Process Based Data Logistics: a Solution for Clinical Integration Problems*

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Abstract. Integration is a big issue in healthcare environments. One aspect of integration is data logistics that supplies physicians with relevant patient data along treatment processes. The two main tasks facilitated by data logistics are data transportation and data transformation. To enable data transport, workflow management concepts are adopted for indirect process support to supply data. To enable data transformation, formats, ontologies and terminologies are considered in an XML based transformation approach. A case study regarding self tonometry illustrates this approach.

1 Introduction

In modern clinical environments many information systems are used simultaneously, for example laboratory systems, clinical information systems or patient information systems. In order to support clinical work, the systems have to communicate with each other, i.e. they must be integrated. As in many other application domains, communication in hospital and clinical supply networks has to be optimized in order to increase data accessibility and quality and to reduce cost and waiting time. Often specialized middleware, called connection server or integration engine, is used to establish the necessary communication relationships in a standardized format, e.g. Health Level 7 (HL7) [HaMo93]. Connection servers achieve this by translating between system specific protocols and by transporting data between producers and receivers. Nevertheless there are problems with communication in clinical environments. A broad variety of systems and applications – often showing overlapping functionality and data – makes this situation complex and complicated. One of the most important issues is to cope with the complexity of communication since often hundreds of communication scenarios have to be supported. Especially, when communication scenarios have to be changed, problems arise since changes often produce unexpected side effects which lead to failures.

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Connection servers and other approaches like the adaptive replication manager [NiHa02] or implementations of the publish/subscribe paradigm [EFGK03] provide solutions to enable and execute communication. But all these approaches show a deficit on the conceptual level. They are more or less implementation and not model driven, which limits the possibility of communicating details of the configuration between domain and implementation experts. In all these approaches a comprehensive model covering all communication scenarios is missing totally. Our method of process based data logistics uses well documented process models to describe the application scenarios. This also supports the idea of evidence based patient treatment according to medical guidelines and clinical pathways [BKMJ04].

In this paper we present an approach to make use of process based data logistics. In Section 2 we introduce basic technologies our approach relies upon: data transformation and workflow management. In Section 3 we present our approach before the concepts developed in this paper are illustrated in a case study and a prototypical implementation in Section 4.

2 Basic Technologies and Approaches

In this section we introduce the basic technologies and concepts that are needed on our way to process based data logistics. Firstly, we have to consider data transformation; it cannot be done without concerning syntax and semantics of data. In medical environments format, ontologies and terminology must be analyzed. Secondly, data transport must be facilitated. Therefore we apply workflow management concepts, however, not in the usual way.

2.1 Formats, Ontologies, and Terminologies

In a typical medical environment several data formats are used. HL7 is a wide spread but by far not ubiquitous standard that helps to solve the integration problems in healthcare. Data formats do not only differ on the syntactical level (How is the data encoded?), but also on an ontological level (How are the concepts described?) and terminological level (What terms are used?). These aspects [BKMJ04] are important when talking about integration in the sense that a target system is able to understand data sent by a source system. Let us have a closer look at these three aspects.

Different systems use different encoding rules to represent data. A lot of up-to-date standards are XML based, but older standards and a lot of systems in healthcare settings use proprietary data formats instead of XML. In general only a syntactical transformation is needed to transform the encoding of one data format into another.

In real world applications it is not sufficient to consider only the encoding on syntactical level. Systems use different concepts to describe an application area. For example, the way a medical finding is structured and described differs from system to system. These phenomena can also be found when considering database schemata. An application area can be modeled and mapped to tables in different ways. Thus concepts or ontologies used to express real world phenomena in information systems must be considered when integrating data from different systems.