An Exploration of Demographic Inconsistencies in Healthcare Information Environments

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INTRODUCTION

Healthcare providers typically use technology in a ubiquitous manner. They choose to rely upon the task-specific capabilities of a specific system, rather than the integration of all systems in the solution space. A typical example of this would be the advancement of ultrasound technologies for 3-D modeling. Whilst the capabilities of the imaging solutions are highly beneficial to the individual's unique needs for healthcare, the integration of this system into a greater solution, or system-of-systems, is often overlooked (Maier, 1998; Maier, 2005). As such, the demographic data accompanying the information may be in a format inconsistent with the requirements for the electronic medical record. Workflow Management Systems attempt to simplify and control the primary data entry methods to the data environment (Choennia, Bakkera, & Baetsa, 2003; Graeber, 1997). However, the design of these systems focuses on an interpretation layer to gather data from varying input sources, including voice and text. There is no guarantee that this information will propagate throughout the system-of-systems, as required. Common information protocols such as Digital Imaging and Communications in Medicine (DICOM) (NEMA, 2004) and Health Level Seven (HL7.org, 2006) provide a framework by which medical data is communicated. However, these standard protocols are subject to interpretation that allows for a high degree of variance in the presentation of data. This creates problems of data redundancy, and confuses the authoritative provisioning of data with referential copies.

The electronic healthcare record (EHR) is a merged presentation of the information obtained through various systems in the healthcare enterprise (Hasselbring, Peterson, Smits, & Spanjers, 2000). Imaging and demographic data contribute to the contents. Additionally, the physician comments, markup, and modality reports also contribute to the record. These individual pieces of the EHR are drawn from many disparate systems throughout the enterprise. The record information system (RIS) or alternatively a health information system (HIS) will be the primary demographic repository for patient information. As such, this text and contextual information will be used as the primary data source for downstream comparison. The Picture Archive and Communication System (PACS) will be used as a repository for imaging data (Miltchenko, Pianykh, & D'Antonio, 2002).

As the global economy and global business practices increase, individuals tend to be more transient. Their medical histories are an important precursor to successful health care provisioning. Contingent upon this medical history record is the successful integration of data from varied sources, including the mobile patient's information. This information must be portable, presentable, and independent of the initial data program from which it was obtained. By far, the greatest concern relates to data inconsistency and subsequent inaccuracy in an environment of disparate systems.

In the next section of this article, we will discuss the Health Level Seven communication protocol. In the third section, we will discuss the protocol DICOM. The application of these protocols into solutions for healthcare information repositories is presented in the fourth section, where both PACS and RIS systems are discussed. The problem of Data Disparity that causes inconsistencies in the intersystem communications will be discussed in the fifth section. The design of the XML Bus solution will be presented in the sixth section. The successes and shortcomings of this design are discussed in the conclusion.

HEALTH LEVEL SEVEN

The HL7 protocol provides an information standard for communicating patients and sites level information into and out of a health information system within the system-of-systems model (HL7 Canada, 2002; HL7.org, 2006; Neotool, 2007). HL7 allows for a loosely framed communication standard between medical IT systems. Without the provisioning of this ANSI standard, interoperability between systems was performed in an ad hoc manner.

The HL7 standard is based on the concept of events referred to as triggers (HL7, 2006, 2007). Each of these triggers fires a process that effects some particular communication of information. For example, the relocation of a patient to a new hospital would require the dissemination of information concerning that location throughout the healthcare system-of-systems. This event would be one of such triggers. A trigger may relate to a single record, as in this example, or it may relate to multiple records. A patient may have a name change due to marriage. This would require an update to all existing records in the information system to ensure data consistency.

Each trigger is composed of segments. The segment is a variable length field separated by a discernable character, such as a comma or pipe. In a manner similar to comma separated values (CSV) files, data can be delineated and also referenced externally though API functions. The content of each segment shall contain ASCII characters. The HL7 committee defines the acceptable character set as "The ASCII displayable character set (hexadecimal values between 20 and 7E, inclusive) is the default character set unless modified in the MSH header segment" (HL7, 2006). The HL7 trigger is represented in Figure 1.

Each field may contain multiple subfields, delimited by a caret character. In the case of a name, |*DOE^JOHN^^^^*| the content between the two pipe symbols is the field of data, whereas the data *DOE* and *JOHN* are considered subfields. The MSH is the message header segment, providing basic instructions on the contents within the trigger message.

This example also makes reference to three other key items: the *PID* that is the patient identifier, the EVN identifying that an event is included in this message, and the PV1 filed, which is followed by information about the patient's stay at the hospital.

One of the important contents within this message is the event type. As per the example, the message type provided is A04. HL7 defines many different message types, each with unique content. There are 51 defined Admission, Discharge or Transfer (ADT) events for HL7 in the V2.5 standard. The following table describes some of these events.

Without elaborating further on some of the many messages available to the HL7, it becomes clear that many distinct attributes are communicated in this protocol. Static entities such as Patient ID, Accession number, and event dates are provided in the same framework as dynamic information, such as location. The messaging protocol is also intended to communicate changes in state, through the provisioning of state-in-time attributes that have an expectation of permanence (Evola, 1997). These attributes, such as Patient ID, may have referential integrity for a site perspective. However, in the conglomerate or regional model of healthcare, that identifier now becomes nonreferential from a global viewpoint, and as such, introduces disparity at a higher system-of-systems level.

Figure 1. Sample HL7 trigger (Interfaceware, 2006)

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MSH|^~\&|EPIC|EPICADT|SMS|SMSADT|199912271408|CHARRIS|ADT^A04|1817457|D|2.3|
EVN|A04|199912271408|||CHARRIS
PID||0493575^^^2^ID 1|454721||DOE^JOHN^^^^|DOE^JOHN^^^^|19480203|M||B|254
E238ST^^EUCLID^OH^44123^USA||(216)731-4359|||M|NON|400003403~1129086|999-|
NK1||CONROY^MARI^^^^|SPO||(216)731-4359||EC|||||||||||||||||||||||
PV1||O|168   ~219~C~PMA^^^^^^^^^^||||277^ALLEN FADZL^BONNIE^^^^||||||||||
||2688684|||||||||||||||||||||||199912271408|||||002376853
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