advance for HEALTH INFORMATION EXECUTIVES

Can We Talk?

Semantic interoperability allows us to understand and use information across various domains, enterprises and computer systems.

Semantic interoperability allows us to understand and use information across various domains, enterprises and computer systems.

By Kasey B. Poon, MD, MS

Health information technology (HIT) increasingly is being viewed as a means to improve quality, increase access and reduce the costs of health care in the United States. Government and industry have taken steps to encourage more widespread use of HIT. The establishment of the federal Office of the National Coordinator for Health Information Technology and groups such as the American Health Information Community, the Certification Commission for Healthcare Information Technology, and the Health Information Technology Standards Panel, shows a growing commitment to furthering the HIT agenda.

While simply adopting and using technology is an important step in improving health care, getting systems to communicate, or *interoperate,* with each other is perhaps an even more crucial step to realizing all of the benefits that HIT promises.

Health care facilities have disparate information systems that collect, store and use a vast array of data. The data may vary in quality and complexity, and it is often formatted in a customized fashion for purposes of performance, ease of use or support for functionalities. Because systems rarely store data in any explicitly defined context, they cannot interpret or exchange data in a meaningful way. Meaningful, or *semantic,* information exchange is being recognized as the key to achieving the full potential of HIT.

Gartner Healthcare listed achieving *semantic interoperability* as one of the CIO's Top 10 Best Moves for 2007. In fact, a study performed by the Center for Information Technology Leadership found that if health care information exchange and interoperability were implemented nationally, annual net savings would be $77.8 billion, or about five percent of annual U.S. health care expenditures.

Talking points

The U.S. National Committee on Vital and Health Statistics (NCVHS) defines interoperability as "the ability of one computer system to exchange data with another computer system." The NCVHS also defines the following three levels of interoperability: basic, functional and semantic.

Basic interoperability is the simple exchange of messages between systems. Systems do not interpret the messages.

Functional interoperability is not only the exchange of messages, but also includes a common structural definition for message fields. This level of interoperability is commonly achieved through the use of integration engines, which utilize standardized message formats, such as HL7, to allow the context of the data to be interpreted.

Semantic interoperability, the highest level, takes everything one step further. More than simple message exchange - or even message exchange with a common field structure definition - semantic interoperability happens when message fields are populated with standard codes. At this level, both the context of messages and the meaning of data content within the message fields can be interpreted, enabling multiple computer systems to translate and understand shared data with little to no information loss. Semantic interoperability allows us to understand and use information across various domains, enterprises and computer systems.

Achieving semantic interoperability requires establishing explicit meaning and context for data, as well as using the same set of codes to encode data throughout a system. This involves the addition of contextual, defined metadata to both structured data (e.g., numerical data in relational databases) and unstructured data (e.g., sentences or passages of free text, images or audio). The addition of contextual metadata drastically reduces the number of mappings required between and among systems. It also adds richer attributes to each data element, such as access levels, priority and intended users, thereby facilitating differential treatment by disparate computer systems and different types of users.

A simple analogy illustrates these concepts. Suppose one wants to make a telephone call to a foreign country. In order for the caller to communicate effectively with the person on the other end, all three levels of interoperability need to exist.

First, the telephone companies in the respective countries supply basic interoperability through their telecommunications infrastructures.

Next, functional interoperability is achieved through the universal customs associated with making and receiving phone calls (e.g., dialing a phone number, picking up the phone when it rings, speaking into the handset, etc.).

Ultimately, however, meaningful communication cannot happen without semantic interoperability. That is, both the caller and the recipient must understand the content of the messages; both of them must speak and understand the same language. If both parties already know a common language (i.e., a standard), then communication is straightforward and direct. However, if neither party speaks a common language, then communication can still be accomplished through a translator.

Becoming fluent

Similarly, there are two ways to get information systems to use the same set of codes. First, a facility can simply replace all the legacy codes in all of its systems with standard codes. This method can be viewed as "teaching all the systems to speak the same language," but it requires a health care organization to essentially abandon all of its legacy data, which has been encoded using the old codes. It also means maintaining the newly designated standard codes within each individual system, updating the codesets whenever a standards development organization makes changes to the standards.

The second way to achieve semantic interoperability is to introduce a translation layer, or an *interlingua,* between disparate systems. This translation layer maps a system's internal codes to standard codes. When information exchange between systems occurs, the standard codes to which the legacy codes have been mapped are used to populate the fields of the messages. This approach allows organizations to continue using their existing codesets, thereby preserving their legacy data.

Using an interlingua, an organization performs terminology maintenance within the translation layer, not within the source systems. This eliminates the need to update and maintain standard codes in individual systems. Another advantage of this approach is that an organization has access to all of the codesets contained within the translation layer, so switching from one standard to another is relatively uncomplicated.

Using a translation layer to achieve semantic interoperability between systems, the work of mapping and maintenance can be completed in an economical and efficient fashion.

Facilities can consider outsourcing the work of standardization and interoperability, relying on experienced subject-matter experts and terminology specialists to do the same tasks more quickly and a lower cost.

Dr. Poon is a medical informaticist with 3M Health Information Systems, Inc.