Digital Healthcare Empowering Europeans
R. Cornet et al. (Eds.)

doi:10.3233/978-1-61499-512-8-15

A Connecting System for Cardiological Lexicons

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Abstract. The purpose of this paper is to present the approach and the development of a software application ("lexicons connecting" system) to correlate effectively and unambiguously the correspondence between the specialist medical vocabulary and the familiar medical vocabulary for the cardiovascular domain. To investigate the question, the idea, the design, and the implementation of such system will be described. To this end, firstly, a number of research methodologies will be examined including domain ontologies development, database design and implementation. Then, the following implementation methodology and its results are presented. Finally, an example of the application use will be depicted and future work will be briefly described.

Keywords. Knowledge Bases, Terminology as Topic, Software, Consumer Health Information, Patient Participation

Introduction

In the field of Healthcare, the use of information and communication technology (ICT) to support the daily activities has increased. In particular, health information technology supports not only medical scientific research, clinical practice, and patient care, but also the healthcare management processes [1]. Furthermore, personal health record (PHR) systems allow consumers or patients to collect and manage their personal health information coming from hospital electronic health records (EHR) [2].

However, the "vocabulary gap" between language familiar to both patients and consumers and terminology used in medical practice and research influences the effectiveness of health communication. The communication occurs between different individuals, such as physicians, doctors, nurses, and patients characterized by different health knowledge and "health literacy". The latter has been defined as "the degree to which individuals have the capacity to obtain, process and understand basic health

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information and services needed to make appropriate health decisions" by the US Institute of Medicine - IOM [3]. Limited health literacy has become an obstacle to overcome [4]. Therefore, while it is important to present health information using consumer terms in consumer/patient software systems, converting specialist medical terms to familiar ones is a challenging task for the consumer/patient [5].

To help the patients more, the objectives of the research work presented here were the requirement specification, the design, the implementation, and the preliminary test of an ontology-based software application – a "lexicon connecting" system for the explanation of the correspondence between the Specialist Medical Lexicon and the Familiar Medical Lexicon for the domain of Cardiology.

1. Methods

1.1. Modeling the standpoint of the consumer/patient

The standpoint of a consumer/patient to his/her health is represented in Figure 1. When he/she supposes that something indicates a disease is present (symptoms), normally, he/she goes to the General Practitioner (GP) or to the Specialist doctor. The doctor diagnoses the patient, or prescribes examinations. When a diagnosis is reached, usually the doctor assigns a therapy. Depending on the diagnosis, the therapy can be surgical, drug, rehabilitative, and so on (Figure 1). The chart shown in Figure 1 is a Unified Modeling Language (UML) class diagram for describing the static aspects of the health status of a subject in the household. Briefly, UML is a language for specifying, visualizing, constructing, and documenting the artifacts of software systems, as well as for business modeling and other non-software systems [6]. Class diagrams show the static structure of concepts, types, classes and class-class relationships. We used that representation as a support to develop an ontology-like taxonomic structure of the familiar medical lexicon in Cardiology, as explained in paragraph 1.3.

1.2. Modeling the Approach to express specialist terminology using familiar vocabulary

For building the lexicons and for expressing specialist terminology using familiar vocabulary we followed the approach represented in Figure 2. Specialist Medical Terminologies are represented on the right side, whereas Consumer Medical Lexicons are represented on the left side (Figure 2). The main connection is the arrow named "Conceptual Correspondences" between the Specialist Medical Terminologies and Consumer Medical Lexicons (Figure 2).

Gathered by the Unified Medical Language System (UMLS) [7] of the US National Library of Medicine, there are many biomedical dictionaries developed by professionals and devoted to professionals. We used UMLS as a source for checking specialist medical terms we extracted from the biomedical ontologies available on the Web site of the National Center for Biomedical Computing, NCBO Bioportal [8].

Unfortunately, the number of the electronic medical dictionaries devoted to consumers is small [5,9,10]. One of them is the open access Consumer Health Vocabulary (CHV) [10] and its terms and concepts are mapped in the UMLS Metathesaurus. We used CHV as a source for familiar medical terms in English.

The alignment between the two contexts – specialist and familiar - has been developed both in Italian and in English using a semi-automatic procedure based on database queries and, in the end, human checked. For this purpose, we considered the UMLS as international terminology standard [7]. The UMLS Metathesaurus associates to every concept a Concept Unique Identifier (CUI). The CUIs allowed us to create the correspondences among the lexicons, and by the UMLS Semantic Network we included the inter-concept relationships of the Italian Specialist Lexicon.

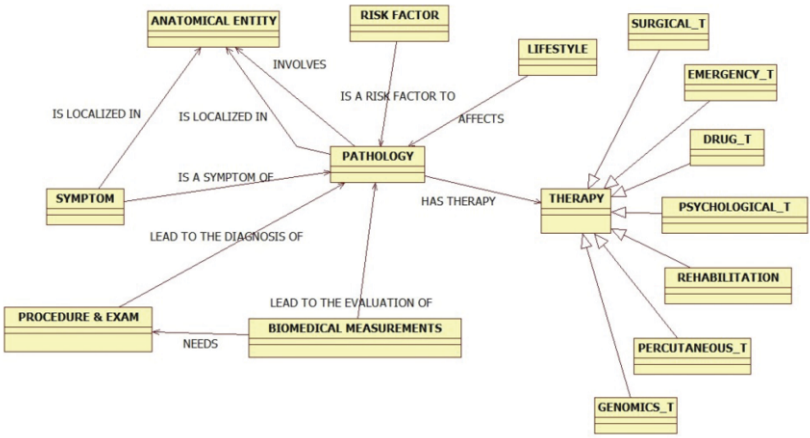

Figure 1. The designed taxonomic-structure. Unlabeled relationships are IS_A.

Medical familiar terms for the development of the lexicon in Italian were extracted with a semi-automatic method from "Lexicon Camera" (upper left side of Figure 2), by translating terms belonging to the CHV vocabulary, and by translating terms from the English dictionary. In addition, duplicates of words or phrase were included only once. "Lexicon Camera" [11,12] is a database we designed and developed that contains indexed words and sentences of health news taken from "Yahoo!Salute Italia" web site. For the objective of the project here described, we suitably revised in contents "Lexicon Camera" considering Cardiology related news by searching keywords (e.g. heart, cardio-, statins) in news' titles. As the terms of CHV vocabulary are indexed by the CUI codes of the UMLS Metathesaurus, we were able to connect Italian medical familiar terms to CUI codes, and thus to the concepts of the UMLS Metathesaurus.

1.3. Designing and developing a lexicons connecting system

For implementing the ontology represented in Figure 1, we used the Protégé software tool that is a free, open source ontology editor, supporting the Ontology Web Language (OWL) language [13]. Then, the ontology was populated with Italian medical familiar terms - expressing concepts and relationships – as described in the paragraph 1.2. After that, we proceeded designing, implementing and populating a relational database (using Microsoft SQL Server 2005 Express edition) containing the four medical lexicons - Specialist Medical lexicons, in English and in Italian, and Consumer Medical lexicons, in English and in Italian -, and their relationships. For enquiring the content of the database, a web application having a graphical user interface has been designed and

then implemented using Microsoft WebMatrix, which is a web development environment for creating, publishing, and maintaining websites.

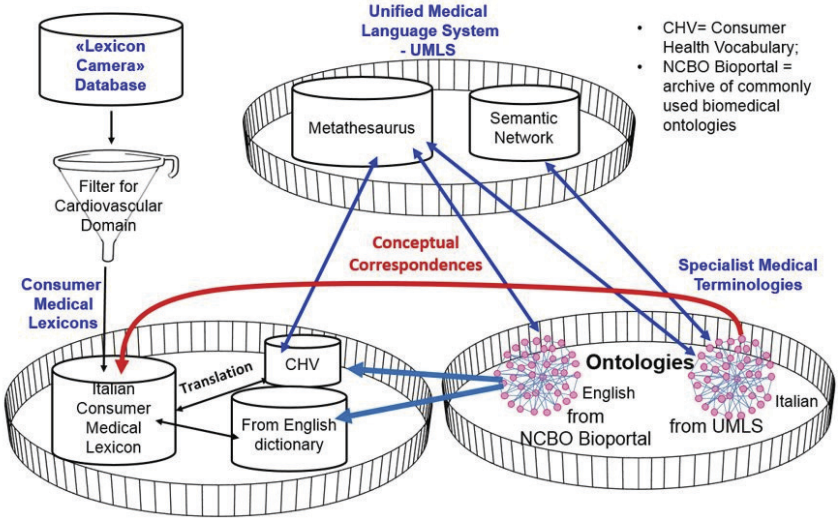

Figure 2. The approach designed for implementing connections among lexicons.

2. Results

The developed ontology is populated by about four hundred terms belonging to the family medical lexicon, divided into 15 classes (Figure 1) and subclasses. These terms are linked to 376 relationships we identified from the considered sources. The developed web software application allows the user performing three types of searches: "Basic Search", "Relationships Search", and "Advanced Search". Considering an Italian specialist medical term as a search term, the "Basic Search" is for getting the familiar medical term, its definition, possible synonyms, and the English term and its definition. Starting from two specialist medical terms or expressions (A, B) connected by a relationship (<R>) (i.e. a *triplet,* A <R> B), the "Relationships Search" is for getting the triplet expressed by familiar medical terms. Finally, the "Advanced Search" includes the results of the "Basic Search" along with all the triplets the specialist and familiar terms (or expressions) are involved in.

3. Discussion

We presented the development of a familiar medical terminology, and of a web application to correlate effectively and unambiguously the correspondence between the specialist medical lexicon and the familiar medical lexicon for the domain of Cardiology. The issue behind our idea is the difficulty of understanding the specialist medical language for the common people [3]. For example, if a patient is not able to understand a medication/drug prescription, he/she will not be compliant to the therapy. Nowadays, clinical documentation is collected and then stored in electronic way. The

Electronic Health Record (EHR) is a main software application used in clinical practice for that task. Some contents of EHR are coded using medical terminologies for creating patient documentation (e.g. the discharge letter) or statistical and public health purposes. For the patient, the use of the proposed system is first for having some form of translation of coded medical terminology of their EHR, then, to better understand their medical condition. In fact, concepts are connected to other concepts by relationships, and relationships have been "translated", too (Figure 1).

Using OWL language for building the ontology has a theoretical and a practical added value. The theoretical added value is the possibility to check the ontology consistency. Protégé ontology editor [13] offers a tool for checking the ontology consistency. So, meaningful conclusions can be drawn from the ontology. Then, the practical added value is that the ontology can be re-used or aligned with other ontologies, as built in a standard language.

The ontology has been built starting from the content of "Lexicon Camera"[9,10]. Its sources were medical news in Italian, so language-specific idioms and similar idiosyncrasies were quite excluded. However, those expressions and their relationships can be included, too.

Future work relates to design and to develop, first, a usability test of the web application, involving not only consumer or patients, but also medical doctors; secondly, a before and after test about health literacy for evaluating some evidence that the system enables low-literate people to cross the vocabulary gap in Cardiology. So, one or more contexts for a more specific purpose of the system could be defined.

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