PROPOSAL INFORMATION

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Topic Category: Data and Information - Securing and streamlining health information to improve care delivery.
Sub-Topic: Clinical Informatics
Format/Level: 60-Minute Lecture (3 Speaker Limit) / Advanced
Target Audiences: Chief Digital Officer/Chief Digital Health Officer, CMIO/CMIO , IT Professional

CONTENT DETAILS

Session Title: Semantic Interoperability: What, Why and the Technical Essentials

Brief Description: Careful chart review studies have shown that on average 680 people die each day from preventable medical errors. Sharing of computable data, information, and knowledge in an open interoperable healthcare ecosystem could dramatically reduce medical errors. However, there are many views of what interoperability means, and many opinions on how it can be achieved. This session will focus on how semantic interoperability (or plug-and-play interoperability) is distinct from the general meaning of interoperability, why semantic interoperability is vital to our ability to improve patient care, what social and political aspects are important for enabling interoperability, and finally, the essential technical underpinnings of interoperability.

Learning Objectives:

• Define semantic interoperability and describe how it can improve patient care.
• List the important social, political, and technical factors necessary to enable interoperability.
• List the essential technical capabilities that underpin semantic interoperability.
• Evaluate how their home organization could become more semantically interoperable.

Background: Provide an introduction/background of your topic.

Careful chart review studies have shown that on average of 680 people die each day from preventable medical errors. Sharing of data, information, and knowledge in an open interoperable healthcare ecosystem could dramatically reduce medical errors. However, many parts of our health care systems operate as they did in the 1980s. Doctors use fax machines; hospitals lack modern software technologies; and patients must fill out the same forms again and again. While the federal government has spent billions of dollars to encourage the digitization of health records, it has failed to require the consistency needed to achieve true interoperability. As a result, hospitals and other health care providers use different digital dialects—too often incomprehensible to each other. Also, providers today face hurdles in adopting new information technologies. This failure delays the adoption of life-saving tools and the progress of science and technology, depriving patients of coordinated and timely care. Semantic interoperability can address many of these issues. Semantic interoperability (or plug and play interoperability) is the ability to share computable data, information, knowledge and workflows without special effort. Semantic interoperability is created by having one preferred way of representing and accessing a given kind of medical information. That is, people voluntarily agree to a very explicit definition of how detailed clinical information will be shared. For example, blood pressure, weight, glucose level, white cell count, deep tendon reflexes, etc., would each have a single preferred computable representation. This agreement on exact data representation allows the development of plug and play applications and decision support software. The applications are called “plug and play” because if they adhere to the standard they can be used (or plugged into the system) without special mapping of data structures and terminology. The applications do not require modifications for each system where they are used.

Note on what we mean by models The word “model” has many meanings. For purposes of this proposal, “model” refers to the structure that defines how data is coded and standardized. Shown below is a simplified example of a model for heart rate. Its most basic logical structure
has a key (the thing being assessed, measured, observed, etc.) and a measured quantitative value (in this case, beats per minute.). Heart Rate Model: Key = Heart rate, Value = 77 beats/min. This model’s structure is agnostic of any programming language or database schema. In actual models, keys and units of measure would be represented by codes from standard coding systems like LOINC, SNOMED CT, and UCUM. A modeling language is a syntax used to outline, define, and constrain a logical model. Different languages can be used to define logical models, including UML, ADL, HL7 FHIR structure definition language, and clinical element modeling language (CEML). Intermountain Healthcare uses CEML for defining logical models. These CEML Language definitions or models are commonly referred to as Clinical Element Models (CEMs). Intermountain created CEMs for all types of health-related data and currently has a library of over 7,500 models that are now supported by Graphite. The number of models will continue to increase as new realms of previously un-modeled clinical data are needed. The currently available models are licensed free for use and can be viewed at: http://www.opencem.org/#!.

Organization: Provide a brief description of the speakers’ organization.

Graphite Health is a member-led non-profit that aims to improve patient care and reduce costs by facilitating plug-and-play (or “semantic”) interoperability. The initial governing members of Graphite are Kaiser Permanente, SSM Health, Intermountain Healthcare, and Presbyterian Health. Once fully deployed, Graphite’s technology will permit a hospital to adopt new software with the ease of downloading an app from a virtual store. No longer will providers have to incur the costs of custom design and testing; this will cut costs significantly and shrink adoption times from years to weeks. Graphite aims to drive the advancement of healthcare by establishing a trusted digital ecosystem for the development and deployment of plug-and-play interoperable applications and algorithms. The Graphite Ecosystem is based on the Public Utility model used successfully by Civica Rx—a similarly-structured non-profit, which dozens of hospital systems formed to address generic drug shortages. The five major components of the Graphite Ecosystem are: 1. Graphite Interoperability Platform a. Graphite Standardization Service – makes data from the member’s existing systems (including EHR) usable by Graphite applications by ingesting, aggregating, and standardizing the data. b. Data Management Service – holds standardized data in a centralized data store that is used to provide API endpoints, track data provenance, and other services necessary to support health applications. 2. Graphite Application Platform (in the Shared Trust Environment) a. Provides an isolated and secure runtime environment for interoperable applications, whether they are developed internally within the health system or by external developers. 3. Graphite Standardization & Policy a. Model Development Services – a collaborative process, managed and prioritized by Graphite, to develop and maintain the resources needed for semantic interoperability with a community of interested stakeholders b. Graphite Standard - standardized data representations that specify a consistent output and expression for healthcare data (see next section). 4. Graphite Labs a. Engagement Services – a collection of tools and services that educate independent application developers on the benefits of using the Graphite Standard to develop interoperable applications. b. Development Environment – an application development environment for building and testing interoperable applications that operate in the Graphite Ecosystem. 5. Graphite Marketplace a. Graphite-Certified Applications – provides for the distribution, certification, and sale of interoperable applications for deployment in the Graphite Application Platform. For clarity, the five components of the Graphite ecosystem listed above are provided by Graphite, but Graphite does not produce or create applications or knowledge. The interoperable applications and knowledge come from Graphite members, independent software developers, government agencies, academic institutions, etc.

Methods: Describe the study/project/process implementation used and provide a timeline. Experience and knowledge gained from interoperability projects involving Intermountain Healthcare, other healthcare providers, public health departments, healthcare payers, commercial laboratories, and retail pharmacy systems were organized and analyzed. A plan for
creating an ecosystem to support semantic interoperability was created that reflected that knowledge and experience.

**Challenges** – Describe any barriers or challenges. What considerations and best practices should an organization follow to mitigate these barriers?

There are 3 key areas that must be addressed in order to create semantic interoperability. First, there must be clinical engagement and ownership. Front line clinicians (nurses, pharmacists, physicians, physical therapists, etc.) must be engaged and provide the real world knowledge used to create the detailed specifications for the data elements. Specific things that clinicians need to decide: What data should be collected? What data needs to be collected will be different for different situations. How should the data be modelled? Should it be represented by one code or field, or by a combination of codes and fields? (This is commonly known as the issue of precoordination versus postcoordination.) What does the data mean? How do we make computable definitions for diabetes mellitus, myocardial infarction, heart failure, chronic renal failure, etc.? Second, we must agree on the technology that will be used. What standards to use for information modeling? – FHIR structure definitions, Archetype Definition Language, Unified modeling language, Clinical Element Modeling Language, etc. What standards to use for terminology/semantics? – SNOMED CT, LOINC, RxNorm, UCUM, ICD, etc. What standards to use for data exchange? – HL7 FHIR, HL7 V2.X, HL7 CCDA, NCPDP Script, ANSI X12, etc. Third, we need to have laws and regulations that incentivize and require the use of the agreed standards. Financial incentives must align with the use of standards. An additional technical challenge is that clinical data can be represented in so many different ways. Below is an illustration of how the same information can be represented in different ways. This example shows two common approaches for how ABO and Rh blood type data can be represented. In the first, the data for both variables are combined into a single set of entries. In the second, data with the exact same meaning is split into entries for each blood type. 1st Approach (precoordinated data representation) ABO+Rh Blood Type Model Key: ABO+Rh Type (a single code or concept) Value: O Rh Positive (the two findings are combined into a single answer) 2nd Approach (postcoordinated data representation) ABO+Rh Blood Type Panel Model (the panel is composed of two separate findings) Key: ABO+Rh Type Panel ABO Blood Type Model Key: ABO Type Value: O Rh Blood Type Model Key: Rh Type Value: Rh Positive A health care worker would know that the data in the two approaches have the same meaning. However, a computer program would not automatically know these two representations are equivalent. Even though both representations are adhering to all ONC adopted standards, they are not semantically interoperable. The best approach is to have one of these models be the preferred representation but map the preferred representation to one or more alternative representations that may be needed in particular situations. When two different models can represent exactly the same information, they are called “isosemantic” because they are just different ways of modeling the exact same information.

**Results/Findings** - Identify any outcomes data (e.g. key performance indicators, pre-implementation performance, or current performance data).

Many organizations have been working to create interoperability for decades. This includes health care providers, payers, government agencies, standards development organizations, public health organizations, and research organizations. The following principles are proposed as a way forward to reach semantic interoperability. 1. Standards for semantic interoperability will include all varieties of health-related data including clinical, patient administration, social determinants of health, preventive medicine, financial, and genetic data. 2. The priorities for developing semantic interoperability will be based on the areas of greatest need as determined by the healthcare community at large. 3. A governance process will be created to guide the creation and evolution of the semantic interoperability standard and all interested stakeholders will be invited to participate in that process. 4. Any new models, terminology, and other content will be submitted to standards development organizations so it can be part of future open-consensus balloted standards. 5. The semantic interoperability standard will be licensed free for use. 6. The semantic interoperability standard will be compliant with all US laws
and regulations related to health data. The semantic interoperability group will work with Congress and government agencies to support laws and regulations that facilitate an open interoperability ecosystem. The standard is specifically based on and compliant with HL7 FHIR, USCDI, LOINC, SNOMED CT, RxNorm, and UCUM. Specific approach the following specific tasks are proposed for creating a semantic interoperability standard. 1. Determine a language or languages for expressing the detailed logical model for clinical data. 2. Create logical models for the highest priority needs. 3. Create HL7 FHIR profiles and other standard representations (HL7 V2.X, CCDA, and perhaps others) based on the logical models. There will be only one preferred model for a given data element. However, alternative models will be created and mappings will be made between preferred models and alternative models. 4. Make both the logical models and the HL7 FHIR profiles available at no cost in an open model library for people to use in creating semantically interoperable applications. 5. Create a software development and testing environment where people can create knowledge and applications and test their products against the semantic interoperability standard. 6. Create a process for certifying that applications and data services comply with the semantic interoperability standard. 7. Make semantically interoperable knowledge and applications available in an open standard marketplace. Lessons learned 1. Some problems of semantic interoperability can only be solved by voluntary agreement by clinicians about what data is essential and agreement that the data elements will be accurately entered into the system. 2. The challenge today is not that there is no way to share data, but that there are too many ways to share data. Given the standards, you can represent any data element in at least two ways, and there are often 5 or more ways to represent the same data. See the example of pre and post coordinated model examples above. 3. Semantic interoperability is hard. It requires 10’s of thousands of very detailed models. It will take several years to be comprehensive of even the most common data elements used in medicine. However, each area or domain of data that is standardized will provide value while work continues in other domains. The long-term value of semantic interoperability immensely outweighs the investment. We need to have a mindset that we are running a marathon, not a 100 yard dash. 4. Most real world applications use both common data elements and also some unusual or uncommon data elements. For this reason, a two pronged approach may work best for developing models. First, develop models in common domains (labs, medications, problems, diagnoses, immunizations, allergies, etc.). Second, work directly with people developing applications to quickly add the uncommon data elements that are needed for their specific application.

Conclusions – Describe any conclusions/lessons learned.
The goal is to establish a trusted digital ecosystem for the development and deployment of plug-and-play applications, which will improve patient care and lower costs. This vision can only be achieved by the standardization of health data so that it can be universally understood by people and computers. This is the future of healthcare we want and need. This is the future of healthcare each and every one of us should demand.

Next Steps/Follow Up Research – If applicable, provide any next steps/follow up that are important to this presentation.
The ultimate goal of this work is to “remove the friction in health care,” supporting better, more efficient care for all patients. It is only by breaking down the barriers to healthcare data standardization and application development we can hope to achieve this goal.

SPEAKER DETAILS

Name: Stanley Huff BS, MD, FACMI
Title/Org/City/State/Country: Chief Medical Informatics Officer, Graphite Health, Utah, United States
Worksite: Others Allied to Healthcare / Entrepreneur, Startup, Disruptor
Bio: Dr. Huff is the Chief Medical Informatics Officer at Graphite Health, and a Professor (Clinical) of Biomedical Informatics at the University of Utah. He is board certified in Clinical Pathology. He has worked in the area of medical vocabularies and medical database architecture for the past 30+ years. He is currently a fellow of the American College of Medical Informatics, a co-chair of the LOINC Committee, and a co-chair of the HL7 Clinical Information Modeling Initiative (CIMI). He is also the Chair of Logica (formerly the Healthcare Services Platform Consortium (HSPC)) and the Chair of the HL7 FHIR Foundation. He is the former CMIO at Intermountain Healthcare, a former member of the ONC HIT Standards Committee and a former member of NCVHS. He is also a previous Chair (twice) of Health Level Seven (HL7). He teaches a course in medical vocabulary and data exchange standards in the Department of Biomedical Informatics at the University of Utah.