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Pediatrics Prescriptions with Ontologies and Treatment Suggestions

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Abstract. Diagnosis and treatment for children healthcare are very sensitive activities. The present work presents an ontology based model for a future information system to support these activities. The input data contains children health status, and drug characteristics. During clinical practice a database with what specialists mark as successful treatments is created. This database is gradually growing bigger and is built by physicians based on their good results related to a treatment for a certain health condition. The new ontology system proposed in this paper is supporting the e-prescription process. The relations are managed using the open source application Protégé and for suggesting treatments, using the database with successful treatments, we developed a special module that offers to physicians a selection from which they can chose the best treatment for their current case.

Keywords. Prescriptions, paediatrics, treatments, Protégé, ontologies.

Introduction

One of the most important departments in clinical practice is pediatrics because it treats and monitors children, which are very sensitive patients. The prescription process for children is more complex doses are more critical and reaction to wrong drugs more violent. Medication errors are responsible for significant mortality rates often caused by adverse drug events. Pediatrics prescription errors have a relatively high occurrence and in general are caused by the process of calculation weight-based doses, due to off-label dosing and other common errors [1].

e-Prescription started 1-st January 2012, in Romania. Physicians use specific software to write and send prescriptions to pharmacy.

Prescription has the same format for all types of patients, adults or children. The prescription contains the series and the number of the prescription, identification data of the medical unit, date of the prescription, and identification data of the physician that writes the prescription, patient data: name, ID (CNP), the assurance status, the number of the consultation file, the codification of the diagnostic in Romanian format and information about the prescribed drugs [2]. This type of prescription lacks in important data related to critical healthcare conditions that affect children.

In a study in [3] the authors reviewed a total of 4019 prescriptions in a pediatric care unit. Physicians that wrote the prescriptions were residents in 76.3% of cases and specialists otherwise. The prescriptions contained a total of 151 drugs and 50% were

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related to the 12 most used ones. According to the study, the error rate of the prescriptions was more than one third, 34.2%.

The doctor community concluded that the medical errors for the domain are often. To reduce this rate we introduce a module for information systems in pediatrics that use ontologies to study relations between the characteristics of the children and the drugs and based on previous results to provide suggestions of already successfully performed treatments.

Pediatrics is a field of clinical practice that manages the diseases of the children, from birth up to 18 years old. Pediatrics is not dealing with a disease or an organ or system like cardiology for example, but it deals with the pathology of a very extensive period. Children have some particularities that the physicians need to know to prevent or treat the illnesses as part of the growing process.

Lehman et al. [4] presents the needed information for clinical decision in pediatrics and to maintain the health of the children. These information results from: collection of maternal information and new born information, following and reporting of the immunizations, monitoring and documentation the growth and development of the children, providing corresponding medication according to age, the weight, laboratory test results, protection of information about patients and exact identification of current child.

An important activity in the treatment process is medication given for a certain disease. In this sense the pediatrician needs support with the correct dose of the drugs. Guidelines and pediatrics practice, state that the dose of each drug is given according to weight and age of the child and taking into consideration other characteristics of the child.

The next section presents the subject of ontology and its application in the medical domain followed by the model for pediatric prescription ontology. Section 2 presents the structure of the pediatric prescription module and the suggested treatment tool, followed by conclusions in section 3.

1. Ontologies in Medical Informatics, ontology-model for pediatric prescription

With the help of ontologies we can capture knowledge about any domain in our work. Ontology describes the concepts of a specific domain and the relationship between these concepts. There exist a lot of ontology languages providing facilities to manipulate the developed ontology.

An ontology language very used is Protégé that we also use to develop the pediatric prescription ontology.

It is proper to use ontologies in medicine because it is a domain with a lot of interrelated information. Figure 1 presents a simple ontology with medical terms and relationship between them. With ontologies is simpler to make correlation between certain diseases, patients and treatments.

This approach supports physicians in their decisions in patient management, and treatment for certain diseases, contributing to reducing medical errors, due to a more complex verification and validation.

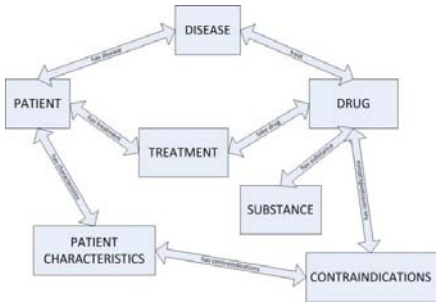

Figure 1. A simple ontology

Providing physicians with a tool that improves their practice and create a more reliable background for diagnosis and treatment is beneficial. This is accomplished supplying an ontology-based module in the process of drug prescription.

For an optimal decision the physician considers information about the child: age, weight, allergies, if the case, current disease, current treatments, and also all the information about the medication to be administrated. When all these information are well correlated and there are no conflicts the prescription is considered good. This means that the suggested medication is not conflicting for the current patient.

The drugs dose administered on children, needs to be according to age and weight, and the ontology module verifies this aspect. It verifies incompatibilities related to allergies to certain substances contained by the drug, and also verifies if there are treatments that may interact with the current one. Figure 2 presents a model of ontology for pediatric prescription process with information and relations developed using Protégé. To generate an improved module we use RxNorm, a nomenclature for clinical drugs produced by the U.S. National Library of Medicine that contains the name of drugs and their main characteristics [5]. The ontology module is used in a software prescription module developed in Visual Studio, previously developed in our group.

Using this model of prescription makes it easier to find all the conflicts and reduce the prescription errors.

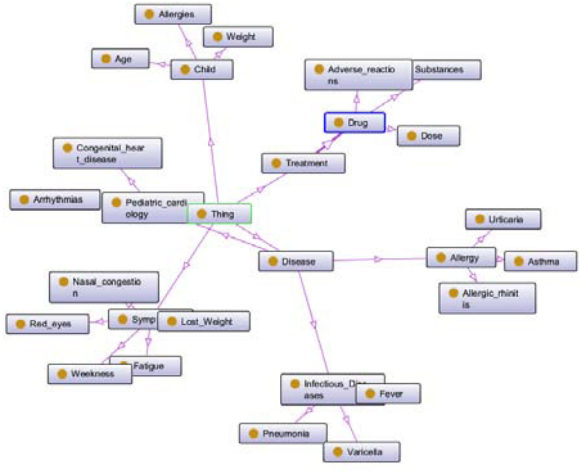

Figure 2. Prescription pediatric ontology

This model we will use next to develop a complex prescription module for pediatrics department.

2. Pediatric prescription and treatment suggestion support

To support better prescription we are using a previously developed module for suggesting treatments according to the disease and child characteristics [6]. When the pediatrician chooses the diagnostic for a case he/she may require from a global database a successful treatment for the child. The module needs the complete information (characteristics) of the child: age, weight, allergies, current treatments, current disease and others important characteristics, and according to this information, and after searching in the successful treatment global database it gets a possible treatment and information about it as rate of treatments of the same disease with this solution, characteristics of the formerly treated child, a.s.o.

The prescription module is extended with the suggestion of treatments module that also supports the physicians in their decision. All the collected treatments are given for to the subscribed physicians who send successful treatments after medical exams that prove that the given treatment treats or ameliorate the illness.

Figure 3 presents the architecture of the entire system. All the data are collected: patient information, consultation information and drugs information from RxNorm nomenclature and the ontology deciding if all interrelated data are correct. In the same time the needed information are sent to the suggested treatments module and is imported as a successful treatment if the case. The resulted prescription can be printed and sent to pharmacy.

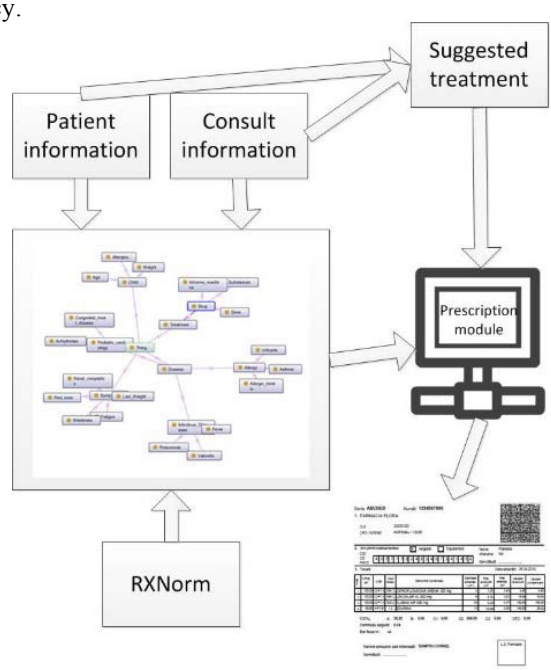

Figure 3. Prescription general architecture

The presented architecture can be used in a medical application for a complex prescription procedure. The module collects all necessary data, make validation of the given information, suggest treatments and make the final prescription for the patient.

3. Conclusion

The paper describes a new support method and an application module for pediatric prescriptions. These modules are connected to previously developed work for a Pediatric information system. In many cases the physicians do not agree the idea of computer assisted programs in medicine because they do not have confidence in the creation process of such systems and with apparently decisions made by computers. The current approach raises the confidence because the application is using real physicians' decisions for suggesting treatments module. The prescription ontology module is performing verifications for inconsistency and alerts useful for the physicians that will not deal with huge amounts of information which may conduct to errors when some data is forgotten or not taken into consideration.

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