

# Embedding Oncologic Protocols into the Provision of Care: The Oncocure Project

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**Abstract.** A computerized Decision Support System (CDSS) can improve the adherence of the clinicians to clinical guidelines and protocols. Integrating it within the clinical workflow can reduce the workload of the physicians, and improve the acceptance of the system. The building of a prescriptive CDSS and its integration with a legacy cancer patient management system is the aim of the Oncocure project, which implements the existing protocol for the medical treatment of breast cancer in the Asbru language, and interfaces the Asbru interpreter with the Electronic Patient Record (EPR) in use in an oncologic unit. Our work is not constrained to a specific domain or EPR implementation, but can be generalized to other fields of medicine and patient management systems. When implemented, our CDSS is expected to reduce the cost of care while improving the adherence to the guideline and the quality of the documentation.

**Keywords.** oncologic care process, clinical practice guidelines, knowledge-based system, computerized decision support system, Asbru

## 1. Introduction

Clinical protocols are a means for efficiently disseminating the ever increasing amount of available clinical knowledge, allowing to reduce the undesired variation in the provision of care and, in turn, improving the quality of clinical care in a healthcare organization. Clinical protocols are a distillation of the knowledge available in books, articles, and clinical guidelines adapted to the local resources and conventions at a specific site. They, however, can still be constituted by dozens of pages, and handling them in paper form in daily practice can be tedious, time consuming, and error prone, especially during a patient-physician encounter. A Computerized Decision Support System (CDSS) supporting guideline-based or protocol-based care in an automated fashion at the time and location of decision-making can promote and improve the compliance of clinicians with protocols, especially when used in combination with an Electronic Patient Record (EPR) and integrated in the clinical workflow [1]. To this end, the Oncocure project aims at designing and implementing a prescriptive guideline-based CDSS integrated with a legacy oncologic EPR in use in the Medical Oncology Unit (MOU) of the regional hospital of Trento (Northern Italy). The CDSS is based on the Asbru encoding [2] of MOU internal protocols of breast cancer medical therapies.

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## 2. Related Work

A number of Clinical Practice Guidelines (CPG) frameworks representing task, plan and decision structures have been proposed in recent years. Some of them have been complemented with active software tools for guideline execution [3]; see [4] for a detailed comparison and [5] for a pattern-based analysis of CPGs. In both comparisons, Asbru scored favorably. The Protocure project modeled the Dutch breast cancer guideline in Asbru and demonstrated the easy maintenance of the model thanks to the usage of the intermediate representation MHB [6]. Although a number of decision support applications based on various guideline languages and technologies have been developed, not many studies have been devoted to the integration of CPGs into care planning or clinical workflows [7]. CPG-based applications include: the Guide Project, a general architecture to manage the whole life cycle of a CPG [8]; the EON-based ATHENA system [9] for hypertension treatment; the SAGE project [10], to provide a methodology and an infrastructure for integrating guideline-based decision support with clinical workflow. In the breast cancer domain, OncoDoc [11] uses hypertextual reading of a knowledge base encoded as a decision tree; TADS [12] applies PROforma technology for supporting the initial diagnostic assessment of the disease; BCF-DSS [13] uses an ontology-based CPG model and a logic-based execution engine for supporting breast cancer follow-up care provided by family physicians.

## 3. The Clinical Setting

### 3.1. Clinical Practice

Each oncologist of the MOU is specialized in one or more cancer types and prepares the internal protocols by gathering and distilling information from national and international guidelines and consensus conferences. In the daily routine, however, an oncologist is required to treat patients with different types of cancer. Pharmacological treatment is also provided in several peripheral hospitals of our province, lacking an oncologic service, under the supervision of the MOU. The cancer treatment is a long-lasting process mainly constituted by periodical encounters of the patients with the MOU oncologists for treatment decisions, therapy administration, outcome assessment, or follow-up controls. Central to each encounter is the collection and registration in the EPR of patient and disease data, which contribute to the clinician decision-making process for the most appropriate therapeutic strategy. In this task oncologists should leverage on the internal protocols; hence, the CDSS may be particularly useful to efficiently provide them the proper recommendation.

### 3.2. Information System Infrastructure

In a preceding project we developed the web-based oncologic EPR [14] in strong collaboration with the end users. A considerable effort was made to codify as many data as possible in order to allow their reuse. Initially deployed in 2000 in the MOU, the EPR was subsequently shared with the Radiant Therapy Unit and the Internal Medicine wards of several peripheral hospitals of our province, for enabling the shared management of cancer patients. By now, the EPR stores more than 12,000 cases, with Breast cancer is by far the most common disease, amounting to about 4,000 cases.

#### 4. The Oncocure Project

The Oncocure project, started in April 2007, intends to design and develop a prescriptive guideline-based CDSS for giving active support at important decisional steps of the oncologic care process, through the execution of the Asbru-encoded protocols of pharmacological therapies for breast cancer. The project aims at integrating the Asbru interpreter with the database and the graphical user interface (GUI) of the EPR, in order to recommend to the user the most appropriate therapeutic strategy in the presence of the specific disease and patient conditions.

##### 4.1. Modeling Process

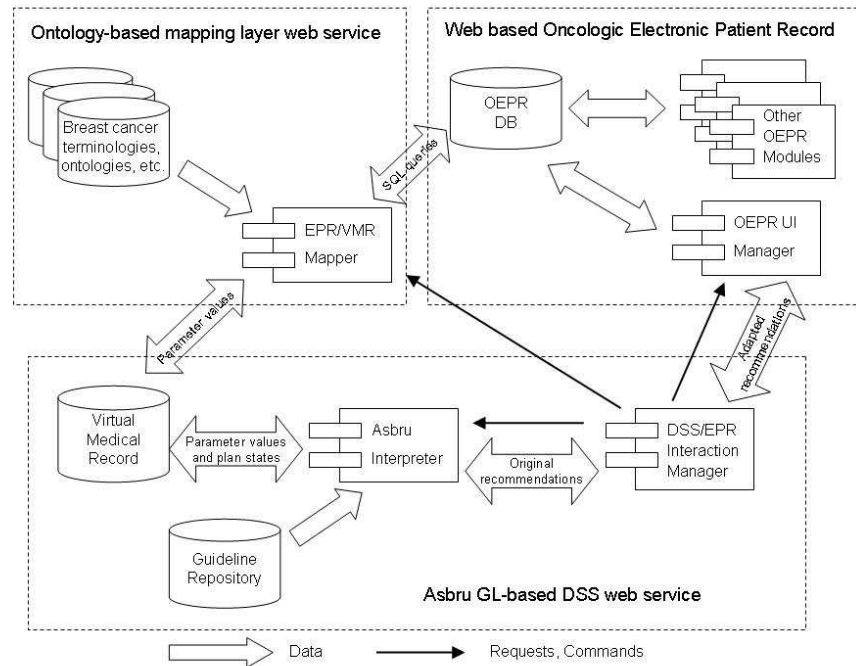
The encoding effort for protocols is smaller than for guidelines, since the former are much more concise and structured than the latter. Nonetheless, the translation is far from trivial, since protocols, like guidelines, are combinations of written text and informal diagrams, and need a lot of implicit process and domain knowledge to be correctly interpreted. In the case of the Oncocure project, the modeling phase required collaboration between oncologists and computer scientists located in Trento and in Vienna. To this end, regular meetings in Trento between a breast cancer specialist of the MOU and a computer scientist were held. The computer scientist conducted non-standardized interviews with the oncologist to gather inputs about the clinical process, the workflow and the resources involved. The oncologist's answers were analyzed and discussed with the computer scientist in Vienna, who encoded the model in Asbru. This interaction needed a continuous exchange of text-based documents between Trento and Vienna, which had to be maintained, updated and all changes had to be traced. To ease the work, we exploited the Semantic MediaWiki technology to implement a web-based tool allowing collaboratively defining skeletal knowledge models with both informal content and formal annotations, subsequently translated in Asbru and refined.

##### 4.2. Integrating the EPR and the CDSS

We designed an architecture ensuring loose coupling between the CDSS, wrapping the Asbru interpreter, and the legacy EPR (see Figure 1), in which the CDSS is a Web service invoked by the physician from the EPR GUI. Moreover, we utilize the Virtual Medical Record (VMR) approach [15], which supports a well-defined structured data model for representing information related to individual patients. The VMR will also store the states reached by the interpreter during guideline execution, allowing the CDSS to hibernate between two consecutive encounters of the long-lasting cancer care process. One major challenge in integrating a guideline-based CDSS with a legacy patient management system is to bridge the gap between parameters required by the CDSS and the clinical data stored in the EPR, even when an uncoupling layer is used. To this end, we divided the parameters required by the model in three groups:

- Data directly available in the EPR (e.g., the regional lymph node staging N);
- Parameters that can be computed without human intervention from lower-level data through clearly defined rule (e.g., the hormone responsiveness);
- 'Holistic' parameters to ask to the doctor, because it is not possible to define a computing algorithm (e.g., aggressiveness of the metastatic tumor).

Moreover, we needed taxonomic abstractions, (e.g., doxorubicine is an anthracycline), as well as temporal abstractions (e.g., taxanes in previous treatments). This analysis allowed to build an ontology for implementing a mapping layer, by which the parameters required by the CDSS are extracted or abstracted from the EPR database, or asked to the doctor through the EPR GUI.



**Figure 1.** Block diagram of the DSS integrated with the legacy EPR

## 5. Conclusion

To our knowledge, the Oncocure project is the first to bring into a clinical ward the translation of a real-world breast cancer protocol into the Asbru language and test its effects in the daily care routine. An important part of the work, in fact, is the test phase, planned for the last months of 2009. From the deployment of the system, the oncologists expect several benefits, especially for junior staff of the MOU and clinicians of the peripheral hospitals not specialized in breast cancer.

- Improved adherence to protocols. This, in turn, can improve the care quality by favoring the use of the best practice.
- Reduction of labor of the clinicians, because the display of only the relevant protocol fragments avoids the necessity to leaf through text protocols to find the right recommendation, especially in the presence of the patient.
- Improved documentation, because each oncologist's decision can be automatically logged in the EPR. Thus, the actual applicability of the protocols can be verified a posteriori and their quality improved.

It is our opinion that the modeling experience and the approach in designing the system allow to easily extend our CDSS to different cancer types and domains of the medicine, and to integrate it with different clinical information systems with a minimal effort.

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