

Process Oriented Knowledge Management to Support Clinical Pathway Execution¹

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Abstract. Processes play an important role in modern hospital settings. Both cost pressure and increasing quality requirements force hospitals to redesign their processes and to document their execution and results. Clinical Pathways are evidence based and interdisciplinary treatment processes for specific diagnosis. Along such treatment processes a lot of documents – both patient specific and unspecific – are produced. All these documents contain knowledge which is interesting for further reuse. This paper presents an approach for process oriented knowledge management along clinical pathways by using semantic document tagging generated by rules in the pathway models.

1 Situation

The public health system in Germany is currently undergoing major changes caused by several factors [3]. The goal of this effort is to reduce cost and at the same time improve efficiency and quality of patient treatment. Both goals can be achieved by using information technology in medical environments [2].

In a typical hospital setting, the medical staff has to deal with several different information systems such as hospital information systems (HIS) [7], tool specific software or laboratory systems. The ideal conception - to collect, store and analyze all information in a single big HIS - is often not put into practice and the medical staff has to spend time and effort to collect the required information from several IT systems [6].

The requested information can be divided into various categories by certain criteria such as type of the disease, date of the patient treatment, clinical ward or responsible physician. In order to improve clinical processes, this type of information has to be easily and quickly accessible. In practice, this is problematic because relating data across system boundaries requires either a lot of time or detailed IT knowledge. In consequence, the medical staff has to be supported by a knowledge management system (KMS) that allows performing similarity searches in the existing clinical data.

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Clinical data is often contained in documents² like for example findings, patient records, measurements, etc. Most of these documents are created, maintained and analyzed by the medical staff using existing clinical IT systems. Thus, the medical staff knows this kind of documents very well and can effectively extract the needed information. The remaining documents are from other sources and often used for reference, like medical guidelines [1], lookup tables, medical terminologies or checklists. This kind of documents must be easily accessible for the medical staff, as well.

A clinical pathway [4] describes the patient's treatment process within a hospital and therefore is a very characteristic and well known means of orientation for the medical staff. Thus, a clinical pathway can be regarded as one common criterion to structure the medical knowledge. Clinical pathways are built on evidence based medicine [4] and clinical practice knowledge adapted to a specific organizational environment. Documents play an important role in both stages of a clinical pathway: Design and execution. For example, medical guidelines are needed to set up a valid clinical path in the design phase. During the execution of a clinical pathway documents are stored and requested as well, e.g. a physician needs to take a look at a radiograph during the examination or a nurse needs a checklist to prepare the operation room for the next surgery. The documents provide both background information and context data.

2 Semantic tagging along the clinical pathway

The situation described in the first section implies that a knowledge management solution for a hospital should be based upon the existing medical documents that are used along the patient treatment process. In fact, using existing documents has several advantages: In contrary to a newly generated representation of extracted knowledge, a more efficient comprehension of the presented knowledge is guaranteed. Accordingly, the acceptance is raised as there is no need for the medical staff to understand the structure of new documents. Furthermore, existing documents can simply be reused and the expensive creation of new documents can be omitted.

The medical documents originate from very different sources and need to be organized and related to each other. A basic principle to structure the knowledge is to tag the documents with different characteristic attributes (e.g. key words) [5]. By adding predefined attributes, the documents gain semantic information that can be automatically processed by a KMS. Typical examples for such attributes are the type of the disease or the responsible physician. What criteria are to be used throughout the KMS depends on the individual needs of the organization. It is very important to define a common understanding of the classification throughout the organization.

The tags cannot be assigned to every document manually. Tagging rules have to be defined that describe what type of attribute has to be assigned in which way to what kind of document. This can be done during the design of the clinical pathway, i.e. knowledge management has to be considered already at the conceptual level (cf. Fig.

² In this context, the term "documents" stands for all kinds of knowledge carriers, like for example forms, diagrams, images, documents, multimedia content, etc.

1). At the modeling stage all necessary data is available: Document source and target systems, data conversion rules, data types, organizational assignments, etc. Using this information, it is possible to define what data affects the attributes of a document. In general this relation is not straightforward, i.e. a simple mapping between the attending physician and the attribute “responsible physician”, is possible but it is not a typical example. Often more complex combinations have to be reflected in these rules, e.g. weight, size and a formula describe the body mass index and are thereby part of the risk classification of a person. The rules need not only to define how the data is transformed, but also how the data is extracted from the document and attached to it afterwards. In order to foster reuse of these rules, they can be stored in a repository and applied to other compatible document types as well. The tagging rules are applied during the execution of the clinical pathway (cf. Fig. 1).

Automatic generation of classification data is, especially in the medical domain,

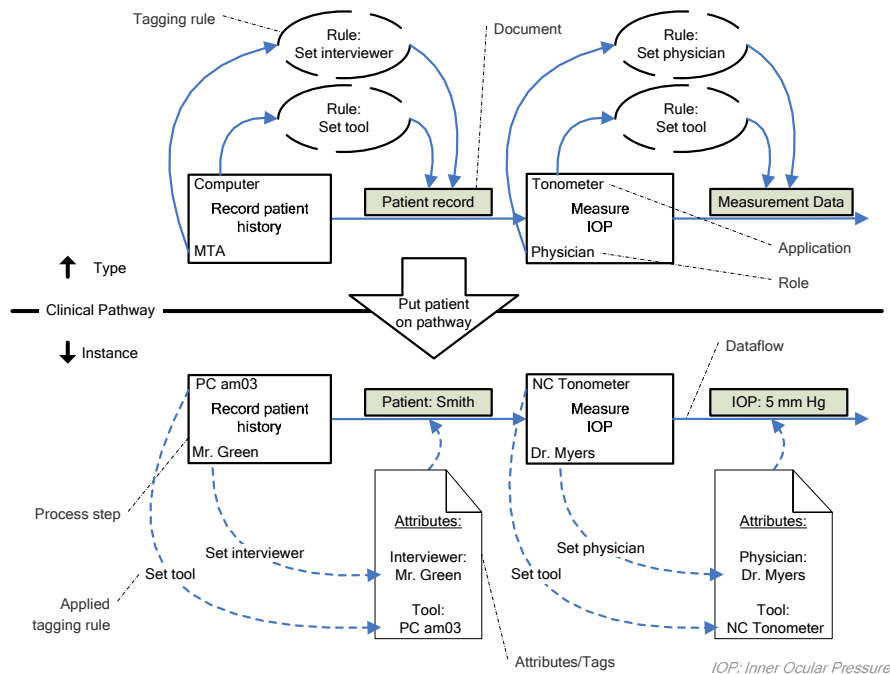


Fig. 1. Tagging rules are defined at the conceptual level of a clinical pathway

restricted to certain areas and must not replace the decisions of qualified medical personnel. Accordingly, it has to be possible for the medical staff to change the attributes of documents if necessary, i.e. the attribute assignment of the KMS must not be static. In order to maximize acceptance and minimize the necessary human interference, the attribute to value assignment of the documents has to consider more than just the last few steps of the clinical pathway. For example, the attribute diagnosis, which might be relevant for most of the collected documents, is normally only known at the end of the clinical pathway. The context of the documents, i.e. the clinical pathway, has to be considered when assigning the attribute values of the

documents. This can be achieved by different strategies, for example by assigning the attributes of all documents not before the end of the execution of the clinical pathway or by using hierarchical attribute sets.

The attribute types define dimensions of a multidimensional classification space. The allowed values of the attributes are the marks within a dimension. The dimensions should be orthogonal to each other in order to avoid misclassification of documents. The structure of the clinical pathways is a well known and very significant means of orientation for the medical staff and should be emphasized. Further eligible candidates for dimensions are for example diagnosis, responsible physician, ward or type of examination. According to our experience, it turns out that four to seven categories (i.e. attribute types) are sufficient to reach a reasonable tradeoff between usability and expressiveness of the KMS.

3 Benefits and Outlook

The basic idea of our approach is to collect and tag documents used during the execution of a clinical pathway. Reusing documents increases the acceptance by presenting the knowledge in a familiar style to the medical staff. The documents are semantically tagged by the system according to rules defined once during the design of the clinical pathway. These semantically enriched documents can be directly linked to the process based KMS described in [5] or used in the context of semantic web applications to support clinical work.

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