Foundations for Healthcare Interoperability

Use Case: A Wearable Cardiac Monitor for Telemedicine
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Introduction

This white paper discusses the foundations of healthcare interoperability and requirements for implementing a standards-based interoperable framework, and defines the work flow of a practical use case for interoperability. Additionally within this use case construct, we examine the underlying technical infrastructure required both today and in the future for an integrated health information ecosystem.

This paper focuses on three key areas:

1. The framework necessary for trusted data interoperability
2. A successful example of data interoperability
3. Actions that lead toward an integrated health information ecosystem

Overview of Interoperability

In a broad sense, interoperability dates back to early civilization with the desire of cultures to interact, exchange currency, trade goods by weight, and travel by measures of distance. The value of interoperability is deeply rooted as a means to progress, and the evolution of today’s healthcare information technology (HIT) industry is a prime example of how far such interactions have come – and how far they have yet to go.

One example of an effort to achieve health IT interoperability is the Direct Project:

“The Direct Project is a set of specifications and service descriptions that, when implemented within a strong policy framework, enables simple, secure point-to-point electronic messages between health care participants.”

In simple terms, Direct Project security specifications are intended to say “messages go where they are meant to, are not altered during transmission, and are not seen by anyone for whom they are not intended.” Additionally, there are several other models of structured interoperable systems. The common underlying phrase from above “…when implemented within a strong policy framework, enables simple, secure...electronic messages between healthcare participants...” applies to all meaningful healthcare data interchanges and interoperable systems. Within this framework, organizations rapidly agree on the adoption and use of standards for implementation allowing meaningful interoperability – a building block of an integrated health information ecosystem. To create this information ecosystem, interoperability must be addressed on several levels including foundational, structural, and ultimately semantic.

2 Ibid
3 Ibid

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Definition of Interoperability

In healthcare, interoperability is the ability of different information technology systems and software applications to communicate, exchange data, and use the information that has been exchanged. Data exchange schema and standards should permit data to be shared across clinicians, labs, hospitals, pharmacies and patients, regardless of the application or application vendor.

In short, interoperability is the ability of health information systems to work together, within and across organizational boundaries, in order to advance the health status of, and the effective delivery of healthcare for, individuals and communities.

There are three levels of health information technology interoperability:

**Foundational**

*Foundational interoperability* allows data exchange from one information technology system to be received by another, but does not require the receiving information technology system to be able to interpret the data.

**Structural**

*Structural interoperability* is an intermediate level that defines the structure or format of data exchange (i.e., the message format standards) where there is uniform movement of health data from one system to another, such that the clinical or operational purpose and meaning of the data is preserved and unaltered. Structural interoperability defines the syntax of the data exchange. It ensures that data exchanges between information technology systems can be interpreted at the data field level.

**Semantic**

*Semantic interoperability* provides interoperability at the highest level, which is the ability of two or more systems or elements to exchange information and to *use* the information that has been exchanged. Semantic interoperability takes advantage of both the structuring of the data exchange and the codification of the data, including vocabulary, so that the receiving information technology systems can interpret the data.

Semantic interoperability supports the electronic exchange of health-related financial data, patient-created wellness data, and patient summary information among caregivers and other authorized parties. This level of interoperability is possible through (potentially disparate) electronic health record (EHR) systems, business-related information systems, medical devices, mobile technologies and other systems to improve wellness, quality, safety, cost-effectiveness of and access to healthcare delivery.

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4 Definition of Interoperability, Approved by the HIMSS Board of Directors April 5, 2013.

Implementing Standards for Interoperability

Structural interoperability is defined and enabled by globally accepted standards governing the common use of clinical information. In order for interoperability to be successful, rules of engagement must exist for all participants or “actors.” When all parties agree to use common standards and similar process frameworks, interoperability can be applied with ever-increasing rigor and structure to achieve more reliable, intelligent and effective results.

In theory, any set of organizations that choose to exchange clinical information can simply agree on the standards and versions they will use, define some standard terminologies to use for various purposes and begin the standards implementation process. Using standards, organizations can transparently manage clinical information exchange and drastically reduce the effort and time required to achieve interoperability.

Consensus-Based Standards

Widely accepted consensus-based standards are important because their use minimizes the expense, risk and time to market associated with implementing the exchange of information between organizations. Without such standards, each pair of organizations that desire to exchange information would have to negotiate and agree upon all of the details of such exchanges – including concepts, coding vocabulary, document formats, communications protocols, and integration strategies – before the implementation can begin. The complexity involved would make such a task enormous and unmanageable.

Although there will continually be a need to create new standards and update specifications, the suite of existing standards for healthcare information exchange is fairly robust.

- Standards such as International Classification of Diseases, Ninth Revision (ICD-9) and International Classification of Diseases, Tenth Revision (ICD-10), Systematized Nomenclature of Medicine-Clinical Terms (SNOMED-CT), and Logical Observation Identifiers Names and Codes (LOINC) govern the coded/controlled vocabulary used in documents to refer to diseases, their diagnosis and their treatment.

- Other standards define the concepts used in clinical settings (e.g., Health Level Seven (HL7) Reference Information Model (RIM), Unified Medical Language System (UMLS)) and the coding of those concepts in formal clinical documents such as the Continuity of Care Record (CCR) and Consolidated Clinical Document Architecture (C-CDA).

- Still more standards define the protocols for transmitting and receiving such documents such as under the implementation guides of HL7 v2.x & v3.0, Digital Imaging and Communications in Medicine (DICOM), Institute of Electrical and Electronics Engineers (IEEE), and National Council for Prescription Drug Programs (NCPDP).

- In some cases standards direct how software applications are to integrate received information into their databases (e.g., the HL7 Clinical Context Object Workgroup (CCOW) and enable the availability and utility of commercial off-the-shelf (COTS) products and software.
Standards Development Organizations
A variety of standards development organizations, or SDOs, are responsible for creating, managing, and updating these standards. One of the most significant SDOs in the HIT industry is the international private alliance known as Health Level 7 (HL7).

Another type of collaboration for developing and promulgating standards for clinical interoperability is the federal government-based Standards & Interoperability (S&I) Framework. The S&I Framework is a public/private partnership initiative of the Office of the National Coordinator (ONC) for Health information Technology, within the Department of Health and Human Services (HHS).

Additionally, the National Institute for Standards & Technology (NIST) is driving forward the acceptance of existing standards and defining new standards as needed. NIST provides facilities for validating interoperable clinical documents (see http://healthcare.nist.gov/NIST-TOOLS/index.html).

For a historical perspective, more detailed description of SDOs and the role of health IT standards leading toward interoperability, see Appendix A of the 2013 HIMSS white paper, Evaluating Health IT Standards, by the Standards Work Group. There are many other SDOs and standards initiatives focused on healthcare data, as well as financial data.

Why Strive for Health Information Interoperability?

The ability to define interoperability at different levels supports sustainability and scalability across infrastructure, hardware, network and platform within a provider organization, as well as across other technology service providers, software application vendors and HIT vendor organizations. This sustainability is the engine for innovation and longevity. With all this effort and complexity, why should the industry attempt health information interoperability? The answer is simple – better health for us all.

The technology to deliver integrated healthcare is available on the market today. People expect that technology to be applied in ways that help them live better, more productive lives. Furthermore, as complex, long-term healthcare scenarios are becoming the norm, efficient, secure data interchange is the only way to effectively deliver health to the growing and aging population.

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Wearable Cardiac Monitor Use Case

As in many other technology-enabled industries (e.g., finance, real-estate, aerospace), information ecosystems drive innovation and sustainability. These information ecosystems are built upon data exchange and interoperability. The mechanisms and tools to exchange data are no different for healthcare than any other industry.

The difference lies in the consequences of the risk: the stakes are high and our personal health and well-being hang in the balance. When life or death outcomes are involved, business actions are significantly more complex. The following work flow for the clinical and business decisions in the following use case consider risk complexity, as well as the benefits of interoperable system efficiencies within the integrated health information ecosystem.

Use Case Description

This use case involving a wearable medical device demonstrates the subtleties and complexities inherent to healthcare interoperability. The medical device – in this example, a cardiac monitor – transmits data directly to a healthcare provider’s “cloud.” Once received by the healthcare provider, the data is entered into the patient’s record and is available to the patient’s care provider team.

Surprisingly, a simple interoperability example can be extremely difficult to implement due to the many regulatory, labor, process and technology barriers that must be overcome to achieve seamless interoperability. These barriers limit and slow adoption of new, life-impacting technologies. Such challenges are highlighted through this data interchange use case.

This use case does not intend to prescribe how a cardiologist should perform their job, but rather focuses on both technology and process infrastructure that must exist between organizations and their corresponding technology systems to deliver this interoperability example. Also, this use case examines both foundational and structural interoperability, and demonstrates how effective interoperability can provide significant patient benefits.

Data Flow from Patient to Providers

A mobile or portable cardiac monitor device monitors the patient’s cardiac rhythm in their home. The device transmits data over the Internet to a web service that brokers the transactions using health information exchange (HIE) activities to direct the data into the healthcare organization’s electronic health record (EHR).

The EHR presents the monitor data within the patient’s record for the care team members. The patient’s care providers use this information to evaluate the patient’s condition and identify any required action or treatment steps. The patient’s care team utilizing the EHR can include physicians, nurses, medical technicians and ancillary staff. Additional non-clinical provider staff that may use patient information include those involved in benefits eligibility checking, admissions and billing. This is one of many examples of how interoperability can be actualized in practice.
**Benefits and Sustainability**

The benefit for the patient in this case is the ability to receive medical care at home. The benefit for the hospital and the physician practice is that a patient does not need to incur the expense and risk of a hospital visit to receive the care. The benefit to the physician and other members of the patient’s care team is improved access to data using computationally intelligent systems.

This is also an example of a sustainable information ecosystem. Sustainability is achieved by many parties being able to participate in high-value activities. Each party brings different core competencies to the ecosystem to achieve a consolidated result. By way of free enterprise and patient demand, this facilitates creation of economic sustainability and longevity, as found in other industry sectors.

**Use Case Work Flow**

1. Patient vital signs are collected at home with a physician-prescribed wearable medical device. Data is transmitted via a home network connection and device gateway.
2. The Medical device data is received by a cloud-based database.
3. The patient data are analyzed for evidence of cardiac disease or disorder.
4. Results are stored in the cloud database to be retrieved as needed.
5. The patient’s physician logs into the hospital’s EHR and reviews the data and analysis for the patient.
Conclusions

The healthcare industry is experiencing a transformation in the way medical products and services are delivered. EHRs are being adopted as standard practice, and cloud-based medical applications are gaining acceptance and demonstrating value to the patient and provider. These systems must be compliant with secure, standards-based communications in order to demonstrate the true value of these revolutionary products, services and standards of care.

Portrayed as the future of technology-enabled healthcare, the integrated health information ecosystem may soon become reality. Taking action today will help successfully navigate future transformation activities and realize the full benefit of the integrated health information ecosystem.

What Can Be Done Today?
These three key steps can be taken by any organization to build toward an interoperable future:

- Lay foundations for interoperability with good security, compliance policies, and procedures.
- Implement interoperability where it can add business value to the organization.
- Look for interoperable solutions to solve immediate business needs

The transformation of the health industry into the integrated health information ecosystem puts healthcare on the forefront in adopting meaningful standards-based interoperability. Health information interoperability is here and changing the way healthcare is delivered. This field will mature over the coming years – faster than anyone imagines.
Acknowledgements

This white paper was developed under the auspices of the HIMSS Interoperability & Standards Committee, Technology Information Exchange (Tech-IE) Work Group. Special acknowledgment and appreciation is extended to Ford Winslow for serving as primary authors of this paper.

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