A Semantic Wiki for Editing and Sharing Decision Guidelines in Oncology

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Abstract. The Internet has totally changed the way information is published and shared in medicine. With web 2.0 and semantic web technologies, web applications allow now collaborative information editing in a way that can be reused by machines. These new tools could be used to in local health networks to promote the editing and sharing of medical knowledge between practitioners. Oncolor, a French oncology network, has edited 144 decision guidelines. These local guidelines rely upon national French guidelines and are built and updated collaboratively by medical experts. To improve working conditions, the need of an online collaborative tool has been expressed. This paper presents ONCOLOGIK, a semantic wiki approach for local oncology guideline editing. Semantic wikis allow online collaborative work and manage semantic annotations which can be reused automatically to bring new services. Applied to oncology guidelines, semantic technologies improves the guideline management and provides additional services such as targeted queries to external bibliographical resources.

Keywords. semantic wikis, social semantic web, oncology decision guidelines, web 2.0.

1. Introduction

Web 2.0 refers to a set of technologies for Internet applications that enables the users to collaboratively create and share information on the World Wide Web. Numerous studies have shown the positive impact of such evolutions on medical information systems [1]. Recently, social semantic web [2] was born from the merging of the web 2.0 technologies with the semantic web, which aims at creating and sharing formalized information in order to make it available to both humans and machines. From now, formal information can be edited collaboratively, shared, and automatically used in the social semantic web.

The oncology network Oncolor is a partnership of public and private health institutions of the Lorraine region (East of France). Oncolor's objective is to improve the care of cancer patients. 144 oncology guidelines have been edited by Oncolor to give recommendations about various decision problems about cancer (e.g. choice of a cancer treatment). Since guidelines are intended for both medical staff and patients, editors have

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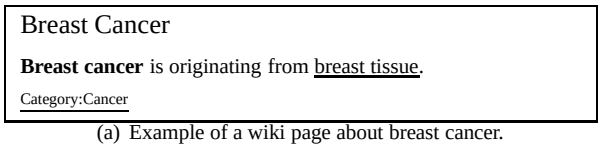
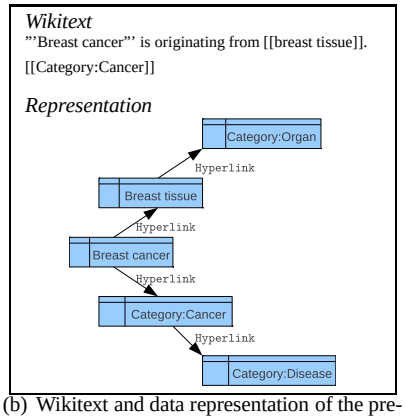
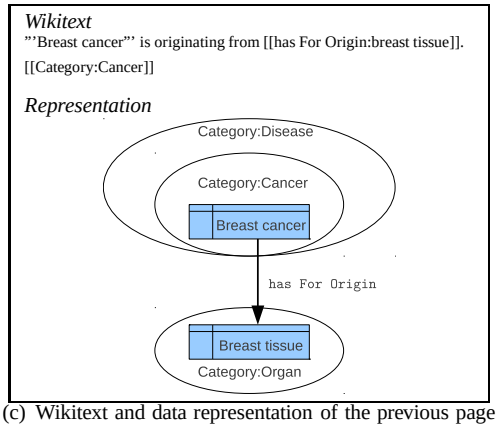


(a) Example of a wiki page about breast cancer.



(b) Wikitext and data representation of the previous page in a classical wiki.



(c) Wikitext and data representation of the previous page in a semantic wiki.

Figure 1. Representation of wiki page about breast cancer (a) in a classical wiki (b) and in a semantic wiki (c).

exploited various kinds of formats in order to be both accurate and didactic. Guidelines are written by a panel of medical experts and are continually updated according to the state of the art in oncology and to the evolutions of the local context. Oncolor plans to update each of them at least once in two years. In order to facilitate the creation, the maintenance, and the publication of guidelines, Oncolor has expressed the need for more effective and more collaborative tools.

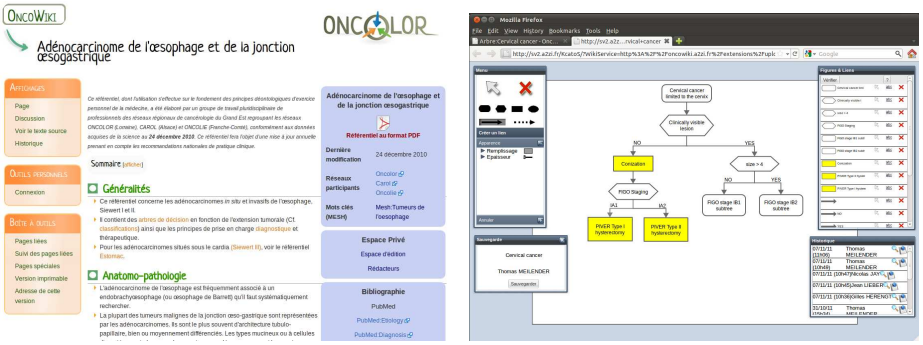
The aim of this paper is to present ONCOLOGIK[2], a tool for editing, updating and sharing local oncology guidelines that implements the social semantic web. ONCOLOGIK is a semantic wiki that allows to write information collaboratively and can reuse this information automatically.

This paper is structured as follows: semantic wikis are introduced in Section 2, while Section 3 presents the implementation of our wiki. Then, Section 4 shows the use of semantic features in ONCOLOGIK. Finally, a discussion about the first evaluation and the presentation of some future work are given in Section 5.

2. Wikis and semantic wikis

Wikis [3] are typical examples of web 2.0 applications. Wikipedia's popularity demonstrates the importance of such systems. Wikis are websites whose pages can be edited by visitors to allow collaborative writing of documents and are usually based on a set of pages, organized into categories and connected by hyperlinks. Editing is made easy by use of a simple language, *wikitext*, that allows to structure and layout pages and to create links between them. Wikis are created and maintained through specific content manage-

[2] `http://www.oncologik.fr/`



(a) An excerpt of guideline in ONCOLOGIK. (b) KCATOS decision tree editor interface.

Figure 2. Examples of interfaces of ONCOLOGIK.

ment systems, the wiki engines. Semantic wikis are born from the merging of wikis and the semantic web. A semantic wiki is similar to a classical one in the sense that it is a website whose content is edited by users. However, it characterizes resources and links between them as shown in Figure 1. In a semantic wiki, an annotation characterizes a page and several annotations can be bound to this page. Such information is formalized and can be automatically reused.

3. A collaborative tool for editing guidelines

3.1. ONCOLOGIK *deployment*

Mediawiki and its extension Semantic Mediawiki (SMW) [4] have been used as wiki engines in this project. Indeed, among all the semantic wiki engines, SMW seems to be the most complete framework and a large community of developers is involved in the project. Thus, many extensions and an efficient support are provided to the users. Moreover, MediaWiki supports the most important wiki functions such as page history, comments, rich media management, etc.

Oncolor had already published guidelines on a static website. Typically, these guidelines are structured documents that are composed of various kinds of contents: texts, decision trees, medical classifications, pictures, references, and glossaries. Some of them are simply imported from other French oncology networks. All these contents have been imported by creating and editing a page per guideline. An example of a guideline is shown in Figure 2(a). To improve indexing in ONCOLOGIK and to simplify browsing, guidelines have been classified through an anatomic classification created by the Oncolor staff and through the network that edit them.

3.2. User right management

Usually, wikis are open systems where everybody can modify documents, even non-specialists and unidentified persons. However, such an approach is not conceivable to provide certified medical information: all the guidelines have to be approved by the medical experts panel before they are shared. Moreover, when a modification is proposed by

an identified medical expert, this modification has also to be checked by Oncolor experts panel. The key idea is to propose a system flexible enough to accept modifications by identified experts, but that always keeps a public version that is approved. Hence, a special namespace has been created and can be viewed as a workspace for the experts. This namespace corresponds to a special part of the wiki where user rights can be attributed independently from the rest of the wiki. Thus, five kinds of users have been identified:

- anonymous users can read pages of the main namespace;
- external medical experts can also read and comments pages in the workspace;
- medical editors can also edit pages in the workspace;
- Oncolor editors can also edit pages of the main namespace and in the workspace;
- administrators can edit all pages, even wiki system pages.

3.3. KCATOS, *a decision tree editor*

Oncolor guidelines contain numerous decision trees. To facilitate their updates, a specific Mediawiki extension has been created. KCATOS allows the collaborative drawing of decision trees based on a small set of geometrical shapes connected by directed edges. Its interface is shown on Figure 2(b). Among various export capabilities, KCATOS proposes an algorithm that transforms decision trees into OWL (the W3C recommendation for representing ontologies). It also provides functions that check if the tree is well-formed (i.e., is a syntactically correct decision tree).

4. Using semantic annotations

4.1. Improving management of guidelines

Annotations can be exploited by the SMW inline query engine. Using a simple query language, semantic search can be done directly in a page and results are displayed as tables, lists, etc. In our project, semantic annotations have been added to improve the guideline management. For example, every guideline is linked by a specific property to a date indicating the last validated update. This date is indicated manually by redactors to mark the current state of the art. Thanks to an inline query, a maintenance page was created to point out the outdated guidelines. Moreover, another query has been added on each guideline to show a warning if the guideline has to be updated. To ensure the consistency of the annotations, the SMW template mechanism is used.

Inline queries are also used to improve browsing. For example, a list can be simply created with all the guidelines related to the respiratory system (in Oncolor classification), that are not authored by Oncolor and that have been updated in the last 6 months.

4.2. Targeted queries to bibliographical resources

Providing complete and updated bibliography to users is a major contribution of ONCOLOGIK. This bibliography is provided by two medical bibliographic databases: PubMed [5], and CISMeF [6], a search engine that indexes a large amount of online medical publications in French. Both PubMed and CISMeF use the MeSH (Medical Subject Headings) thesaurus to index medical publications. Thus, templates were designed to

simplify the annotation of the guidelines using MeSH. MeSH terms have been imported in ONCOLOGIK that also manages their French translation. Annotations are then automatically exploited to generate targeted query to PuMed and CISMeF. By following hyperlinks, users can browse PubMed or Cismef where lists of the most recent publications related to the annotated guideline are shown. Moreover, by using the PubMed "Clinical Query" system [7], requests can be precised by category ("Etiology", "Diagnosis", "Therapy", "Prognosis", or "Clinical Prediction Guides").

5. User evaluation and future work

A first evaluation of the tool has been led by investigating the opinions of a panel of four users involved into guideline editing. None of them had ever contributed to a wiki before ONCOLOGIK but all of them acknowledged that wikis are easy to learn by self-training. Among the advantages of the wiki system, our panel agreed that it is reactive and flexible and that ONCOLOGIK increases the quality of the editing process and the quality of the guidelines themselves by standardizing and simplifying the work on layouts. It has also been acknowledged that wikis improve working conditions by allowing distant work, which was impossible with the previous system.

There are many challenges with semantic wikis in health. For now, an improvement of targeted queries is studied. Current queries depend on the guideline as a concept, but it would be interesting to manage annotations on the contents of the guideline itself to make them more precise. An intermediary step could be to add annotations to each paragraph of the guidelines. Another future work is related to the use of data from semantic web. Indeed, lots of resources are available such as open data or distant databases. However, the use of external data is a major concern in the medical domain, due to the critical nature of the data. Each source will have to be approved by Oncolor before it can be exploited by ONCOLOGIK. Finally, future improvements include linking ONCOLOGIK to other semantic web applications such as EDHIBOU [8] and to medical resources such as electronic medical records. This challenge will lead us to consider semantic interoperability by means of existing bio-medical ontologies such as SNOMED or GALEN [9]. It will be then an interesting opportunity to tackle alignment problems between semantic wikis and existing resources.

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