Experience with an Ontology of Pediatric Electrolyte Disorders in a developing country

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Motivation

There are few pediatric nephrologists in Thailand and physicians in rural Thailand have limited access to up-to-date biomedical information such, as biomedical journals. Moreover, biomedical information is often compiled in developed countries and may not appropriate for use in developing countries. For example, the guidelines established by the World Health Organization (WHO) for the treatment of acute diarrhea in children are not always applicable in the case of rotavirus gastroenteritis, because the concentration of sodium in oral saline solutions is too high for infants. In this context, we believe ontologies can play an important role in patient management. Semantic Web ontologies foster sharing and reuse of knowledge and facilitate collaboration between pediatricians and consultant pediatric nephrologists. Such ontologies can be part of the telemedicine arsenal and help physicians in rural areas of Thailand to better manage difficult cases. In this paper, we report our experience in developing and using an ontology of pediatric electrolyte disorders.

Developing and publishing the ontology

In the knowledge elicitation phase, we used concept maps to formalize the knowledge of a small group of eleven experts. Knowledge was contributed by pediatric nephrologists, pediatricians, general practitioners, as well as extracted from clinical practice guidelines, text books and the medical pediatric literature. Some 500 concepts were identified in the domain of pediatric electrolyte disorders.

These concepts were then organized into an ontology and related to other concepts. Textual definitions were created. For example, the concept *severe hyponatremia* is defined as "Sodium concentration is below 125 mEq/l" and is a subclass of the concept *disease*. In addition to subclass relations, we use the relationship "look for" between diseases and symptoms. Another example is the concept *Urine Sodium concentration*, subclass of *Urine test*, and for which an important property is "more than or less than 20 mEq/l". The Web Ontology Language OWL-DL was selected for representing the ontology. In this phase, we used Protégé-OWL (http://protege.stanford.edu/, Stanford University and University of Manchester) and SWOOP (http://www.mindswap.org/2004/-SWOOP/, University of Maryland) for building a prototype of the Pediatric Electrolyte Disorder Ontology. There is a reliable ADSL network in the capital Bangkok. Protégé and Swoop installed on a web server are used to publish and share the ontology. The same applications are also installed on client computers and can be used both online and offline.

Usability study

In order to evaluate the ontology, questionnaires were sent to the 25 end users, i.e., general pediatricians and family physicians in rural areas. 24 responses were received and analyzed. Most physicians involved with the study were young (age 30-40).

The Jambalaya plug-in in Protégé was found to provide good visualization support, displaying 2D interactive representations of the domain of the electrolyte disorders. Some pediatricians liked Swoop publishing, because it is easy to understand, especially in Text mode.

Speed was sometimes an issue in those areas with a large number of ADSL users. Even lower connectivity was available in rural areas. In some cases, the ontology had to be sent by email in several pieces. However, once downloaded, the OWL ontology can be exploited offline, using Swoop or Protégé.

Conclusions

The development of our ontology of pediatric electrolyte disorders took more than one year. It was motivated by the need for providing up-to-date therapeutic to general practitioners in this specialized domain, and to tailor this information to the particular patient population. Preliminary results show that the ontology has helped physicians better manage pediatric patients, especially in the rural areas of Thailand. Despite limited connectivity in some areas and limited performance of computer systems, the experience was globally successful, in both creating the ontology from expert knowledge and making it available to physicians in rural areas. Ontologies such as the one we created for pediatric electrolyte disorders will play an increasing role in telemedicine.

In future work, we plan to build a larger Semantic Web Ontology for Pediatric Nephrology. Rule languages such as SWRL – the Semantic Web Rule Language – may be used in addition to OWL in order to represent clinical guidelines.