

Chapter 24

Semantic Interoperability– Enabled Architecture for Connected Health Services

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ABSTRACT

With the increasing availability of connected health organisations, key medical information is expected to be accessible at the point of care. However, the high sensitivity of the clinical data and the large heterogeneity in health information systems pose a great interoperability challenge, including solutions that rely solely on the use of data exchange standards. Due to low adoption of these standards, such solutions will not sufficiently scale to achieve this objective. This chapter presents a service-based approach that utilises domain models combined with extensible problem models, enriched with domain terminology and knowledge services to enable autonomous data governance and semantic interoperability. The chapter addresses the resulting requirements, describes the proposed a solution and reports the results from the prototype of the approach.

INTRODUCTION

The increasing availability of connected health, demand on healthcare to be present at each point of care has become a normal expectation. To achieve, it requires health institutions to share medical data for both delivering and improving healthcare, and facilitating clinical research [Stead W. et al (2000), Garde, S. et al (2007), Taweel, A. et al (2006), Taweel, A. et al (2004)]. The need for integrated systems that can provide up-to-date information about patients and their healthcare is not only critical to the day-to-day running and delivery of health functions but also potentially means saving lives. It is increasingly expected that patient health information is available at the point of care irrespective of its location. This expectation is driven by rapid developments in information technology, alongside their increasing dominance at the heart of individual healthcare institutions, through the use of data-intensive electronic health records systems (EHRs) that drive the health care process. One of the primary visions of eHealth

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has been to achieve a technology supported, seamlessly integrated health service that ensures the delivery of the right information about the right individual to the right person at the right time (Stead et al., 2000; Taweel, et al., 2006). This vision, however, present many challenges, including:

- The heterogeneity of health systems and their data representations across health institutions, not just across the health domain as whole but even within individual clinical domains, e.g. secondary care, primary care etc.
- Delivery of complete clinical information at the point of care, potentially requires health information exchange across geographically distributed health centres, thus creating a massive scalability challenge that puts demands on networking and distributed system architectures.
- Legacy and proprietary systems and the lack of, or at best, slow pace adoption of standards make exchanging clinical data more difficult and hampers the chances of integrated healthcare. This puts demands on knowledge representation methodologies that must cope with the complexity of (heterogeneous) health information, whilst remaining easy to deploy and use by system providers.
- The requirements of patient privacy and confidentiality that require strict data governance policies. These policies vary across institutions to include a variation of access constraints that observe strict ethical rules to maintain patient confidentiality at all times. This requires secure yet configurable independent data sharing policies that reflect the needs of the participating organizations within the domain.

The large number of system providers and their business models and variations in ethical and regulations for accessing clinical information across health organisations implies an exponential explosion in the number and type of stakeholders that need to be involved in achieving the seamless interoperability required to achieve the above vision. To achieve the need is to enable interoperation between data centres not just at the system or data levels but also at the governance level. However, consider the complexity involved in reaching agreements on or enforcing conformance to interoperability standards at these different levels within a single enterprise let alone multiple enterprises or countries. Therefore, the approach taken here is motivated by the practical implications of not being able to completely rely on the use of common interoperability standards (Orguna, et al 2006; Naml, et al., 2009) to address this issue. Instead, this needs to be addressed at the granularity of the application, data and/or centre levels, in which an interoperability framework should overcome heterogeneity and adapt at run-time and dynamically interoperate with data providers. Heterogeneity between health information systems and data, however, takes several dimensions; the most challenging of which is the semantic one, which the approach proposed in this paper attempt to address.

In this chapter, we focus on health data sharing in the context of clinical research, in the context of health organisations that use electronic health records systems (EHRs) through which patient health data is managed and stored. The stores that hold patient health data are referred to in this chapter as data sources. We present an approach based on the use of domain ontologies (Musen, 1998) combined with rich terminology and knowledge driven *problem* models used at the heart of a service-based framework to enhance semantic interoperability in eHealth services. An example of an eHealth service is EHRs or data sources that in this service-based framework become (for example web or grid) services (thus referred to below as eHealth services or services). The chapter proposes the use of extensible problem models enriched with well-defined domain concepts that can be dynamically translated into individual data sources (or services). Data sources or services themselves are semantically described in terms of

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