

AVICENA, ontology for the design of executable clinical practice guidelines

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Abstract

Clinical practice guidelines (CPG) are increasingly more demanded as a necessary tool in the supply of health care. In spite of their continuous evolution and spreading, their usage in the context of the new information technologies is still not enough developed. There is much work to be done in the area of execution of CPG, and, consequently, it is difficult to find repositories of formal and executable CPG. The project AVICENA is a new proposal of an ontology for the modelling of executable guidelines, that (1) creates new ways for the representation of clinical knowledge and (2) allows the management of the dynamics of health-related processes.

Motivation

Medical organizations are today doing a very high pressure in order to standardize clinical processes, which have grown very much in the last decades, both in complexity and quantity. Factors such as universal access to health resources, ubiquity in the provision of services, growing complexity and specialization of medical organizations, and higher costs, between others, and driving the health supply system to adopt more efficient approaches, based in information technologies and managed business processes. The development of this new entrepreneurial organization is based in a mixture of new methods and techniques: standardisation and personalization of clinical activities, cost-effectiveness analysis, fast adaptability to new practices and resources, evidence based practices, effective management of knowledge, etc.

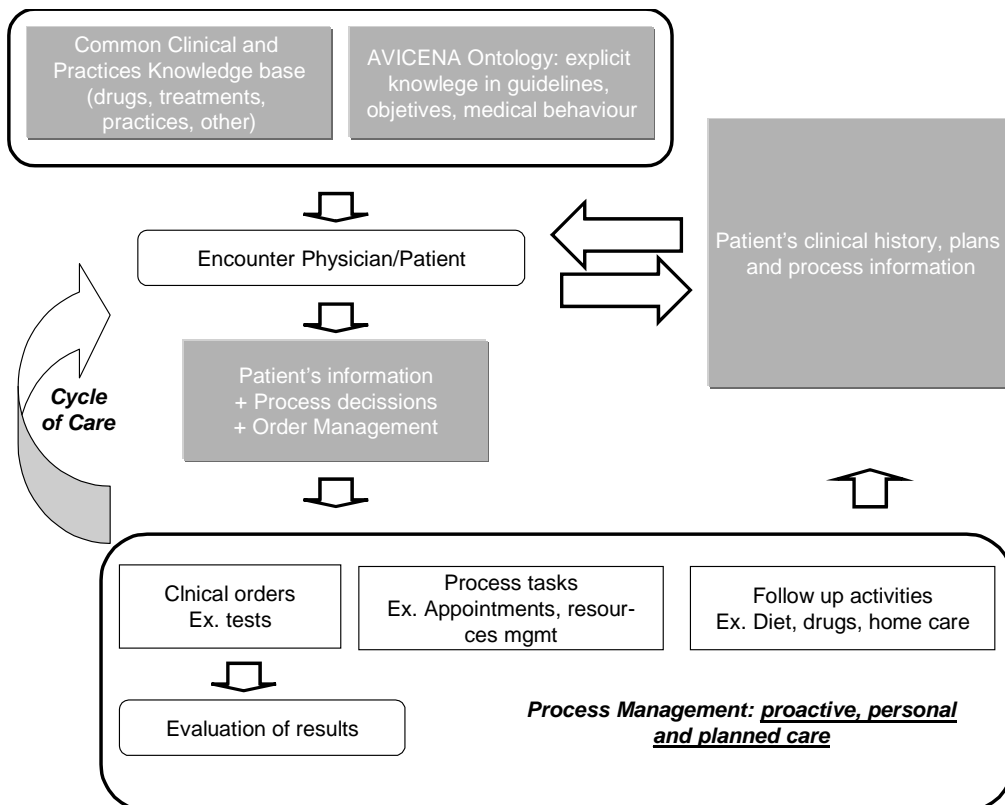
The standardization of practices is largely solved with the definition and use of clinical guidelines and pathways, that determine the expected behaviour and clinical outputs for the different classifications of diagnosis, techniques or symptoms, enhancing the capability of the medical system to provide care in an efficient way. The benefits are very clear:

- Reduce care variance: medical attention is guided by standard procedures, derived from clinical evidences, and local policies.
- Enhance quality of attention: optimise the use of resources and the cost-efficiency ratio, eliminate unnecessary tests, reduce hospitalisation time and optimise quality and time used for encounters
- Personalize patient attention. Guides define and control the concrete behaviour of the whole care system for each single patient, not for the complete universe of all possible patients. Therefore, the attention turns to be proactive and planned, instead of reactive and spontaneous.
- Using guides, the medical system distributes knowledge and maintains homogeneous and up-to-date procedures. New evidences are added to guides, and this knowledge is quickly disseminated along the organization.

Project scope

The AVICENA project was started in 2005 by BET and UAM with the support of the Spanish Ministry of Industry, Tourism and Commerce (FIT-350300-2005-33). The objective of the project is to build a family of ontologies and systems for performing health care activities by means of the management of processes and knowledge. The project joints two areas of systems development: the capability to define and represent knowledge (clinical, organizational), and the ability to manage business processes based on that knowledge.

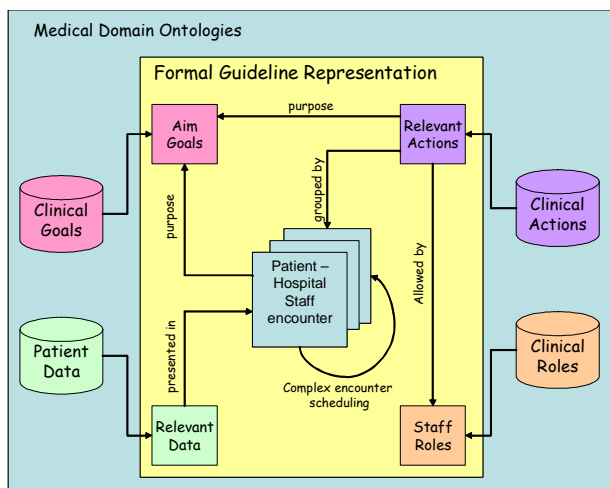
The following diagram summarises the scope of the project, with their different components and working areas:



The system is designed to interact in the care process at its very centre: the relation between the doctor or nurse and the patient, making a coherent view on the various domains of information related: the process information about the patient, the clinical history, the management of orders, and the reference clinical information used.

AVICENA ontology

AVICENA is an ontology for the representation of executable clinical guidelines that surges from the application of Semantic Web concepts to the fields of health and process representation. This ontology is defined in OWL, and has been developed using Protégé. The following diagram illustrates the composition of a clinical guideline.



AVICENA introduces various areas for the representation of the guides:

- The encounters, and the encounters planning network, that allow managing a non-linear approach in the process.
- The clinical objectives, that permit to trace a different path of activities depending on the evaluation (qualitative, quantitative, maybe automated) of certain variables and on its evolution
- The role of the person that is attending the patient, to adapt to different situations with doctors, nurses, other support personnel, etc.
- The interoperability (via semantic web) of the process with other systems around: clinical history, order processing, tests results, etc.
- The plan and distribution of activities along the persons, groups and organization(s) involved in the supply of services for the patient

Other main areas of interest taken on account in AVICENA, although not still developed, are reasoning and inference (within the guide, and in relation with the process and patient data), reusability, management of clinical objectives and versioning.

Process Guidelines

The whole business in health care has the core procedure in the contact of the physician and the patient: the encounter. Each time the doctor/nurse meets the patient, the situation is totally evaluated, the history of the patient and his current situation, test results, treatments on course, along with all the related information about the process type, the state-of-the-art, the local usual practices, etc. Decisions taken in the encounter will drive the future of the patient and of the medical organization(s) responsible of the care. AVICENA defines encounters of two types: the most classical discrete (when it occurs in a definite moment of time) and continuous, where the encounter takes some time (maybe days) to reach an objective and finish, usually adapted to hospital treatment.

The encounter has three domains of information: (1) The knowledge used by the physician, which can be represented in a knowledge base repository; (2) The AVICENA ontology where all formal clinical strategies and procedures are defined and (3) the specific clinical and process data for that particular patient. These data is composed of annotations in the HCE, the information produced by the process on its own, and all reference data related with order processing and results.

Process Management

This approach of the relation between the physician and the patient allows to manage the consequences, using a Business Process Management System (BPMS), coupled with the ontology. Using the information provided by the ontology, the system is able to asses physician in the ways for the attention to the patient, to define and distribute activities along the

organization, to create and track activity plans for that patient, and to track order processing and evaluate or distribute results.

Each encounter type (a subset of a guideline) becomes a node in a graph of pathways. Each path is a strategy to treat the specific problem of a given patient. Therefore, the doctor determines a planned strategy each time he/she meets the patient. Those strategies can be thought as a superset of a pathway, and are a common policy of the organization where the assistance is provided.

The care cycle is therefore managed using a process perspective, that is, each single patient is an instance of a managed process, which comprises the situations, singularities, resources and plans. Thus, the attention is personal, proactive, controlled and planned. This has very deep impact in the way care is delivered, the quality of the service, in the efficient use of resources and in the control of costs.

Current work done

The ontology and its conceptualization has been developed as an abstraction of various works done in clinical organizations: Adeslas (a health insurance company with over two million customers) and Hospital de la Ribera (a large private hospital) specifically in the areas of cardiovascular risk control, diabetes, and HIV with some thousands patient's processes currently under control.

Conclusions and future work

AVICENA is a valuable approach to the state-of-the-art of representation of clinical processes. First, adds new concepts in this area, like the definition of encounters, the use of objectives to define treatment paths, and the incorporation of Support Processes to the definition of the care cycle. Secondly it imports techniques from other areas, like Semantic Web, to cover recently discovered needs, such as the execution of guides in distributed and heterogeneous organizations.

AVICENA core components have passed the research phase, and currently we are in development phase, profiting from the prototypes already in use.

We have identified some kinds of processes with evident and direct benefits: preventive treatments for risk populations, geriatrics, pregnancy, patients with multiple pathologies, and chronic diseases, between others, although the ontology is not limited in its usage to any specific type of process.