Chapter 6.8
Supporting Knowledge–Based Decision Making in the Medical Context:
The GLARE Approach

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ABSTRACT

Knowledge-based clinical decision making is one of the most challenging activities of physicians. Clinical Practice Guidelines are commonly recognized as a useful tool to help physicians in such activities by encoding the indications provided by evidence-based medicine. Computer-based approaches can provide useful facilities to put guidelines into practice and to support physicians in decision-making. Specifically, GLARE (GuideLine Acquisition, Representation and Execution) is a domain-independent prototypical tool providing advanced Artificial Intelligence techniques to support medical decision making, including what-if analysis, temporal reasoning, and decision theory analysis. The paper describes such facilities considering a real-world running example and focusing on the treatment of therapeutic decisions.

INTRODUCTION

Nowadays, the rationalization of the healthcare systems is a task of fundamental importance in order to grant both the quality and the standardization of healthcare services, and the minimization

of costs. Clinical Practice Guidelines (CPGs) are one of the major tools that have been introduced to achieve such a challenging task. CPGs are, in the definition of the USA Institute of Medicine, "systematically developed statements to assist practitioner and patient decisions about appropriate health care in specific clinical circumstances" (Institute of Medicine, 2001, p. 151). Thousands of CPGs have been devised in the last years. For instance, the Guideline International Network (http://www.g-i-n.net) groups 77 organizations of 4 continents, and provides a library of more than 5000 CPGs. CPGs are commonly recognized as a tool to encode and support the practical adoption of evidence-based medicine (EBM). They can be used by managers as a means to optimize the organization of clinical processes. However, the main purpose of CPGs is to support physicians in their everyday knowledge-based decision making when treating patients.

The adoption of computerized approaches to acquire, represent, execute and reason with CPGs can further increase the advantages of CPGs, providing crucial advantages to:

1. Patients, granting them that they will receive the best quality medical treatments (since CPGs are actually a way of putting EBM into practice);
2. Physicians, providing them with a standard reference which they may consult, with a way of certifying the quality of their activity (e.g., for insurance or legal purposes), as well as with advanced support to their decision-making activity;
3. Hospitals and health-care centers, providing them with tools to grant the quality and the standardization of their services, as well as with a means to evaluate quality, and to optimize costs and resources.

As a matter of fact, in the last two decades, several computer-based approaches to CPGs have been developed (see the "Related Work" section).

GLARE (GuideLine Acquisition, Representation and Execution) (Terenziani, Molino & Torchio, 2001; Terenziani et al., 2008) is one of these systems, which we sketch in the next Section. The unique feature of GLARE, distinguishing it from the other approaches in the Medical Informatics literature, is its focus on the development of advanced techniques (mostly based on Artificial Intelligence methodologies) in order to support physicians in knowledge-based decision making. As a matter of fact, GLARE (as well as most computer-based approaches to CPGs (de Clercq, Kaiser, & Hasman, 2008) provides a formalism to encode the "logic" underlying diagnostic and therapeutic decisions. However, often physicians have to decide under uncertainty, in the sense that the status of the specific patient may be partially unknown, and the effect of therapies on him\her is partially unpredictable. Thus, additional knowledge may be helpful in order to take the most appropriate decisions. While diagnostic decisions are taken by the physician at hand, therapeutic decisions may also involve different forms of analysis. For instance, when choosing among clinically "equivalent" (with respect to the patient at hand) therapies, the "long term" effects of the therapeutic choice (e.g., what path of actions should be performed next, what are their costs, durations and expected utilities) may be helpful to discriminate. Such a knowledge is implicitly present in the CPGs, in sense that it can be automatically inferred on the basis of the local pieces of information scattered in the CPGs. Computer-based approaches can provide a crucial support to physician decision making by "gathering" and "elaborating" these relevant pieces of information, and by presenting the results to physicians.

In this paper, we describe the facilities provided by GLARE to support physicians facing therapeutic decisions, on the basis of a real-world running example. The paper is organized as follows. First, we briefly sketch GLARE. The running example is introduced in section "Case Study". Then, we

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