Digital Dr. House: A semantic alerting platform for the ICU

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Do you know Dr. Gregory House? He and his staff are medical experts. Together they can tackle almost any medical problem. At the Intensive Care department of the University Hospital of Ghent, we have developed a digital Dr. House.

In the Intensive Care department there is a lot of data [1]. Per patient more than 20,000 values are generated each day [4]. Studies show that people can interpret at most 7 parameters at once [3]. As many doctors have different expertise, they look at different parameters. Still, they cant interpret them all together. A computer however does not really (besides memory constraints) have any constraints on how many data it can process.

To efficiently analyze all the clinical data, a semantic alerting platform, called the digital Dr. House was built, as shown in Figure 1. The platform is able to rapidly consolidate all the gathered parameters and link them together by using an ontology. The ontology describes all the knowledge about the medical domain and is thus able to semantically enrich the gathered data. A reasoner, which acts like a human brain, can process data against the ontology and can infer new facts from this data. If it finds interesting facts, it can trigger an alert that is send to a doctor. As such, this digital Dr. House is able derive and filter interesting knowledge from a huge amount of clinical data. This allows this platform to rapidly form a view about the current health status of a patient and automatically notify the staff about any anomalies. Afterward the physicians are able to give feedback to alerts so that the system could eventually become self-learning.

However, to generate the appropriate alerts, these alerts need to be expressed as rules/axioms in the ontology. These are usually specified by an IT specialist. However, this often leads to a lot of communication problems between the physicians and the IT specialists. The IT specialists talk about databases, queries, etc. The ICU specialists talk about nosocomial respiratory infections, co morbidity, staphylococcus aureus, etc. As you can see they almost talk a different language. An interface was therefore created, such that the IT specialist and physician can view the ontology and easily inserts new alerts together. Eventually, the goal is to let the physicians enter the rules/axioms without intervention of an IT specialist.

To determine the feasibility, scalability and performance of the platform, a use case scenario based on the study of Micek, et al. [2] was implemented in which the physicians automatically receive alerts when the antibiotic treatment of a respiratory infection can be stopped early based on the monitoring of some medical objective parameters such as body temperature, white blood cell count and sputum.
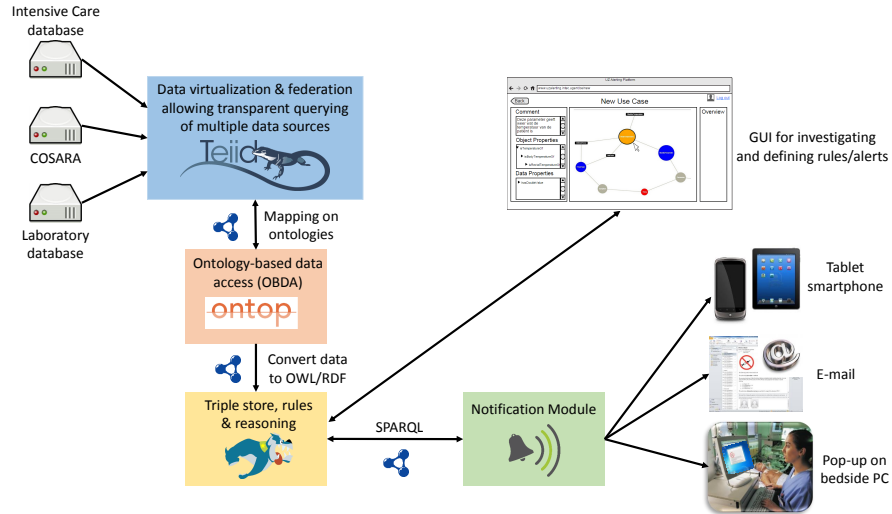

Fig. 1: General overview of the digital Dr. House

Keywords: Alerting platform, Semantic, Intensive care unit, eHealth, Knowledge management

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