospitalization
Co-morbidities	Preexisting diseases, currently active, that generate actions by the physician
Complications	Conditions that appear during the episode that are related to the principal diagnosis or procedures
Principal procedure	The main invasive procedure undergone by the patient, related to the principal diagnosis
Other procedures	Procedures that do not meet criteria to be considered a principal procedure

New requirements

It was established that changes in the discharge summary interface would enforce the selection of terms already included in the TS by interacting with the user during data input. The TS should also provide interactive information for refining concepts. This feature of the TS is achieved using semantic information included on SNOMED CT, navigating the sub-types/super-types hierarchy.

The new user interface should:

- Provide automatic coding for known terms
- Offer more detailed instances of a concept for refinement
- Suggest similar terms as alternatives for unknown terms.

Interactive model

Every time the physician enters a term, two situations can take place:

- Automatic codification: when there is an exact match, the entry term is automatically codified using the code of the institutional vocabulary term (e.g. measles)
- Non-autocodifiable text: refers to the situation where the physician enters text that is unknown, invalid or can be refined. It also takes into account spelling mistakes and synonyms, all contained in our server. The three different variants are outlined below.

Unknown text

If the physician enters a term that is not included in the institutional thesaurus, the system offers the user a list of possible valid terms so can they can select one of them. If the physician considers none of these terms exactly reflects the intended meaning, it is possible to choose to save the original text for manual revision.

Invalid text

If the physician enters a term that is manually marked as 'non-valid for this domain', the system alerts the user and offers, in some cases, an alternative valid term but does not allow the invalid term to be saved. If the system doesn't offer valid alternatives, the physician must enter a new term.

Refinable text

The text is related to a valid concept but there are more specific concepts available. The system displays more detailed options so the physician can choose one and make a more specific entry (e.g. arterial hypertension). The text is valid but the system will offer more specific options such as primary arterial hypertension or secondary arterial hypertension.

Impact of the new system

The impact of the automatic codification process was easily measured through the ST records using rates of automatic coded terms of May 2006 and June 2006, prior and after the software implementation respectively.

Evaluation of usability

We decided to evaluate the usability of the software prior to its implementation. We choose 5 physicians from different specialties to represent the users of the discharge summary software. A resident physician of the Medical Informatics service observed while these physicians used the software in their usual workplace. After observation, the physicians were asked to complete the QUIS (Questionnaire for User Interaction Satisfaction) Spanish version 7.0. QUIS was developed and validated by the Human-Computer Interaction Laboratory of Maryland University [7]. We used the brief version of the questionnaire due to the limited time available with the physicians. QUIS uses the Likert scale from 1 to 9. It is divided into 12 parts, 5 of which were not applicable in our setting. Part 1 evaluates the experience with the system; part 2 the experience in general when using computers; part 3 examines the general impression of the user; part 4, the screen design; part 5, the terminology used; part 6 makes reference to the learning capacity; and part 7 evaluates system qualities such as velocity, consistence and facility to use it.

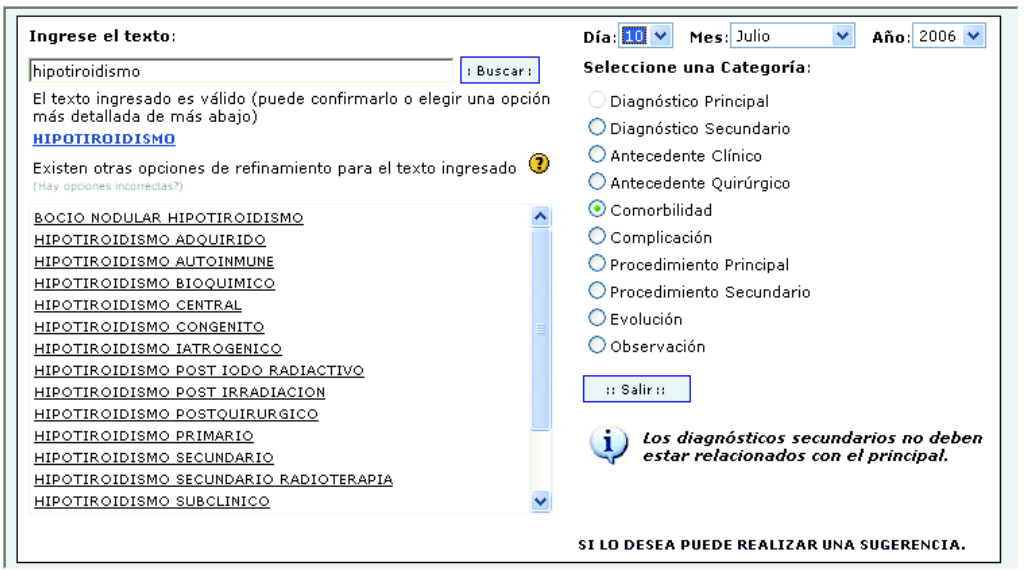

Figure 1 - New interactive coding application

Implementation

The software was successfully implemented in June 2006. The software was programmed in Java, as are all our electronic medical records. The access to the terminology services was made through store procedures programmed in PL-SQL in an Oracle 10g base. The user interface screen is showed in Figure 1.

Results

Using the previous discharge summary software, only 12,830 (61.5%) terms were automatically coded from a total of 20,862 terms in one month. During the month after the implementation of the new user interface, 16,826 (88.39%) were automatically coded from a total of 19,036 terms, as shown in Figure 2.

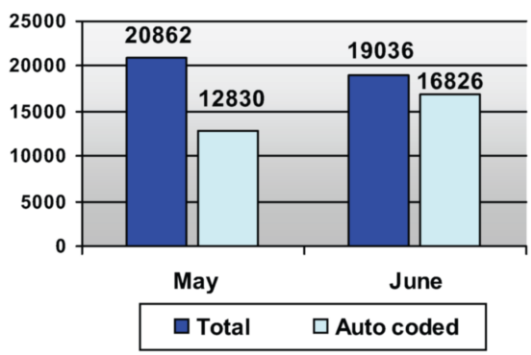

Figure 2 - Automatic code rate pre and post implementation

In spite of the modifications made to the interface, resident physicians were completely satisfied and none needed help while using it. QUIS results are shown in Figure 3.

Part 1: Experience with the system. Users had at least 1 or 2 years using the system, between 1 and 4 hours weekly.

Part 2: Prior experience. All users had prior experience using Windows OS ® and were users of previous clinical applications including discharge summary, order entry and results manager.

Part 3: Users general impression. Users rated the discharge summary screen as good, stimulating, easy to use, adequate and flexible.

Part 4: Screen design. Users found screens to be easily readable, with a clear sequence. Highlighted elements in screen were of medium utility, as well as screen format.

Part 5: Terminology and information about the system. Users found the terminology to be consistent and appropriate. The on-screen messages were clear and consistent. The system usually informed about what it was doing. The error messages were helpful.

Part 6: Learning. The users think the system is easy to learn and tasks were done mostly without complications. Names and instructions were easy to remember.

Part 7: System capacity. Users found the system to have a good working speed. It was easy to correct mistakes. The usability was directly related with the user's level of experience.

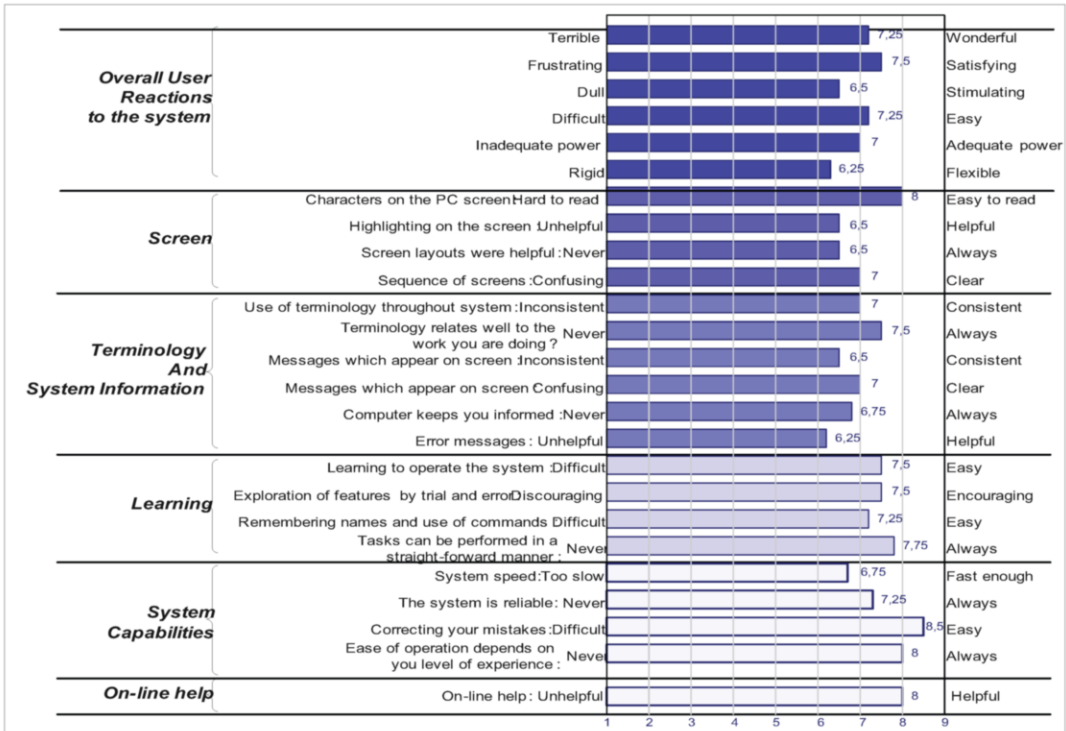

Figure 3 - QUIS results

Discussion

Health care organizations currently pay attention to systems usability [8, 9] and this can be carried out with few resources. Systems usability can be evaluated by a trained person with a notepad and five users who are representative of the users' population [10]. We decided to use QUIS as a validation instrument because we wanted to ensure before implementing the new system that medical residents would not have any problems using the new interface, and that it would not interfere with their complex daily tasks.

We think this improvement relies greatly on the important amount of text (synonyms, abbreviations and local jargon) available in the terminology server, and the relationships established between the different terms through the use of SNOMED CT.

The availability of online consultation about the terminology and input terms created acceptance among users, and led us to maximize the benefits of free and structured texts.

After going through the process of manual revision of new terms, a new version of the user interface will further restrict the data entry process, and disallow the clinical use of unknown terms. A mechanism to propose new terms will be maintained, but new terms will not be assigned to a patient until they are approved by the terminology team.

References

1. Middleton B, Renner K, Leavitt M. Ambulatory practice clinical information management: problems and prospects. Healthc Inf Manage 1997; 11(4):97-112.
2. Gonzalez Bernaldo de Quiros F, Soriano E, Luna D, Gomez A, Martinez M, Schpilberg M, Lopez Osornio A. Desarrollo e implementación de una Historia Clínica Electrónica de Internación en un Hospital de alta complejidad. In: 6to Simposio de Informática en Salud - 32 JAIIO; 2003; Buenos Aires, Argentina: Sociedad Argentina de Informática e Investigación Operativa (SADIO).
3. Lopez Osornio A, Luna D, Bernaldo de Quiros FG. Creación de un sistema para la codificación automática de una lista de problemas. In: 5to Simposio de Informática en Salud - 31 JAIIO; 2002; Santa Fe, Argentina: Sociedad Argentina de Informática e Investigación Operativa (SADIO).
4. Lopez Osornio A, Gambarte ML, Otero C, Gomez A, Martinez M, Soriano E, Luna D, Otero P, Clusella MM, Mitre MG, Reynoso G, Gonzalez Bernaldo de Quiros F. Desarrollo de un servidor de terminología clínico. In: 8mo Simposio de Informática en Salud - 34 JAIIO; 2005; Santa Fé, Argentina: Sociedad Argentina de Informática e Investigación Operativa (SADIO).
5. Luna D, Lopez Osornio A, Plazotta F, De los Ríos E, Montenegro S, Martinez M, Paris M, Bernaldo de Quiros FG. Creation of an Web Based DRG Grouper. Technol Health Care 2004; 12(5):375-6.
6. Wang SJ, Bates DW, Chueh HC, Karson AS, Maviglia SM, Greim JA, Frost JP, Kuperman GJ. Automated coded

ambulatory problem lists: evaluation of a vocabulary and a data entry tool. Int J Med Inform 2003; 72(1-3):17-28.
7. University of Maryland (UMD). QUIS: The Questionnaire for User Interaction Satisfaction. Available at: http://www.cs.umd.edu/hcil/quis Last accessed: Jul 2006.
8. Sittig DF, Kuperman GJ, Fiskio J. Evaluating physician satisfaction regarding user interactions with an electronic medical record system. Proc AMIA Symp 1999:400-4.
9. Hortman PA, Thompson CB. Evaluation of user interface satisfaction of a clinical outcomes database. Comput Inform Nurs 2005; 23(6):301-7.
10. Nielsen J. Why you only need to test with 5 users. Available at: http://www.useit.com/alertbox/20000319.html Last accessed: Jul 2006.

Address for correspondence

Hernan Navas, MD
Department of Medical Informatics
Hospital Italiano de Buenos Aires
Gascón 450
(C1181ACH) Buenos Aires – Argentina
e-mail: hernan.navas@hospitalitaliano.org.ar