Leveraging SNOMED and ICD-9 cross mapping for semantic interoperability at a RHIO

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Abstract: The HEAL10-NY grant, funded by the New York State Government, is an outcome of the state's effort to integrate hospitals, clinics and laboratories in New York. This paper discusses the mapping strategies adopted for the semantic and process interoperability between two hospital systems that have been implemented at two different clinical settings using standard vocabularies. Allscripts EMR is being used at ante/prenatal clinics to document ante/prenatal care and General Electricity's Centricity Perinatal (CPN) is being used at labor and delivery units in the hospital. Both applications differ in their content usage, software/hardware architectures, and platforms. Clinical information from these prenatal clinics/hospitals is transmitted after every visit to the RHIO, which acts as a clinical data repository and an aggregator of clinical information. At the time of admission for labor and delivery, the aggregated data is pushed to the inpatient labor and delivery system. This paper describes the usage of the recursive functions to traverse the SNOMED hierarchies to match the granularity levels of the Allscripts EMR application as well as SNOMED→ICD-9 crosswalk tables.

Keywords: Health Efficiency and Affordability Law for New Yorkers Phase 10 (HEAL10-NY) grant, Regional Health Information Organization (RHIO), recursive queries

Background: Lack of communication between healthcare providers at the hospitals, labs, and clinics is a common problem that leads to poor care coordination, and may result in low quality, or inefficient, patient care. [1] While most healthcare communities are able to achieve semantic interoperability at varying degrees, full interoperability is not accomplished until process interoperability is achieved. Semantic interoperability ensue that the various systems exchange and understand this clinical and/or administrative data without ambiguity. [4] However, unless the exchanged information is interpreted, aggregated and is presented to humans to facilitate better understanding of the patient's clinical condition, all the five rights for patient safety (the right patient, the right drug, the right dose, at the right time, with the right method of administration) cannot be ensured. This process interoperability will undoubtedly minimize unnecessary, or irrelevant, interventions on the patients. It will also coordinate work flow and enable the business processes at the healthcare facility.

Story Board Presentation: This section describes a typical case of high risk pregnant woman:

Before HEAL-10 Project: *A pregnant woman visits a private physician group practice for an antenatal checkup during her first trimester. Her initial visit to group practice didn't reveal any abnormalities. During her 18th gestational week, her primary obstetrician gives her a paper requisition to make an appointment at North Shore Long Island Jewish (NSLIJ) hospital for ultrasound. The performing obstetrician from NSLIJ calls her primary obstetrician and reads out the interpretation of the ultrasound. At month 6, her obstetrician at group practice diagnoses her with hypertension, and refers her to a specialist at Maternal & Fetal Medicine Unit within NSLIJ to examine her prenatal history and put her on a treatment program. Later, the patient visits the group practice a few times for a follow up. She also gets her lab work done at a private lab in Long Island. In month 9, the patient is admitted to NSLIJ for labor pains. The on-call obstetrician has no clue of how she was treated for hypertension during her antenatal period unless he/she calls the patient's primary obstetrician. Added to this, it becomes a challenge to get full information of this high risk pregnant woman who attended multiple clinics and/or hospitals/group practices elsewhere.*

After HEAL-10 Project: *The high risk pregnant woman was seen at a group practice and NSLIJ during her antenatal period. She got her lab work done at a private lab on Long Island. Her antenatal history and treatment were all recorded and stored at RHIO. She goes to NSLIJ for labor pains. The registration system at NSLIJ triggers a query to pull her antenatal history and treatment from RHIO. The system at RHIO summarizes her antenatal history and sends it to the system hosted at the OBGYN unit. The on-call obstetrician at NSLIJ can read through her antepartum record and can now make better decision and provide better care to this patient.*

The HEAL-10 project is a grant funded by New York State Department of Health (DOH) and Dormitory Authority of the State of New York (DASNY) to develop health information technology (Health IT) and restructure health care delivery system[5]. As part of HEAL Phase 10, NSLIJ partnered with LIPIX (a RHIO on Long Island)[6], and a number of physician practices, to develop 'A Patient Centered Medical Home Model for High Risk Obstetrics Using Electronic Medical Records'. High-risk pregnancy cases are most often complex and require a high coordination of care between the different care providers.

Most of the applications that record antepartum history essentially capture the clinical information recommended by the American College of Obstetrics and Gynecology (ACOG)[7]. Allscripts EHR, hosted at NSLIJ's Antenatal clinics, captures the obstetric history, the patients' pre-existing conditions, and the patients' medications. Few group practices in Long Island use GE's Centricity to document the antenatal care provided by their obstetricians.[8] External clinics send antenatal information to the RHIO. A Health information exchange (HIE) technology with a backend Centralized Data Repository (CDR) is required to ensure aggregation, normalization, and de-duplication of information from multiple systems that recorded the patients' information during the prenatal visits. LIPIX deployed a HIE product, 'HealthShare', developed by Intersystems Inc. HealthShare is a service oriented based vendor product operating on web services and is mostly used for exchange of health information across organizations.[9] Outpatient group practices send antenatal information asynchronously to HealthShare either as a batch process operating during night or as real time when a visit was completed. Data is sent as a combination of HL7 messages for ADT information and Continuity of Care Document (CCD). It is highly important for sending applications to codify clinical diagnoses (i.e. the problem list) to ICD-9 before transmitting CCD to HealthShare.

The data stored in HealthShare at LIPIX is 'pushed' to the GE Centricity Perinatal system when the patient presents to the hospital for labor and delivery. The GE Centricity Perinatal system is a specialized EMR developed by the obstetricians at the labor unit. This application does not have traditional ACOG problem list and was designed to capture only the essence of antenatal and critical clinical information. Further the system was built on a set of documentation templates that can be filled in based on patient's response. The goal of the project was to automatically populate the relevant fields in the admission history and physical examination templates with data coming from LIPIX. Critical to the process of importing data elements from external systems is mapping of the inbound data elements to CPN's data elements. Several thousands of clinical data elements have to be mapped to CPN's data elements and the challenge was to map concepts of higher granular to low granular concepts in CPN.

Mapping process: The first step in the mapping process was to identify the different sets of diagnoses in CPN. Some of the categories included Liver diseases, Gastro-intestinal diseases, Neurological disorders, Thyroid disorders etc. The basic idea was to leverage the SNOMED ontology and to treat each of the diagnoses categories in CPN as 'parent' concept and determine its child concepts in SNOMED database. We leveraged the 'is-a' relationship and recursively queried the SNOMED tables for all child concepts for each of the categories. In some instances there would be multiple categories for a given disease. E.g. Diabetic neuropathy could be classified as both a Diabetes Mellitus and Neurological disorder. After the SNOMED codes for the child concepts for each of the parent categories were determined, we cross-walked each of SNOMED concepts to their best ICD9 concept. We leveraged the SNOMED-ICD crosswalk provided by a commercial vendor Intelligent Medical Objects. The translated codes were then loaded into the HealthShare application to handle the ICD encoded prenatal clinical information coming from outpatient Allscripts EMR and mapped to concepts in inpatient CPN system. The methodology that we used allowed us to rapidly create mapping tables in an automated fashion. Since we leveraged existing SNOMED ontology, we eliminated the need for extensive testing of the mappings in itself. The discrete nature of the data allows us to leverage the exchanged information for various purposes including analytics and clinical decision support.

Conclusion and Future Work: Recursive functions are very useful in a hierarchical ontology database to query the child concepts. Use of recursive queries and automation of cross matching ontology tables becomes very significant for a regional health information organization that serves several hospitals in a region. Because hospitals deploys several hundreds of applications that have a dynamic life cycle, RHIOs need to constantly update their mapping tables in order to receive clinical information from sending application and cross map to meet the requirements of the receiving application. Automation of this process is quicker as well as less proned to errors. Most of the times a clinician review of mapping tables is indicated since a single error in cross map may result in dangerous outcomes.

References:

[1] S. Kripalani, F. LeFevre, C. O. Phillips, M. V. Williams, P. Basaviah, and D. W. Baker, "Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care," *JAMA*, vol. 297, no. 8, pp. 831–841, Feb. 2007.

[4] T. Benson, *Principles of Health Interoperability HL7 and SNOMED (Health Informatics) [Hardcover]*. Springer, 2009.

[5] "Request for Grant Applications - HEAL NY Phase 10 - Improving Care Coordination and Management Through a Patient Centered Medical Home Model Supported by an Interoperable Health Information Infrastructure." [Online]. Available: http://www.health.ny.gov/funding/rfa/inactive/0903160302/. [Accessed: 30-Jul-2012].

[6] "LIPIX - Long Island Patient Information Exchange Home." Available: http://www.lipix.org/. [Accessed: 17-Jul-2012].

[7] "ACOG - American Congress of Obstetricians and Gynecologists." Available: http://www.acog.org/. [Accessed: 30-Jul-2012].

[8] "GE Healthcare HIMSS." [Online]. Available: http://www.gehealthcare.com/centricity/. [Accessed: 19-Jul-2012].

[9] "InterSystems HealthShare - Revolutionizing Healthcare Informatics." Available: http://www.intersystems.com/healthshare/index.html. [Accessed: 17-Jul-2012].