Chapter VI

A Semantically Advanced Querying Methodology for Medical Knowledge and Decision Support

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INTRODUCTION

A large part of all activities in healthcare deals with decision making regarding which examinations and tests need to be done or, on the basis of earlier examinations, which further tests need to be ordered. Recently, guidelines for an appropriateness and necessity indication of medical interventions have been elaborated and consulted in order to evaluate the quality of decisions in specific medical domains such as cardiology and hysterectomy.

In all decision supporting procedures, however, two types of knowledge are involved:

- **Scientific or formal knowledge** which results from the literature such as books or articles in journals. This type of knowledge deals with cognition or deduction, which means that one must know and understand the principles of biological processes and relationships between pathophysiological conditions and disease symptoms.
• Experiential knowledge as condensed in well-documented patient databases or validated guidelines as specified by panels of experts. This type of knowledge is related to recognition or induction, which means that the clinician has seen certain symptoms before and recognizes the underlying disease.

In practice, these two types of knowledge are extremes of a continuum of clinical knowledge and are interwoven when clinicians reason about signs and symptoms of a specific patient. The same holds for quality assessment of medical interventions. In most instances, clinicians have enough knowledge and sufficient patient data are normally available to make the right decision. Yet, there remain reasons why computers may be required such as:

1) Clinicians cannot keep up with the ever-increasing medical knowledge,
2) Healthcare organizations may mandate certain clinical practices both to improve the quality of care and to lower the cost of care.

Computers require, however, that such knowledge should be structured and formalized in order to make it available at the place and time when it is needed. This is similar to data structuring in database management. Only then can patient data and medical knowledge be used for computer-supported decision making, assisting the knowledge in and the reasoning by human brains.

Major issues of medical knowledge which hamper computer-supported decision making in healthcare, however, have been:

1) The ever-expanding knowledge,
2) That patient data are sometimes only partly available,
3) The problem of a specific patient may be new and unique.

Nevertheless, once medical knowledge for decision support has been made available, the problems of structuring knowledge in a computer as well as the availability of the right answers to clinicians arise. The latter is considered as one of the crucial factors for dissemination and usage of medical knowledge, since the query answering systems providing answers out of the structured medical knowledge need to cope with scientific terms and conditions, which underlie the specification of the medical domain.

Regardless how medical knowledge has been structured and managed, clinicians, who are called end users in the following, must be mostly familiar with the syntax formalisms of database or knowledge base specific query languages (Catell & Barry, 1997; Groff & Weinberg, 1999; Maier, 1998; Robie, Lapp & Schach, 1998) and/or understand very well the data/knowledge model of the knowledge repository. In order to improve usability and alleviate end users from syntax-based formulation of queries, advanced (visual) query interfaces and/or languages (Catarci, Costabile, Levialdi & Batini, 1997) have been designed, which provide a syntax-free (visual) formalism for query
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