

An Ontology-Based Tool for the Analysis of the Social Network for Cancer Outpatients

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Abstract— In the framework of a research project funded by INCa (French National Institute for Cancer), a team of sociologists has conducted interviews with cancer outpatients, with the goal of analyzing their social support network and its evolution over time. This paper describes the ontology-driven tool supporting the collection and analysis of this sociological data.

Keywords: Social support for outpatients; health ontologies.

I. INTRODUCTION

The healthcare management of cancer has witnessed dramatical changes in the recent years. With the development of ambulatory treatments and oral chemotherapy, only 10% of anticancer chemotherapy in France is now performed in full hospitalization [1]. There is currently a reduction in hospitalization time, and conventional inpatient treatment is gradually replaced by other less expensive methods, such as home hospitalization or ambulatory care.

Although outpatient medical care favours patient autonomy, it also leads to patients and their relatives carrying a new burden of responsibility in defining and implementing their own care pathways. In the framework of a research project funded by INCa (French National Institute for Cancer), a team of sociologists has conducted interviews with post-cancer outpatients, with the goal of assessing the main hypothesis that the success of a healthcare pathway is increasingly dependent on the "resources" that the patients can mobilize to come to terms with their illness.

These resources are obtained within two major types of networks: those structured around the close relatives and those structured around friendly and professional relationships. The complexity of these networks may vary, and their structure is likely to partly explain the social dynamics observed in disease trajectories. This graph of resources and relationships defines the patient's socio-technical network of support, co-constructed by patients themselves, close acquaintances, health professionals, individual and social environment, and technologies.

In the following sections, we present a tool designed to support the collection and sharing of the information gathered during interviews, and permitting a convenient visualization of the evolution of the patient's social graph over time.

II. TOOL SUPPORT

In the framework of this project, we have developed a software tool allowing the sociologist investigators to analyze how cancer patients construct their healthcare pathway in connection with the medical care team, but also in continuous interaction with their social supports. At the start of the project, the sociologist partners were transcribing their interviews with patients using a structured Excel® sheet, which was fitted with a detailed usage guide, aimed at enhancing the homogeneity of transcriptions made by different investigators. Although this mode of transcription had several advantages (such as familiarity and flexibility) it proved ill-suited in the long term, mainly due to the use of different terminologies by the investigators, who were using various synonymous terms to transcribe the same resources or relationships, thus hampering the possibility of automatic treatment.

To overcome these problems, and to enable the automatic processing and analysis of the recorded data, we developed a software tool, with the goal of preserving the flexibility of the original process, but also to favor the development and sharing of consistent terminologies between investigators. The tool enables a graphical edition of the patients' social relationship network, which is conceived as a graph of *resources* and *relationships* between resources.

Considering that the consistency of the terminologies used for labeling the resources and relationships are of prime importance for enabling further automatic processing, the conceptual design of the tool is based on ontological approach [2]. In order to reach the objectives of flexibility expressed by the investigators (and confirmed by the analysis of interviews in Excel format), the tool allows for the development of a dynamic ontology of resources and relationships, defined and controlled by the investigators themselves [3], [4].

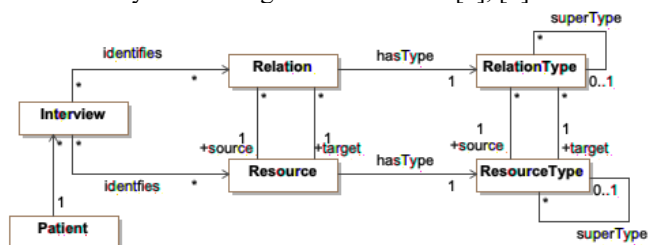


Figure 1. Simplified conceptual model.

A detailed analysis of interviews collected in Excel format led to the conceptual model illustrated in Figure 1, expressed in the Unified Modelling Notation (UML), and was mapped to a relational implementation using the principles described in [5]. For each *patient* under scrutiny, several *interviews* are conducted. During these interviews, the investigators identify the *resources* that are part of the social relationship network of the patient, and the *relationships* between these resources. To ensure the consistency of the interviews' modelling, resources and relationships must be instances of a well-defined ontology, which is illustrated in the right part of Figure 1. This dynamic ontology (*ResourceType* and *RelationType*) constitutes a meta-model for the social network graph of a patient, defining a consistent terminology for resource types (e.g., “informational resource”, or “medical act”), and for the legal relationships between resource types (e.g., the relation type “Information acquisition” mandatorily links a resource of type “person” to a resource of type “informational resource”). This metamodel can be dynamically extended by the investigators to accommodate new situations, or even be completely redesigned if a new study requires a change of focus regarding the information of interest.

Resource types and relation types are organized as a covariant tree-structure of subtypes [7]. Thus, for instance, the “information acquisition” relationship could relate to a resource of type “Doctor”, which is a sub-type of “Person”. The software tool allows for a graphical edition of the social relationship graph (Figure 2), and the user interface permits an easy navigation between the successive interviews of a patient, which promotes a visual and intuitive evaluation of the evolution the patient's social graph over time.

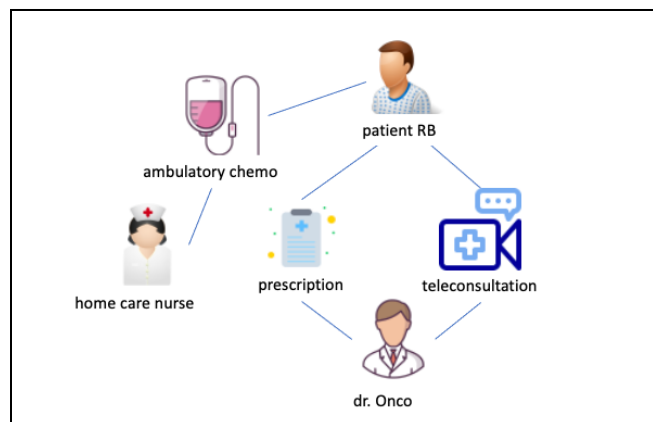


Figure 2. Visual representation of the social graph.

III. CONCLUSION AND PERSPECTIVES

The tool has successfully replaced the spreadsheet-based data collection previously used, ensuring the consistency of terminologies amongst sociologist investigators and promoting the sharing of information. The ontology-driven design of the tool opens the possibility of automatic transformation of the collected data in Resource Description Framework (RDF) format [8], which enables the use of specific ontology request languages [9] to integrate network analysis algorithms [10], such as the identification of critical resources.

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