

Semantic Interoperability in Healthcare: Challenges and Roadblocks

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Abstract. Semantic Interoperability plays a pivotal role in healthcare organizations enabling ubiquitous forms of knowledge representation. By integrating heterogeneous information, it strives to answer complex queries and pursue information sharing in healthcare. Its absence within and across organizational boundaries, however, impedes the ability to exchange information in a complex network of computerized systems developed by widely different manufacturers. This study aims to stress the need for achieving semantic interoperability and explore the implementation challenges and roadblocks that exceed the technical difficulties and evolves around cultural, social, policy and economic barriers to data sharing.

Keywords: Healthcare, Interoperability, Semantics.

1 Introduction

Automated data sharing enhances communication among computers and speeds up response time, which is a requirement for effective healthcare delivery. In healthcare, data exchange schema and standards allow data sharing across clinicians, lab, hospital, pharmacy, and patient regardless of the application or application vendor. However, the absence of interoperability within and across organizational boundaries impedes the ability to exchange information in a complex network of computerized systems developed by widely different manufacturers. The Institute of Electrical and Electronics Engineers defines interoperability as the “ability of two or more components to exchange information and to use the information that has been exchanged” [1]. In medicine, interoperability enforces the ability to transfer data accurately, effectively, securely and consistently regardless of information technology systems, software applications, and networks in various settings. It also facilitates the exchange of information such that clinical or operational purpose and meaning of the data are preserved and unaltered [2]. The latter definition alludes to the ability of the systems to fully participate in a semantically interoperable environment, which is only possible by adopting standards for message format as well as the content.

There is no shortage of research about standards and their role in facilitating data exchange in healthcare. The problem is well defined, and standards such as HL7 V 2.x series offer primary clinical messaging format standards for information exchange between and across organizations. However, in reality, the implementation of semantic interoperability has faced challenges and roadblocks that exceed the technical difficulties and evolves around cultural, social, policy and economic barriers to data sharing. Dolin and Alschuler [3] state that “challenges to profile-less communication with today's model and terminology include ambiguities, lack of complete expressivity, redundant representations that cannot be computationally converted into a common canonical form, implicit semantics, and a less-than-perfect understanding of context.”

This study aims to stress the need for achieving semantic interoperability to enhance healthcare delivery and cites the implementation challenges for semantic interoperability in the healthcare industry. The organization of the paper is as follows: Section 2 describes interoperability in healthcare. Section 3 introduces standards for achieving Semantic operability in healthcare. Section 4 offers concluding remarks.

2 Health Information Technology Interoperability

The need for fluent machine-to-machine communication in healthcare is crucial. However, the accuracy of such communication depends on the ability of different HIT systems to map different terms to shared semantics, or meaning. The HIMSS has divided health information technology interoperability into three levels: 1) Foundational; 2) Structural, and 3) Semantic [4]. According to HIMSS, these three levels of interoperability must be achieved to enforce the data exchange initiatives. Most healthcare organizations have achieved the first step of foundational interoperability allowing electronic data exchange in understood formats. An extensive effort is on the horizon to achieve the next level of structural interoperability to provide the capability for IT systems to interpret data at field level. To achieve semantic interoperability, which is the highest and final level, involves the understanding of the meaning of information. Dolin and Alschuler describe the final step for accurate data exchange as “the ability to import utterances from another computer without prior negotiation, and have your decision support, data queries and business rules continue to work reliably against these utterances.” It is commonly understood that achieving broad-based, scalable and computable semantic interoperability across multiple domains requires the integration of multiple standards. However, a problem arises when the sheer number of acronyms become confusing and overwhelming.

3 Standards for achieving Semantic

Clinical-level semantic interoperability is an elusive goal. The semantic component becomes notoriously difficult to extract when humans create the clinical description and then share it with a computer. The problem of semantic interoperability occurs when clinically meaningful data are passed from machine to machine. Standards, like HL7,

are intended to provide solutions at this level using methods for object-oriented software for a distributed environment. The key problem for developing a standard that would support interoperability is the boundary between a computer network and human users that are employing different tools to extract meaning. The challenge is how to ensure that meaning has not been changed when crossing this boundary. Without standards based on a common vocabulary, health information system semantic interoperability remains wishful thinking. Whether semantic interoperability enables a seamless communication among computers is open to speculation and difficult to answer, but keeping the discussion alive is a useful undertaking.

4 Discussion

In healthcare; an environment, characterized by large distributed, autonomous, diverse, and dynamic information sources, access to relevant and accurate information is becoming increasingly complex. This complexity is intensified by the evolving system, semantic and structural heterogeneity of these potentially global, cross-disciplinary, multicultural and rich-media technologies. Solutions to these challenges require addressing directly a variety of interoperability issues. Information blocking practiced by some healthcare providers and health IT developers are among other issues that jeopardize the meaningful use of semantic interoperability. This practice undermines the overall goal to achieve secure, appropriate and efficient sharing of electronic health information across the healthcare continuum. Health information exchange interoperability is a difficult problem that has many aspects: financial, organizational, political, and technical. Recent studies have attempted to address some of these issues (5, 6, 7, 8, and 9) and have offered suggestions to optimize healthcare delivery across the board. From the theoretical point of view, the most difficult problem is the semantic interoperability of clinical data, which requires either finding a way to translate the natural language of medicine to computer codes, or changing how doctors communicate their clinical observations. Either way is far from completion.

5 References

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