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14. ABSTRACT

The Department of Defense/Tricare system faces significant challenges in protecting the health of nine million service members, their families, and retirees. At the same time these entities must control costs and monitor, measure, and improve the quality of care provided to its members.

Clinical Looking Glass (CLG) provides actionable health care metrics on longitudinal patterns of care generated from a data repository of clinical and administrative information. Implementation of CLG on a "proof-of-concept" data set from the Military Health Service will allow demonstration of its effectiveness as part of the DoD's arsenal of quality of care analysis tools.

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Introduction

Clinical Looking Glass (CLG) is a medical surveillance and quality improvement software system that provides actionable health care metrics on longitudinal patterns of care generated from a data repository of clinical and administrative information. It is in production use at Montefiore Medical Center (MMC) in New York City. CLG fosters a cultural environment that rewards initiative while still protecting patient privacy and standardization of analysis.

This project creates a proof-of-concept implementation of Clinical Looking Glass housed in a secure military data center and mapped to Military Health Service (MHS) Protected Health Information (PHI) data. This proof of concept will be evaluated by clinical users at Walter Reed National Military Medical Center and National Naval Medical Center Bethesda. In support of this objective, the project includes development of training materials and formal end user training. Also included are environmental and application security reviews and mitigation of critical security risks, and support of the development of additional application features that will benefit the MHS user community.

Body

Overview

Personnel

The project team experienced some personnel churn during the reporting period. Effort was redistributed among remaining team members after departures, and new team members were brought on board as efficiently as possible. All persons with need to access the proof-of-concept implementation housed at SPAWAR have been cleared for a position of public trust, including new team members.

Data and Data Use

Three years of PHI data, ending in May 2012, have been loaded to the CLG proof-of-concept data mart. The team has evaluated the data and is developing clinical scenarios meaningful to MHS providers for training and demonstration purposes.

A local EHIT environment is maintained for testing and is populated with test data mapped to the MHS data model used in the proof-of-concept.

Air Force Population Health has determined that the data it has supplied for this project is covered under its existing data use agreement.

Dr. Burke at WRNMMC is working with the Walter Reed Institutional Review Board (IRB) in collaboration with the Principle Investigator to develop policies similar to those in effect at Montefiore Medical Center governing the use of Beneficiary Encrypted File (BEF) and PHI data extracted using CLG for research, quality improvement, training, and direct patient care at Walter Reed.

Security

The CLG team has reviewed the security scan report provided by SPAWAR and developed requirements for necessary application changes. These changes will be scheduled for implementation over the next two to three months and released in CLG version 4.3.See objectives 1, 2, and 5.

Training

The Clinical Looking Glass end user training materials have been completely revised to include new functionality developed during the course of the award and to remove functionality sundowned with the release of CLG 4.1. The CLG training team is currently creating customized end user documentation for the MHS CLG proof-of-concept, using MHS-relevant clinical examples based on data available in the proof-of-concept data mart.

Objective 1: Data Encryption

The CLG environment and application were scanned by the SPAWAR security team and high priority items identified for remediation. Environmental settings were changed in compliance with high priority environmental items and the and application tested. Exceptions will be requested and are expected to be granted for high priority environmental items that are incompatible with CLG. High level requirements for implementation of FIPS 140-2 standard for data, key generation and management, and logging were developed, analyzed, and estimated. The development work necessary to support these requirements will be scheduled in the first quarter of 2013.

Objective Completion: 40%

Objective 2: Process Improvement

Threat modeling and security planning have been incorporated into the CLG quality assurance lifecycle. A test suite has been incorporated into the required regression test plan to exercise known risks including browser hacks, PHI exposure, and application account security. Requirements to close security gaps have been defined and the highest priority items related to PHI exposure have been implemented.

Objective Completion: 60%

Objective 3: Data Analysis and Upload for Review

The CLG data mart housed in the Air Force enclave at the SPAWAR data center was populated with MHS encrypted data and mapped to the application.

Objective Completion: 100%

Objective 4: DIACAP Process Management

Since development of the original scope for this award, it has been determined that the CLG proof-of-concept is not subject to DIACAP because it is housed inside the Air Force secure enclave. If CLG is adopted as an operational product by the MHS DIACAP may need to be performed at that time.

Objective Completion: N/A

Objective 5: Usability and Security Enhancements

Requirements gathering for more granular user entitlements and restrictions is dependent upon user acceptance testing and experimental usage of CLG as currently configured; MHS users must understand CLG usage in order to specify these changes. Due to the data-loading schedule, training of the first classes of CLG proof-of-concept users has not yet occurred. This training is anticipated to be scheduled during the first quarter of 2013.

Objective Completion: 0%

Objective 6: Component Modernization

R-Evolution has been fully integrated into CLG.

Objective Completion: 100%

Feature Development

Study Designer

Study Designer allows users to create studies that include Time to Outcome, List, and Time in Range methods and use both internally specified cohorts and uploaded cohorts. Development work to further enhance Study Designer functionality occurred during this reporting period. Study Designer was included in the CLG 4.1 update to the MHS CLG proof-of-concept and will be included in training of MHS users.

Scalability Research

Performance and scalability requirements were defined and prioritized based on clinical scenarios. The CLG team then performed technical decomposition to identify areas for research, upgrade, and modification.

The highest priority performance requirement is the ability to append many outcomes to two or more large patient lists. The target parameters were two groups of 100K patients each with fifty outcomes. CLG 4.1, currently in production at Montefiore and the DoD proof-of-concept, supports groups of this size, but can reliably provide results one outcome. To accomplish the successful run of up to fifty outcomes, changes have to be made to the mart database, the processing engine, and the user interface. Some of these changes also address other performance goals, such as better support of multiple concurrent users.

Performance and Scalability Work

This section provides details of the performance improvement and scalability work identified. Completed items were done by or before the sprint ending on October 31, 2012. All effort in the following sprint is related to hardening the application for release. No new development is included. Items that were not completed before October 31 are to be scheduled within the next six months.

24916 List Complexity (high-level requirement, parent to all the rest)
Run a list method with fifty outcomes on two patient groups of 100K each.

25506 Execute multiple analysis definitions in parallel
Take advantage of parallel processing infrastructure implemented in other work items to process all outcomes at once instead of sequentially.

25507 Save study configuration with multiple analysis definitions (complete)
When the user configures a list method with up to fifty outcomes, the system must save that configuration. This work item parallelizes and improves the efficiency of some back-end tasks so that studies with many outcomes properly save.

25819 Collapsed/Expanded state of ADs in List Configurator (complete)
User interface enhancements to improve the management of many outcomes.

25523 Measure performance with Oracle 11g (complete)
Compare performance of key application queries on the Oracle 11g platform to the performance on these same queries on SQL Server 2012. Recommend database solution.

25526 Modify post processing engine queries
Redesign the queries to find multiple instances of patient events (e.g., all lab tests or admissions during a given period) and that store the cohort data to take better advantage of SQL Server 2012 features and therefore improve processing performance.

25533 Move cohort data to module build results table
Addresses technical debt incurred during development of event collection capabilities. Unifies the storage of cohort and event collection data and includes regular cleanup of aged objects. Improves performance of multiple users building cohorts concurrently.

25534 Implement WCF Broker in an HPC cluster
Like load balancing, the WCF Broker assigns tasks across multiple nodes for parallel processing. This improves performance of list method with multiple outcomes.

25536 Break workflow into small activities to improve cancellation response time
When the user cancels running a study, the system has to wait until the current task completes to terminate the run. Breaking the workflow into more smaller tasks will create more possible break points where cancellation can take effect, returning resources to the available pool faster.

25537 Redesign data service for List/wide view (complete)
Create multiple session transformers to support parallel processing in data services. Combine the results when all are complete. Because the shape of the resulting data is different for wide view vs long view, this work item only addresses wide view (the default).

25539 Migrate TTO to New data services workflow
Refactor TTO patient list results to take advantage of the refactored data services workflow. Until this is done, the system must support both the old and the new versions of data services.

25540 Migrate TIR to new data services workflow
Refactor TIR patient list results to take advantage of the refactored data services workflow. Until this is done, the system must support both the old and the new versions of data services.

25542 Evaluate Silverlight 5 upgrade (complete)
Silverlight 5 will better support the configuration of up to fifty outcomes in the user interface. This work item included full regression testing with Silverlight 5.

25543 Remove validation of analysis definitions from study designer management pane loading
When the user accesses Study Designer, the application validates all analysis definitions to determine their fitness for use with the various method types. Depending on how many analysis definitions the user has, this validation can take several seconds. It is not necessary until the user is ready to use an analysis definition in a method (which, in fact, the user may never do). This work item will move the validation to a more appropriate point in the workflow.

25558 Install and measure performance of SQL Server 2012 (complete)
Once SQL Server was identified as the optimal next-step database platform, it was installed and fully regression tested.

26387 Export large data sets (upgrade ASPose)
ASPose is COTS component that requires upgrade in order to support export to CSV or spreadsheet of groups of more than 300K patients with more than twenty outcomes. CLG's output generator requires some modification to work with the upgraded ASPose. This upgrade will also allow upgrade of data services and the output generator to 64bit – these components are currently 32bit only because the earlier version of ASPose requires it.

25541 Redesign data services for pivot
Refactor Pivot to take advantage of the refactored data services workflow. Until this is done, the system must support both the old and the new versions of data services.

25538 Redesign data services for List long view
Refactor long view to take advantage of the refactored data services workflow. Until this is done, the system must support both the old and the new versions of data services.

25525 Manage study results (Grid with sample)
To reduce results processing time, instead of displaying all list results on screen, display a sample. Make all possible export formats immediately available so that the user need not wait for additional processing after seeing the sample set.

Key Research Accomplishments

- Completion of load of PHI data on SPAWAR servers
- Study Designer release for use by all users
- Position of public trust authorization received for all team members accessing MHS CLG proof-of-concept

Reportable Outcomes

- Received additional JPC funding to support further effort through 2012.
- Applied for no-funds extension to continue project through 2013.

Conclusion

At the close of this year we are on the verge of training our first MHS users at WRNMMC. To reach this goal over the course of this year we have relied upon our relationship with Air Force Population Health and the SPAWAR data center to support CLG and provide MHS data to its data mart. During the reporting period the CLG servers were moved out of the Washington Navy Yard data center along with the rest of the Air Force enclave. This move was not significantly disruptive to our progress. Population Health's commitment to the project was exemplified by the subsequent load of expanded PHI data to the CLG data mart.

The team underwent some churn during the reporting period. Several software engineers departed and were replaced. The Senior Clinical Analyst, responsible for training and end user mentoring, departed and a replacement identified. Several months of development were allocated to performance and scalability improvements. Release 4.1 of CLG was rolled out to the Montefiore community and subsequently installed on the proof-of-concept and fully tested there.

The CLG PHI proof-of-concept is poised to be revealed to MHS users. The CLG team eagerly awaits the opportunity to train members of this community in the use of this powerful tool.

References

None Cited.

Appendix

List of CLG team members whose salaries were wholly or partially funded by this contract. Percentages of salary vary due to shifting participation and effort as personnel left and joined the team.

CSI	
Chowdhury, Soma	0-40%
Edwards, Richie	25-30%
Geberer, Noah	60-70%
Golden, Joe	15-30%
Lee, William	0-15%
McCroskey, Mia	29-50%
Muresan, Mircea	0-30%
Patel, Saurabh	10-30%

Paul, Lisha	15-30%
Powers, Ken	20-60%
Srivastava, Navneet	20-30%
Swamy, Harish	10-20%
Zappulla, Ron	45-50%
Luis Lira	100%
Weissman, Judith	0-80%
Ding, Jinlin	20%
Mukerji, Himadri	10-100%
James Lee	30-40%
JPC	
Castro, Moises	0-100%
Abramov, Margarita	100%
Yousef, Jason	100%