Request for Information Technical Response White Paper for Joint Operational Medicine Information Systems (JOMIS)

Challenge 3: Data Interoperability

Ensuring Continuity of Data

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1.0 Introduction

The JOMIS Program Office has designed an iterative and incremental build model to deliver the software capabilities needed to meet the Theater Medical Information Requirements (TMIR). Execution of this model requires successfully addressing several technical challenges. These challenges include movement of patient information in a communications constrained environment, legacy/new system data interoperability and improved data entry and capture. To facilitate discussion of potential technology solutions, each of these areas are investigated separately. This white paper is, therefore, one of three presented by Northrop Grumman and addresses the specific issue of data interoperability between legacy and emerging systems.

While we discuss each of the challenge areas separately, none of the potential solution approaches addressed in this paper would operate in isolation. Northrop Grumman advocates a total system integration approach in designing the solutions to these challenges. This is especially true when considering the need for data and system protection; both for patient privacy and system security. Measures for providing such security must operate across system components. Therefore, this paper also presents some security measure concepts that operate at the level of the technology solutions presented but satisfy system level needs. A total system approach is also critical in ensuring compliance to joint and service data and network design directives and guidance, such as the Joint Information Environment (DoD Directive 8000.1) and the Army Data Strategy (Version 1.0, Feb 2016).

2.0 Problem Statement

Theater medical systems of today are built on technology, system and software architecture approaches developed over 20 years ago. As these systems evolved, they became tightly integrated with each other as part of a closed system to move critical patient information from the battlefield back to brick and mortar hospitals without thought or need to integrate with new capabilities or systems. With the recent acquisition of Cerner Millennium and Henry Schein Dental through the MHS GENESIS program, the paradigm for what systems are deployed in the operational medicine space is set to change. These changes will include the need to operate both legacy theater applications alongside MHS GENESIS for a period of time. However, the data format used by Cerner is different than that used by the legacy systems. This will introduce new challenges for how to integrate and share data within the theater environment as well as between theater and garrison based medical applications. In order for patient information to continue to move with the patient from point of injury through care back home while new and legacy systems co-exist, methods to ensure data interoperability must be designed and developed.

3.0 Background and Discussion

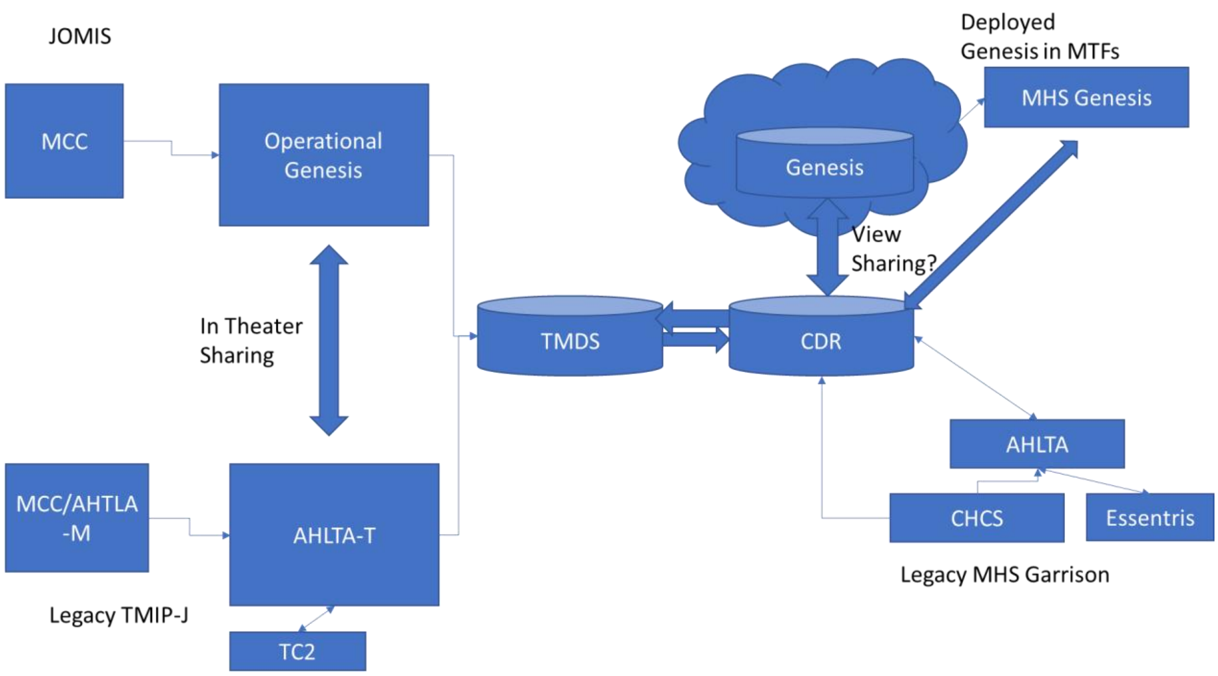
In today’s battlefield environment the movement of patient data from point of injury through the echelons of care back to full-fledge medical hospitals requires medical information to move with the patient. Without the movement and exchange of data between each hand off of the patient, critical information about the care, observations, medications and other injury related information could be delayed and ultimately impact the long-term condition of the patient and his or her survival.

Within the joint theater, patient digital data structures are defined by the legacy architecture and set of systems comprising the TMIP-J suite of applications. These systems consisting of AHLTA-M/MCC, TC2 and AHLTA-T provide the core electronic healthcare record used in the operational medicine space. They provide field medic and forward deployed medical care practitioners with the tools and workflows to provide preventive, routine, emergency, surgical, en-route care and diagnostic care. Embedded within their design is the concept of data movement between these applications to ensure that patient care administered in the battle space is transferred back to garrison and becomes part of the soldier’s longitudinal healthcare record.

Starting in February 2017, MHS GENESIS began its initial deployment in garrison operation as the medical record of the future for Military Health. MHS GENESIS will ultimately replace and retire the legacy electronic health record of AHLTA/CHCS in garrison operations and is planned to eventually replace the theater operational medicine applications of AHLTA-T and TC2. MHS GENESIS promises to provide new capabilities for the care of the active duty member including enabling clinical decision support and more interoperable and shareable healthcare records between the DoD, VA and external third party providers.

However, it is anticipated that deployment of MHS GENESIS will take a long time to fully replace all legacy applications in garrison and even longer to replace the operational medicine TMIP-J applications across each role of care. Additionally, the pace and process of introduction may be different for each service. In the operational medicine space, this will result in both MHS GENESIS capabilities and legacy TMIP-J applications being deployed simultaneously.

As the TMIP-J applications are all tightly bound and designed to work only with each other through custom interfaces, data exchange and interoperability for moving critical patient data while in the field will become a new operational challenge. MHS GENESIS and legacy systems will need to work together anywhere in the patient information flow throughout the echelons of care. Specifically, it is conceivable that in the operational space, Medics, troops and transportation of the patient across the forces will each be at different states of deployment of MHS GENESIS. This will result in mixed mode TMIP-J/GENESIS operations for several years. The figure below provides a representation of this mixed mode operations highlighting where data exchange across generations of applications occurs. Without the ability for a bi-directional exchange of information between Legacy and MHS GENESIS in the field, significant delays in moving the information with the patient are likely to occur.



Future State of Operational Medicine - Mixed Mode Deployment of MHS GENESIS and TMIP-J applications with a need to exchange information in the field directly between the two.

Exchange of information across the generations of applications is currently not possible. There are differences in data structure, data syntax and data semantics that all need to be addressed. Both TMIP-J applications and MHS GENESIS applications were designed to extract and transmit patient and medical information upstream and between applications through the use of standard data structures and formats using HL7. HL7, although a standard, does not provide guidelines on how messages and data structures should be implemented. As a result, both MHS-GENESIS and legacy TMIP-J have both implemented HL7 messages and data structures in their own way, designed to operate only with the applications they were designed to share information with and not designed to share information directly with each other. In other words, within their own contexts, the data structures and mapping of information to specific data elements inside these structures facilitates the movement of patient data and supports the Operational Medicine paradigm of transmitting care information between applications and devices. However, because HL7 messages are unique in how they are implemented, direct ingestion and exchange of TMIP-J data in MHS GENESIS and vice versa is currently not accommodated.

The syntactic issues with data exchange arise since both TMIP –J applications and MHS GENESIS contain data elements that are unique and required for the clinical workflows they support. Operational medicine for military enterprise contain unique data elements, fields and data values not typically found in commercial applications such as MHS GENESIS. In addition, commercial applications may capture more information related to commercial medicine, which may not be applicable in operational medicine. Both contain their own terminologies, data dictionaries and data sets presenting an obstacle to data interoperability and exchange.

The meaning of the data exchanged, its semantics, must also be addressed. Historically, MHS applications such as TC2 and AHLTA-T have used a mix of data vocabulary standards such as LOINC, SNOMED-CT, CPT codes along with custom vocabulary sets specific to military medicine. All the coded values represent different values for how information is stored, but present a semantic challenge in how information is shared. As an example, just because two systems use the same code sets of LOINC does not mean that they use all the values within the code set equally or uniformly, creating gaps in how data is interpreted between systems when information is exchanged.

4.0 Approaches and Solutions

The most direct and efficient method to enable full data interoperability between legacy TMIP-J and MHS GENESIS applications is to introduce a transitional software architecture to be deployed at the device level. This transitional framework would provide an alternative data flow to the current TMIP applications to TMDS, and serve as a separate message broker and handler capable of performing HL7 message structural transformation and data translation between legacy and new. The architecture would be designed to be light-weight and deployable on small form factors such as mobile and handheld, and be remotely updatable when connected to the network.

Central to the approach and thinking is to take advantage of concepts of loosely coupled architectures and creating a framework that is not reliant on point-to-point interfaces by directly integrating legacy TMIP-J and garrison applications. This framework would enable both legacy applications to continue in their current and support state, without changing their architecture or message types, and remove the reliance and need for MHS GENESIS to be modified to ingest TMIP generated data in its native form. This middle tier architecture could be centrally managed, updated, and controlled and be used to mitigate effects of changes that may occur in either legacy systems or MHS GENESIS in terms of the data produced and exported for exchange. Most importantly, the architecture would facilitate the bi-directional exchange of information in the field, allowing for the mixed-mode, hybrid deployed environment to share and exchange patient data ensuring the continued flow of information from point of injury through each echelon of care.

Data Structural and Syntax Transformation
To address differences in data structure, well defined maps can be developed and deployed in the transitional architecture. These maps would take the current message structures produced by the legacy theater applications and MHS GENESIS and map each individualized format to an agreed upon set of HL7 formats. The HL7 formats would be based on current approved standards, and the maps produced would take each data element from every message produced by legacy TMIP and MHS GENESIS, and align the same data elements from each system to a specific place and context within each message structure map required for the exchange of data. These maps would be stored as executable transformation scripts within the transformational architecture and would enable data presented from TMIP to be transformed into structures that MHS GENESIS natively ingests and vice versa.

This mapping process would also identify and bring forward those data elements that do not map directly between the systems and enable discussions for how to handle, map and store critical values required by one system or the other to be brought forward. This is a critical problem that will need more study and analysis to develop mitigation strategies, such as default values and generation of values from other data.

Semantic Translation
Beyond the structure and mapping of data elements between the systems, the allowable and interpretable values stored in the data elements also need to be addressed and mapped. As previously noted, TMIP-J applications were designed to work with each other and not necessarily exchange data with other applications such as MHS GENESIS. MHS GENESIS was designed as a commercial application without context or need to exchange data with TMIP. Therefore the values each system uses and the use of coding systems such as LOINC, Snomed-CT and CPT are deployed differently between the applications, requiring the transactional framework to perform translation of values as part of the exchange process. These semantic issues can be addressed through the development of data values maps that would become translation tables used in the transitional framework architecture. These maps would take all exchanged data elements from each system and map them to a set of standard values such as Snomed-CT in a uniform manner that will enable the translation of values between MHS GENESIS and TMIP bi-directionally.

Data Governance
While both structural and semantic maps enable the exchange, there is a need for effective data governance to ensure continued interoperability. Specifically, through the establishment of data governance, changes made to legacy TMIP, MHS GENESIS and related data maps can be captured in a scheduled and coordinated fashion.

Network Security
Cyber attackers are well aware that the quickest path into their target's network is through the least secure area. Traditionally, within healthcare, this rests with medical devices (of all types). Northrop Grumman is keenly aware of this vulnerable attack surface and offers a secure solution. Tempered Networks' provides a comprehensive security platform addressing the requirement to secure medical devices by enabling easy and rapid provision private overlay networks, with military-grade security. Their overlay networks address security and hardening similar to 'air gap' networks to keep out bad actors, yet offer easy secure remote access for trusted devices and people. Northrop Grumman will propose using Tempered Networks HIPswitch appliances—each with a baked-in Tempered Networks' signed certificate—so DoD can create a configurable number of trusted private overlay networks. Each overlay network has a defined whitelist identifying trusted HIPswitches and peers (e.g. smart devices, sensors, IT servers, etc.) that are allowed to

be a part of this private network. All communication between sensors and receivers in the Tempered overlay networks is encrypted using AES 256-bit encryption. This entire process cloaks the network so cyber attackers would not even be able to detect it in order to attempt hacking into the network. This strategy, encased around our secure field medical device, offers solid risk-based assurance of protected health data while in theater and allows for secure transmission of data during patient transportation to any hospital. This approach builds a “cloaked” network around legacy systems. Implementation of this network at the same time as implementation of the translation discussed above can offer a cost effective system approach.

5.0 Summary

Data interoperability between legacy TMIP-J and MHS GENESIS applications can be readily accomplished. The key will be the implementation of software architecture that allows for efficient exchange between any two devices in theater and in making the mappings light weight enough that they do not degrade the operation of any of the devices. The concepts presented represent a light weight transitional architecture that can be deployed down to the lowest echelon of care to handle the data interoperability challenge created by mixed mode deployment. We have also identified that such an architecture operate in conjunction with the system level security measures needed to ensure patient privacy and system integrity.

Northrop Grumman encourages a dialogue on the approaches discussed above and the incorporation of them in an engineered approach for a total system solution. Our past successes as systems integrators provides us the experience to identify the optimal technologies to address the issues and combine them into an effective system solution. We look forward to the opportunity to further discuss development of solutions to the issues facing the JOMIS PMO.