VistA 4 Product Roadmap

Department of Veterans Affairs

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Executive Summary

The VistA 4 Product Roadmap outlines how the Department of Veterans Affairs (VA), under the direction of the VistA Evolution Program, will build upon the previous success and institutional knowledge investment in Veterans Health Information Systems and Technology Architecture (VistA) Electronic Health Record (EHR). The evolution of VA's existing EHR product will be known as VistA 4. The updated VA EHR system will be interoperable with the EHR systems of the Department of Defense (DoD) and other healthcare partners to enhance patient-centered, team- and evidence-based care by giving healthcare providers a complete picture of a patient's care and treatment history.

The VistA 4 Product Roadmap includes the migration to a robust, efficient and scalable technology platform and outlines a stream of enhancements that facilitate Care Coordination as a New Models of Care and continuous quality improvement. This model consists of team-based, patient-centric care inclusive of the Veteran and their patient-driven goals. The product roadmap incorporates significant functional enhancements and improved integration to clinical ancillary systems (laboratory, pharmacy and radiology) and the adoption of clinical coding standards that will improve interoperability among care settings and support evidence based clinical decision support (CDS). This roadmap will also lay the groundwork for improved Medical Device Integration (MDI) as these industry standards mature.

VistA 4 enhancements will be built upon an efficient and agile SOA framework for ease of development and deployment. The program will also continue to ensure an interoperable, secure and reliable technical infrastructure while adopting enhancements outlined by the VA Enterprise Infrastructure design inclusive of regional Data Centers and a fault-tolerant NextGen Wide Area Network (WAN).

Per the National Defense Authorization Act (NDAA) Section 713(g), by December 31, 2016, the VistA Evolution Program will deliver an interoperable Generation 3 EHR, which is a system that has the technical capability to bring evidence-based medicine to the point of care and provide functionality for multiple care venues. VistA 4 will empower VA healthcare stakeholders to maintain their track record as the benchmark of excellence, value and quality in healthcare delivery to Veterans, Service members, and their dependents.

1. Introduction

VistA Evolution is a joint program of the VA Office of Information Technology (OIT) and the Veterans Health Administration (VHA) and will provide interoperability with EHR systems of the DoD and other healthcare partners to promote improved outcomes in quality, safety, efficiency, and satisfaction in healthcare for Veterans, Service members, and their dependents. Interoperable EHR systems will ensure that authorized beneficiary and medical data are accessible, usable, shared, and secure to meet the needs of VA patients, healthcare providers, and other stakeholders.

VistA Evolution will modernize the VA EHR and ancillary health information technology (IT) systems to facilitate their use by clinicians inside and outside VA. The modernized VA system will be interoperable with the EHR systems of the DoD and other healthcare partners to enhance patient-centered, team- and evidence-based care by giving healthcare providers a complete picture of a patient's care and treatment history.

1.1 Background

In 2009, President Barack Obama charged the Departments of Veterans Affairs and Defense to establish a method by which active and retired Service members and Veterans could easily access their health records. Specifically, the Departments were called upon to "work together to define and build a seamless system of integration so that when a member of the Armed Forces separates from the military, he or she will no longer have to walk paperwork from a DoD duty station to a local VA health center. Their electronic records will transition along with them and remain with them forever."

The VA and DoD are working together to fundamentally and positively impact the health outcomes of active duty military, Veterans and beneficiaries, pursuing two distinct goals -- create seamless integration of VA, DoD, and private provider health data and modernize the software supporting DoD and VA clinicians. The Departments are on complementary paths for modernizing their respective clinical care software and remain fully committed to the use of open standards and open architecture to ensure seamless interoperability and information sharing across the two systems. Both VA and DoD will update their respective healthcare management systems, replacing or enhancing existing legacy systems to give clinicians and patients the best healthcare software support, including state-of-the-art clinical decision support and analytics, to provide service members, other beneficiaries and veterans the best healthcare possible.

DoD established the DoD Healthcare Management System Modernization (DHMSM) Program to focus on delivering modernized, openly-architected clinical EHR capabilities with a goal of fielding no later than 2017. DoD will use a competitive acquisition process to consider alternatives that will likely include VistA based variants. As part of DoD's acquisition process, the Department will require offerors to demonstrate how their solution leverages open standards endorsed by the Office of the National Coordinator (ONC) and adheres to key open architecture tenets such as open transport formats (e.g., HL7 messaging), open interface specifications, and design patterns that enable an open and scalable solution.

VA established the VistA Evolution Program to focus on delivering an evolved VistA that is open architected and non-proprietary in design. VistA 4 will be delivered in FY18, with the exception of the Laboratory Information System (LIS). Planned incremental deployment of the LIS will begin in FY16 at two VA medical facilities. Following successful deployment at

these initial facilities, further deployments will take place at 50 VA medical facilities per year, starting in FY17. By the end of FY19, the LIS will be deployed at all 152 VA medical facilities.

The VistA 4 Product Roadmap leverages open standards endorsed by the Office of the National Coordinator and adheres to key open architecture tenets such as open transport formats (e.g., HL7 messaging), open interface specifications, and design patterns that enable an open and scalable solution. It is VA's intent that the evolved VistA will be in a position to effectively compete in DoD's acquisition process.

The DoD/VA Interagency Program Office (IPO) Charter signed December 5, 2012 establishes the office to serve as the single point of accountability for leading the implementation of national health data standards for interoperability. The IPO will be responsible for establishing, monitoring, and approving the clinical and technical standards profile and processes to ensure seamless integration of health data between the two departments and private healthcare providers.

This VistA Evolution Program Plan specifically focuses on the system enhancements required to evolve VistA to meet VA's Product Set 1's clinical capability goals in 2014, meet VA/DoD incremental interoperability goals in 2014 as established by the IPO and begin the work necessary to achieve Product Set 2's clinical capability goals. The Program Plan covers delivery of new VistA functionality and changes to VistA data and interfaces that are required to enable seamless integration of health record data with the DoD, thereby achieving the President's goal: "when a member of the Armed Forces separates from the military, he or she will no longer have to walk paperwork from a DoD duty station to a local VA health center, their electronic records will transition along with them."

1.2 VistA 4 Product

VistA 4 will promote the delivery of an interoperable, effective, safe, and efficient healthcare that improves the lives of Veterans, Service members, and their dependents. VistA 4 will support VA's vision to continue to be the benchmark of excellence and value in healthcare and benefits by providing exemplary services that are patient-centered and evidence-based. Notably, VistA 4 targets care coordination, a model of healthcare delivery in which teams of clinicians and patients collaboratively improve the health of the Veteran, according to clear patient-driven goals. Care coordination also promotes quality improvement in healthcare processes for all patients. VistA 4 will increase the satisfaction of VistA users, reduce the risks, time, and cost associated with acquiring new EHR functionality, and ensure compliance with regulatory and statutory requirements.

Clinical Information Systems Adoption Best Practices and Lessons Learned

The clinical perspective is critical to ensure an overall successful workflow design, and is vital to the overall success of any new clinical system. Clinicians need to be involved from day one. It is helpful to have clinical informaticists on the product management team to represent the provider perspective.

VistA 4 will rely upon infrastructure, data models, and services that support an open, modular, and extensible EHR platform that allows VA to provide high-quality solutions at increased speed and decreased cost. The resulting system will be flexible and agile, accommodating new technology advances and achieving optimal results more efficiently. Upon implementation and integration of VistA 4, VA will be well positioned to interoperate with DoD, and other healthcare partners, using modern, flexible technologies and standards.

This ensures the ability to improve the health status of Veterans, Service members, and their dependents through the delivery of a longitudinal integrated health record that supports the continuum of care.

The product vision for VistA 4 includes:

- An EHR interoperable with that of the DoD and other healthcare partners;
- A modernized EHR to enhance patient-centered, team- and evidence-based care by giving healthcare providers a complete picture of a patient's care and treatment history;
- A user experience that integrates information for improved quality of clinician and patient reasoning;
- Sharable CDS to promote best clinical practices tailored to the patient's clinical condition and health-related goals;
- Capabilities for clinicians, managers, and researchers to define and manage patient populations;
- Management of activities that improve human and material resource utilization and clarify plans of care for all members of the team including the patient;
- Explicit incorporation of patient goals in the care plan, to support patient-defined terms of success, and;
- Enterprise-wide deployment.

This pathway supports the triple goals of improving the experience of care, improving the health of populations, and reducing per capita costs of healthcare.

1.3 Purpose

The VistA 4 Product Roadmap provides an overview of the functional capabilities that will be delivered in the following four major milestones for the VistA Evolution Program:

1. **Product Set 1 by September 30, 2014**
   (Short-term priorities and enhancements)

2. **Product Set 2 by September 30, 2015**
   (ONC 2014 Edition EHR Certification)

3. **Product Set 3 by December 31, 2016**
   (Interoperability of EHR, per FY 2014 NDAA, Section 713)

4. **Product Set 4 by September 30, 2018**
   (Longer-term care coordination and interoperability objectives)

    a. The enterprise-wide deployment of the Laboratory Information System (LIS) will be completed by September 30, 2019.

A schedule of the detailed deliverables will be discussed in the corresponding sections.

The VistA 4 Product Roadmap is a supplement to the VistA Evolution Program Plan. These two documents should be considered linked therefore; adjustments to one document will require modifications to the other to ensure they remain synchronized.

1.4 Scope

This document includes the background and vision for VistA 4, along with the functional capabilities and the proposed technical architecture to be delivered as specified in Product Set 1 and Product Set 4. Also outlined are desired outcomes per fiscal year (FY), clinical benefits, provider adoption approach, and performance metrics.

The architectural diagrams shown in this document represent a potential future state. Until the final design is completed to include meeting the critical performance requirements at each and every Veterans Affairs medical facility, the diagrams are illustrative in nature and do not necessarily reflect the final design.

1.5 Authorities

Any information pertaining to the structure, authority, or governance of the VistA Evolution Program exists in the VistA Evolution Program Plan.

1.6 Assumptions

Assumptions guiding the VistA 4 Product Roadmap are listed below.

- The IPO, Interagency Clinical Informatics Board (ICIB), and Healthcare Architecture Review Board (HARB), are the authoritative sources for all guidance related to interoperability.
- Actions are being taken to resolve the following items from the DoD/VA Gap Analysis Summary Report:
    - Ensure that the gaps identified by the DoD/VA Gap Analysis are addressed;
    - Ensure interfaces to data sources are standards-based;
    - Work toward “horizontal consistency” – use of the same small set of standards across all exchanges;
    - Work more closely with VA and DoD to create standards-compliant adapters to data sources and provision for 2014 Edition EHR certification.
- The data standards for interoperability are defined in Joint Executive Committee Joint Strategic Plan FY 2013–2015 and Appendix A from the 2013 DoD/VA Target Health Standards Profile (HSP).
- Products must support and comply with the OneVA Enterprise Architecture (EA).
- The DoD and VA will continue efforts to share information about the Veteran, find common representations of Veteran information that can be understood, and make this information available on demand (under appropriate security controls).
- Both Departments will store information about the Veteran, making it readily available to the other Department.

- Sufficient funding is available and properly phased in the out-years.
- VistA 4 will be based upon VA SOA Design principles that are baselined and approved prior to June 2014.
- The following terms are defined as:
    - Interoperability: The Institute for Electrical and Electronic Engineering (IEEE) Standard Computer Dictionary definition for Interoperability has been adopted by the ONC and reads as follows:

      The ability of two or more systems or components to exchange information and to use the information that has been exchanged.
    - Generation 3: The term ‘‘generation 3’’ means, with respect to an electronic health system, a system that has the technical capability to bring evidence-based medicine to the point of care and provide functionality for multiple care venues.
    - Interoperable: The term ‘‘interoperable’’ refers to the ability of different electronic health records systems or software to meaningfully exchange information in real time and provide useful results to one or more systems.
    - Integrated: The term ‘‘integrated’’ refers to the combination of health data from the DoD, VA, and outside providers to provide clinicians with a comprehensive medical record that allows data from disparate systems to be shared or accessed across functional or system boundaries, in order to make the most informed decisions when treating patients.

2. Generation 3 EHR

VA uses VistA as its EHR System. The VistA Evolution Program will execute implementation of best practice technology to support team-based care coordination, clinical decision making, medical device integration, and ancillary service integration. These improvements to VistA are planned and managed under the VistA Evolution Program. While focusing on interoperability, this program includes advancing the VistA technical platform to more easily integrate functionality to improve quality, safety, efficiency, and satisfaction in healthcare for Veterans, Service members, and their dependents.

The VistA Evolution Program will incrementally deliver a Generation 3 EHR through FY 2018. A Generation 3 EHR is defined as a system that has the technical capability to bring evidence-based medicine to the point of care and provide functionality for multiple care venues. These systems include episodic and encounter data and use decision support tools to assist clinicians, functional in, at a minimum both ambulatory and inpatient settings.

VistA 4 will provide interoperability, enhanced clinical functionality, and a more flexible technical architecture, while meeting current 2014 Edition ONC EHR certification standards and the Centers for Medicare & Medicaid Services (CMS) Meaningful Use (MU) requirements. These technical enhancements will ultimately benefit the Veteran by allowing the VistA 4 environment to continually change, adapt, and be more responsive to changes in practice, provider and patient needs, system priorities, and advances in technology.

Upon completion in FY 2018, VistA 4 will provide the tools necessary for the VA to maintain its track record as a benchmark of excellence and value in healthcare delivery. Consistent with VHA and federal healthcare goals, VistA 4 will leverage best practice technology to support delivery of services that are both patient-centric and evidence-based, including: CDS, enhanced ancillary services (laboratory, immunizations, and pharmacy), while laying the groundwork for adoption of technologies such as Medical Device Integration (MDI) once industry standards have matured.

As VA becomes compliant to the ONC 2014 Edition EHR certification criteria, VistA 4 will be a Generation 3 EHR.

2.1 Compliance Criteria

One of the goals of the VistA Evolution Program is to build a state-of-the art EHR that meets or exceeds industry benchmark standards and is compliant with industry EHR certification criteria. To meet this objective, VistA 4 will be compliant with the latest ONC EHR certification criteria (i.e., 2014 Edition) and the VA will demonstrate MU of this technology.

2.1.1 EHR Certification

The Office of Management and Budget (OMB) issued a memorandum on September 17, 2010 requiring that selected federal agencies, including the VA, achieve five Health Information Technology (HIT) Principle Processes by the end of FY 2012.

Included in these HIT Principle Processes is the requirement to become Meaningful Users of Certified EHR Technology (CEHRT). It further specified that federal entities with HIT investments and activities become Meaningful Users by meeting the defined MU criteria, or

demonstrating the process to meet those criteria in their systems regardless of eligibility for HIT incentive payments.

The ONC for HIT Technology establishes the certification criteria EHRs must meet to be certified. ONC periodically releases editions of the EHR certification criteria and VA is currently seeking certification of the 2014 Edition criteria in both ambulatory and inpatient settings. Criteria for demonstrating MU of CEHRT are established by the CMS. MU demonstration is a staged approach, where two years of MU demonstration occur in each stage before moving to the next stage, where requirements become more difficult to achieve. The current MU demonstration criteria are at Stage 2.

For more details on how VA will achieve ONC 2014 Edition EHR certification please refer to the **Meaningful Use** section.

3. Interoperability

Veterans, Service members, and their dependents frequently seek medical treatment from DoD, VA, or private sector healthcare providers. In addition, active Service members may transition to the VA healthcare system. In order to provide the most timely, efficient, safe and effective care in any of these care settings, it is imperative that healthcare providers have timely access to all relevant patient records from previous episodes of care regardless of the institution providing this care.

As directed in the FY 2014 NDAA, Section 713, VA must ensure that its EHR systems are interoperable with DoD EHR systems, providing integrated display of data, and complying with national standards and architectural requirements identified by the IPO, in collaboration with the ONC of the Department of Health and Human Services (HHS). VA must achieve interoperability with DoD EHR systems by no later than December 31, 2016.

The VistA 4 Product Roadmap defines VA's approach to the development and deployment of an interoperable EHR that exchanges computable health information with DoD and the external healthcare community, and modernizes its electronic health record software to fully leverage this health information in support of the care delivery model of the VHA.

In February 2013, the Secretaries of VA and DoD announced that the focus of the iEHR (integrated Electronic Health Record) effort in the near term would shift from integration of VA's and DoD's EHR systems to interoperability of these systems:

> *"Rather than building a single integrated system from scratch, we will focus our immediate efforts on integrating VA and DoD health data as quickly as possible, by focusing on interoperability and using existing solutions."*
>
> *VA Secretary Eric Shinseki and DoD Secretary Leon Panetta, 5 Feb 2013*

Section 713 of the NDAA for FY 2014 requires VA to provide detailed programs plan for the oversight and execution of the interoperable electronic health records with an integrated display of data, or a single electronic health record.

3.1 Benefits

The main benefits of VA's approach to interoperability are as follows:

- Sharing of information among multiple providers, independent of location. This will reduce the time spent by a clinician on collecting and correlating patient information;
- Enabling more accurate clinical decision support, including medication safety checks, by taking into account more information on the patient's clinical condition and treatments;
- Creating a user experience that integrates information for improved quality and effective clinical decision making. This will provide clinicians with an easier-to-read, consolidated patient record;
- Providing the capability for clinicians and researchers to deliver evidence-based care, by enabling the definition and management of patient populations across the entire VA. A patient population is a cohort formed by applying specific criteria (e.g., age,

weight, disease, allergies, location). For example, "Rural Diabetic Veteran ages 55-65 exhibiting macular degeneration" would be a type of patient population.

3.2 Interoperability Major Milestone 1: October 1, 2014

Per FY 2014 NDAA, Section 713(g)(1), VA will provide all healthcare data and information from our existing health systems in a computable, real-time manner using existing data standards and establish relevant policies and processes to achieve the objective of creating one unified, lifetime health record for each Service member/Veteran. To facilitate the outcome, DoD/VA Health Executive Council (HEC) exercises review and approval authority to enable interdepartmental progression via the DoD/VA HARB. The HARB provides enterprise and technical architecture oversight for health IT initiatives, to include the determination of standards, quality assurance and integration. To this end, the HARB is currently performing a critical role in generating standards-based data exchange specifications for health data interoperability between DoD and VA.

The Departments are working together to ensure seamless interoperability to meet computable needs by relying on the use of standards in the DoD/VA Target HSP. The HSP is a common set of information, data, security, and technical standards. Thus, while using IEEE and the already established body of work by other national organizations such as the ONC, the Departments recognize the need to embrace emerging technologies and processes to enable seamless interoperability and real-time data computability.

3.3 Interoperability Major Milestone 2: December 31, 2016

December 2016 capabilities for interoperability will support clinical and infrastructure content and deploy, with DoD, an interoperable EHR, providing seamless electronic sharing of medical health data and integrated data display. This includes the implementation of plans to modernize VA's EHR that support clinical operations. Interoperability will provide seamless, integrated sharing of standardized health data among DoD and private sector providers. To achieve these objectives, the VistA Evolution Program will focus on the following outcomes:

- Execute data mapping to establish the relationship between the Department specific terminology and data element identifiers and the national standards;
- Implement standards-based health data exchange in accordance with IPO and National data interoperability standards policy and technical guidance;
- Achieve the ONC 2014 Edition EHR certification.

The planned mechanism to incorporate the external sources of health record information is to leverage the existing Virtual Lifetime Electronic Record (VLER) Health gateway. The focus on interoperability will deliver value to both patient and clinician with enhanced functionality, improved operational efficiency, quality-better care, cost savings, and improved customer satisfaction.

3.4 Interoperability Framework

The DoD/VA EHR interoperability framework is intended to enable the reliable, context-sensitive management and delivery of semantically-interoperable clinical information and

terminology. The DoD/VA EHR interoperability framework provides a standards-based foundation of data, terminologies, information structures, and data interchange services, which together constitute the common terminology services. Through their establishment, enterprise syntactic and semantic health information interoperability can be ensured.

The DoD/VA EHR interoperability framework includes the Common Terminology Services (CTS) and Common Logical Information Model (CLIM). The CTS defines, specifies, and provides oversight with respect to the deployment of CTS and the evaluation of selected standards. The CTS enables interoperability by translating the DoD and VA terminologies into National Standard vocabulary sets (LOINC, RxNorm, SNOMED-CT, etc.). The CLIM not only establishes a data element level confidentiality and secondary use framework, but also develops and analyzes common logical information models.

As a way to address recognized gaps in interoperability efforts, in June 2013, the HARB ensured alignment of DoD, IPO, and VA by commissioning a gap analysis which identifies opportunities for improved implementable, standards-based profile for clinical data exchange between the enterprises. This task led to development of the DoD/VA Architectural Alignment Analysis report that provided alignment criteria for inter-enterprise data exchanges. That report provided the Interoperability Alignment Framework (IAF), comprised of nine levels, shown in **Figure 1**. The IAF is a mechanism for VistA 4 to satisfy interoperability compliance criteria. The relationship of the CTS and the CLIM creates a convergence at the second level of the IAF described below.

Figure 1, below, shows the proposed interoperability alignment framework to achieve an implementable standards based profile for clinical data exchange between the VA and DoD enterprises. The information exchange profile describes the design pattern needed to define the rules for implementing the data exchange. The nine levels of interoperability are grouped in three information types: data, transport, and security.

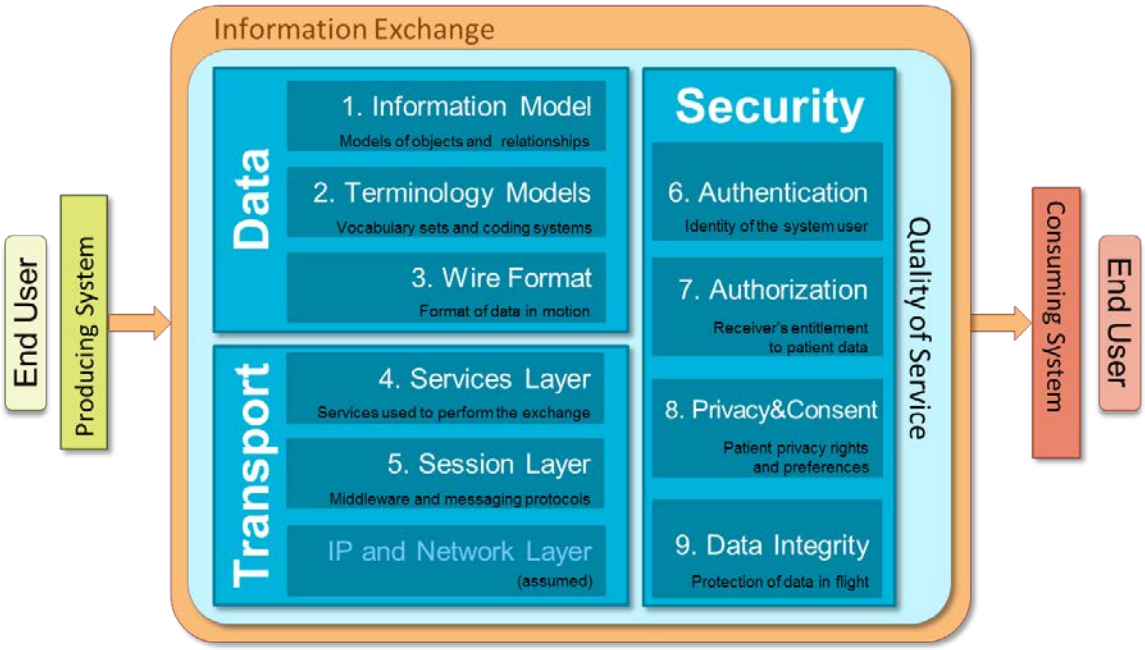

Figure 1. Levels of Alignment for Information Interoperability

The information exchange profile states that interoperable information exchanges must be aligned in terms of:

Data

1. The data exchanged and how that data is modeled (information model);
2. The vocabulary used in the model, especially medical coding systems (terminology model);
3. The format of the data as it passes between enterprises (wire format);

Transport

4. The services used to perform the exchange and mechanics of calling those services (services layer);
5. The use of any middleware or messaging protocol to create and manage the interactions (session layer);

Security

6. Ensuring the identity of the system user (authentication);
7. Assuring the receiver is permitted to see the data he or she requests (authorization),
8. Enforcement of patient privacy and application of patient consent (privacy & consent); and
9. The means of data protection during transfer, including the use of encryption (data integrity).

Note that the IAF addresses interoperability at the technical and semantic layers, not the business process level. For additional details on IAF please refer to DoD/VA Health Architecture Alignment Gap Analysis Report from September, 2013.

3.4.1 Information Model Harmonization

Level 1 of the IAF indicates that the exchange partners must agree on the information to be exchanged and its meaning. The DoD/VA interoperability approach solves this problem by adopting Consolidated Clinical Document Architecture (CCDA) for external exchanges, thus following National standards, and adopting HL7's Fast Healthcare Interoperability Resources (FHIR) standard for real-time, dynamic DoD/VA exchanges. Use of the common intermediate model allows both parties to the exchange to bi-directionally translate their local representations to the common format.

It is also recommended that VA continue to work with Standards Development Organizations (SDO) and National Standards Organizations (NSO), to incorporate emerging standards as defined in the One VA EA as health data standards. In particular, even though efforts are underway for HL7 to recognized FHIR as an international standard for health interoperability, FHIR is not yet part of the DoD/VA Target HSP, nor a Nationally-approved standard. VA plans to take advantage of this opportunity by providing direction and input to shape the standards, as they mature.

3.4.2 Terminology Harmonization

Level 2 of the IAF indicates the need for harmonizing terminology between information exchange partners. The use of common terminology based on National Standards, enables all parties to understand the meaning of common terms. If national standards do not exist as of the date on which the record is being established, the default process would be to leverage the Health Data Dictionary until such national standards are established. Terminology translation is a keystone of the DoD/VA interoperability approach.

Figure 2, below, is a simplified illustration of how the same data for common diabetic measures such as pulse, temperature, and glucose levels can be expressed in different ways depending upon the originating system. Translation to a shared medical coding system enables federation of this data into one record.

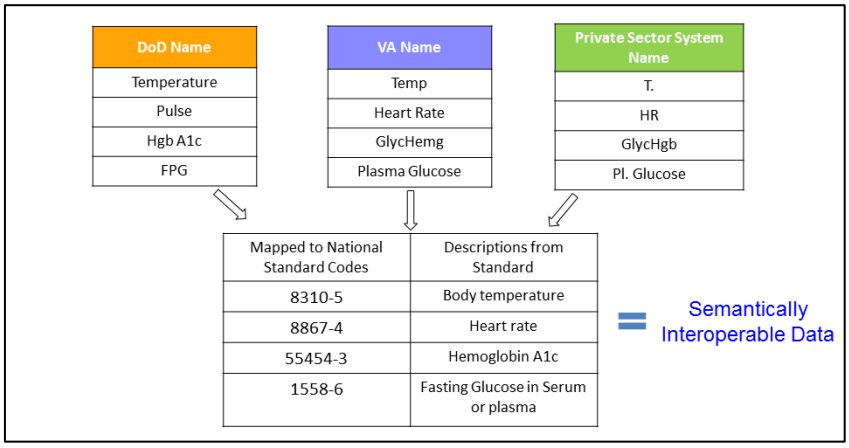

Figure 2. Terminology Harmonization for Blood Pressure Diabetic Measures

The use of medical coding systems to represent clinical data is required to completely and faithfully capture the clinical care process. A representation of each clinician's "original intent" must be captured when documenting any episode of care, including problems treated, medications prescribed, lab results obtained, and notes documented. Each of these domains are actually quite complex. For example, a blood pressure measurement must not only

capture a standard, nationally understood code for the procedure, but also must capture the important metadata, such as ‘large adult sphygmomanometer cuff, applied to the left biceps, with the patient at rest in the upright position, 30 seconds after suddenly standing’.

The data standards for interoperability are defined in Joint Executive Committee Joint Strategic Plan FY 2013–2015 and Appendix A from the 2013 DoD/VA Target HSP.

At present, DoD and VA vocabularies are different, partially overlapping, relatively small subsets of the national standards. For example, today in the Vital Signs domain, VA has 9 vital signs, all correctly mapped to LOINC, and DoD has 19 vital signs, also all mapped. However, only four of these 28 are shared in common. For example, the vital sign concept of "blood pressure": presently in VA will send "Blood pressure" (LOINC 55284-4) and DoD Systolic BP" (LOINC = 8480-6) and Diastolic BP (8462-4). Mapping these two sets to a common standard does not allow a DoD clinician to precisely communicate to the VA clinician.

Because of this limitation, DoD/VA EHR interoperability will evolve over time to allow DoD and VA physicians to use the same native medical coding systems as well as more advanced information models and data representations, facilitating more precise communication, and reducing the dependence on translation. Any new development should embrace native standards, such as a coherent implementation of LOINC, RxNorm, SNOMED-CT.

3.4.3 Wire Format Harmonization

The DoD/VA Interoperability approach use harmonized physical models for data in motion, based on Extensible Markup Language (XML) and JSON (Java Script Object Notation). These are widely-recognized web-friendly standards that are easily produced and consumed by systems on both ends of the communication. For example, typical browsers and mobile computing devices have the ability to consume these formats. The information model standards used in the DoD/VA EHR interoperability approach, namely CCDA and FHIR, define specific XML and JSON formats for health data.

4. Product Set 1

Clinical Information Systems Adoption Best Practices and Lessons Learned

Phased deployments have proven more successful than switching entire systems on at a given facility at once. Phasing deployment allows users and leadership to correct glitches on a smaller scale while building user confidence and realizing incremental benefits.

The first phases of the VistA Evolution Program will provide the foundation for functionality to be delivered in later years. In FY 2014, Product Set 1's core capabilities will be enabled at two sites. VistA 4's Product Set 1 is scheduled to be complete by the end of September 2014. VistA 4's Product Set 1 will be available to a group of Community Based Outpatient Clinics (CBOC) users at the Hampton VA Medical Center (VAMC), in Hampton, VA and Audie L. Murphy VA Hospital, South Texas Veterans Health Care System (STVHCS), in San Antonio, TX. The VistA 4 Product Set 1 also includes the following capabilities:

- Interoperability: VA/DoD information sharing via the Joint Legacy Viewer (JLV).
- VistA Standardization: The two Product Set 1 sites were standardized on the 74 VistA products that support the 42 EHR Core Capabilities as determined by the IPO and VHA.
- Immunizations: Upgrade VistA file to allow use of standardized data and capabilities to read and write immunizations;
- Laboratory: Acquisition of a Laboratory Information System (LIS) to be deployed over several years;
- Graphical User Interface (GUI) Tools: Delivery of new tools to support Google-like searches within patient records, context-aware InfoButtons that link to clinical monographs on the web, and tools to facilitate medication reviews.
- VistA 4 Application Programming Interface (API) Initial Release: Exposes an initial set of VistA services via standard web services programming interfaces.
    - Approximately 226 APIs will be exposed as services on the Enterprise Service Bus (ESB) and Service Registry/Service Repository. An application outside of the M-Code (Massachusetts General Hospital Utility Multi-Programming System Code) environment can use a Remote Procedure Call (RPC) to invoke a VistA API. APIs, exposed as a service, will provide complete, secure, and unambiguous access to information in the selected VistA packages.

The above capabilities are reflected in the Product Set 1 Gantt Chart, shown below in **Figure 3**.This represents VA's commitment to rapid and continuous deployment of state-of-the-art functionality and alignment with industry standards to enhance the clinical user experience and improve quality of care for Veterans, Service members, and their dependents. With this approach and principles guiding development, VistA 4's Product Set 1 will deliver new user functionality, enable industry standard capabilities, and positively impact the quality, safety, efficiency, and satisfaction of healthcare for Veterans, Service members, and their dependents.

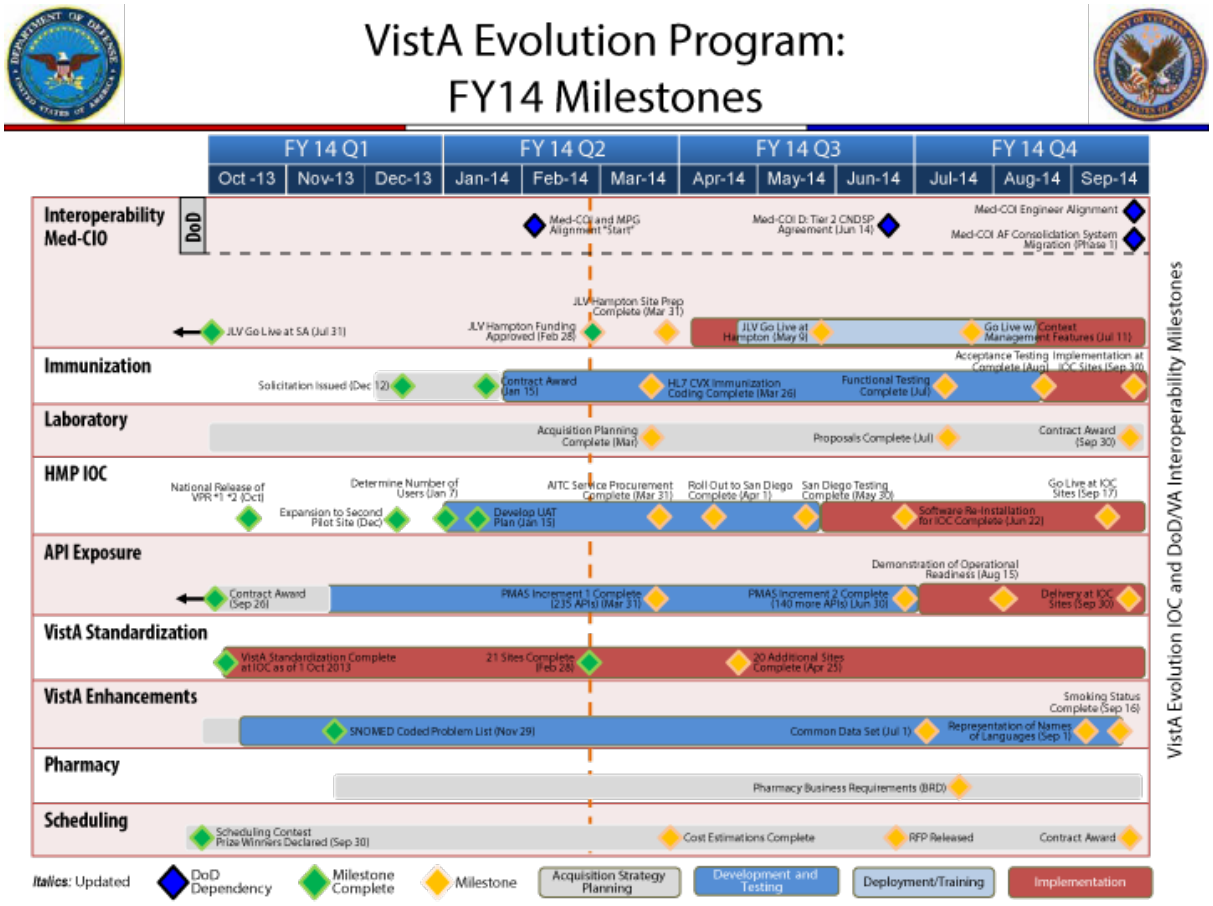

Figure 3. Product Set 1 Gantt Chart

The aforementioned major deliverables are described in more detail below:

Influence of Laboratory Medicine on Quality, Efficiency, and Cost of Healthcare

Lab services account for less than 3 percent of annual healthcare spending, yet the results of lab tests affect an estimated 70 percent of medical decisions, highlighting the potential influence of laboratory medicine on the quality, efficiency, and cost of healthcare. "The Value of Clinical Laboratory Services," American Clinical Lab Association (2011).

- Laboratory: VA will conduct an open competitive acquisition process to acquire a state-of-the-art LIS that allows pathologists and technicians to more efficiently follow best practices, resulting in improved results for Veterans, Service members, and their dependents. Among the new functions, the LIS will support the use of coding standards for orders and results. Given the significant role that laboratory results play in driving CDS and population analytics, the new LIS capability will play a critical role in the treatment and on-going management of the health of Veterans, Service members, and their dependents. With orders and results now using standard terminology code sets the new LIS will enable interoperability and clinical data exchange with internal VA systems, DoD, and other healthcare partners.
- Immunizations: VistA enhancements will accommodate data required for immunization capture and interoperability, allowing for enhanced immunization-data portability for Veterans, Service members, and their dependents, and fulfilling the required vocabulary standard for EHR certification. The enhanced functions will

better ensure that Veterans, Service members, and their dependents get recommended immunizations on time; and through interoperability, allow VA to keep track of immunizations received outside of VA, ultimately improving the health of Veterans, Service members, and their dependents through proactive health management.

- Data Standards/Interoperability: The standardization of Veteran record information from external sources, including DoD and external partners, will enable the user interface to consistently display the right information in the right form. This will permit the display of the same data from multiple sites as a single concept, depicted in one graph or one table column, helping clinicians get an accurate idea of Veteran status. This will improve speed and quality of decisions, as well as enhance Veteran understanding of their data.

  From a population health perspective, adoption of data standards will enable VA to perform extensive clinical treatment analytics across specific Veteran patient population groups, informing optimum treatment protocols, tailored to the unique attributes of that population. Data standardization will provide the foundation for continued data sharing enhancements between VA, DoD, and other healthcare partners, while aligning with several ONC MU requirements.

  Importance of Standards and Interoperability

  Data standards are critical for interoperability between disparate technologies and organizations. Agreed upon standards for content and terminology, are necessary for true semantic interoperability. Standards are important to exchange clinical data, as well as administrative and financial data.

- User Interface Improvements: During the delivery of Product Set 1, VistA 4 will provide an improved user experience for clinicians by enabling many ease-of-use features to enhance system adoption, productivity, and overall user satisfaction.
  - Search functionality will enable users to find information in the patient record more quickly and accurately, similar to the familiar functions of a web search engine.
  - InfoButtons located next to data such as laboratory results, medications, problem list entries and diagnoses will allow quick access to additional information, specific to that data, with a simple click. Additional information may be simple attributes about the data, or a detailed set of relevant reference materials.

    Dynamic InfoButtons

    For example, clicking an InfoButton next to a fasting blood glucose (sugar) result could present the date and time the specimen was collected; another InfoButton click could display the medical journal or local VA protocol for treatment response to elevated blood sugar.

  - Medication Review and Reconciliation is a clinical standard of care practice and a MU functional requirement due to the significant implications on patient safety. A medication review and reconciliation screen will pull all of the patient's medication history across disparate systems into one view, including order, administration, refill history, and renewal dates. InfoButtons may also display additional information about the medication orders, calculations, and links to further pharmaceutical references.

    Medication Reconciliation is a Stage 1 MU Requirement

    The Joint Commission mandated hospitals must reconcile a list of patient medications on admission, transfer and discharge. Medication reconciliation is now part of stage 1 MU criteria.

- VistA 4 API Exposure Project: To enable interoperability and build the foundation for VistA 4 envisioned architecture, this project will take a foundational suite of VistA application packages, and undertake necessary work to integrate these applications with the VA/DoD interoperability infrastructure. There are three functions that these APIs can perform; they can provide a read of data from VistA, a write of data to VistA, or serve as an "event driver", or trigger to notify when a noteworthy write has taken place within VistA.

The arrangement of additional capabilities and functionality into Product Sets 2 through 4 will be included in future releases of this Product Roadmap. The VistA Evolution Program will release periodic releases of this plan until all product set requirements are identified and defined. Section 5 lays out the final product vision for VistA 4.

5. Product Set 4

The final VistA 4 Increment completes the VistA 4 evolution. VistA 4 will be interoperable with the DoD and other private providers, certified EHR 2014 Edition, compliant with Stage 2 MU requirements, achieve or exceed industry standards, and be deployed consistently across the VA care setting enterprise. Product Set 4 will be completed in FY18, with the exception of the Laboratory Information System (LIS). The maturation process for VistA 4 will leverage the foundation of the enhanced graphical user interface, standards-based data, and core clinical applications laid during previous increments, with continued attention and commitment to the core principles discussed in the **Principles** section. The functional focus areas for the final increment of VistA 4 will:

Product Set 4 Outcomes

VistA 4 will be compliant with:

- FY 2014 NDAA requirements for interoperability
- Stage 2 MU requirements
- Industry standards
- VA Directive 6402 Standardization of VistA National Software
  - Deployed consistently across the VA care setting

- Continue the adoption and implementation of interoperability standards for sharing clinical records and images across organizations;
- Complete a coherent but flexible end-user experience in which VistA 4 features can be seamlessly deployed improve user adoption, productivity and satisfaction;
- Support business process re-engineering to bring full-featured patient-centered care coordination as the care model woven throughout the design to enhance quality and value in care;
- Complete enhancements to existing Pharmacy and Radiology systems.
- Propagate the usability features and end-user experience throughout all VistA 4 enhancements to improve user adoption, productivity and satisfaction;
- Enable patient-centered care coordination as the care model woven throughout the design;
- Leverage the Digital Imaging and Communications in Medicine (DICOM) reporting and transmission standard for radiology, which will allow imaging interoperability with our partners, including the DoD.
- Complete enhancements to women's health and other specialty-care functionality.
- Complete initial deployment of the LIS in FY16 at two VA medical facilities. Further deployments will take place at 50 VA medical facilities per year, starting in FY17. By the end of FY19, the LIS will be deployed at all 152 VA medical facilities.

The resulting VistA 4 application suite and underlying technical architecture will represent a state-of-the-art enterprise EHR solution that is compliant with ONC 2016 Edition functionality and CEHRT requirements. The VistA 4 platform will enable continued agile development of system enhancements deployed consistently across the enterprise, satisfying regulatory and statutory requirements.

The following subsections describe some of the detailed functional principles of VistA 4, along with the benefits to clinical users, Veterans, Service members, and their dependents. These main components of VistA 4 will be configured to store data and accommodate workflow for the variety of clinical specialties including new workflows for emergency

medicine, women's health and genomic medicine. Additional clinical capabilities will continue to evolve, and inevitably become available, over the lifecycle of the VistA product.

5.1 Graphical User Interface

The VistA 4 user experience will be the focal point for a modern, flexible, powerful and responsive software package used by providers at the point of care. The VistA 4 user experience will incorporate advanced, evidence-based design principles proven to improve users' ability to find, understand, and use health information. The GUI is a subcomponent of the VistA 4 user experience.

Today, VA providers depend on a point-of-care GUI called Computerized Patient Record System (CPRS) for accessing and recording most of the patient information needed for clinical documentation and decisions. CPRS provides very limited capability for accessing patient information that may have been recorded in many different locations both during and after a Veteran's military service. While CPRS has been an effective tool for over 17 years, its GUI is based on a paper-chart metaphor and segregates data that need to be considered together to improve understanding of the patient's state of health. For example, medications often need to be considered with laboratory tests to understand how medications might affect these results in negative or positive ways. In CPRS, users must frequently switch between windows to see both medication and other data.

The VistA 4 GUI will facilitate display of interoperable data and help drive data standardization. The VistA 4 GUI, when integrated with a shared VA/DoD interoperability platform, will provide access to a Veteran's complete longitudinal health record, comprised of data collected from every military and VA treatment facility in which the Veteran has received care. For many Veterans, health data from other providers will be available through eHealth connections with participating institutions. The rich, multi-sourced data comprising a Veteran's longitudinal health record must be understood by all systems accessing and adding to it, including the VistA 4 GUI. The VistA 4 user experience will drive advances in the application of national standards for coding, sharing and interpreting health information both in VA and the nation. For example, in order to reliably graph vital signs or laboratory results, the GUI must be served homogeneous data such as a particular chemical measured by blood and not urine tests. The units of measurement must also be the same to allow meaningful comparison of all results.

The new GUI will reflect advanced design principles of cognitive support and user-centric design. It will improve the ease and accuracy of understanding what is going on with the health of Veterans and making the most appropriate decision tailored to a Veteran's goals. The VistA 4 GUI will incorporate logic into actions and processes to reduce the burden of data entry, while still enabling creation of rich structured data necessary for communication and fulfillment of certification requirements. It will minimize use of interruptive alerts to guide rather than correct user decisions.

VistA 4 will shift the nature of documentation from static, long documents such as progress notes to active displays of smaller chunks of data with which users can more naturally interact. The following actions illustrate the active information environment. Users will be able to point to any bit of data on the screen and click to see how it relates to other data, drag the information to spatially associate with other information, hover to see more detailed information, or right-click to initiate an action such as updating an observation, initiating an

order, or communicating with another team member. Importantly, various components of the user interface will be aware of what the user is doing to other components. If a user clicks on a disease in one component, laboratory results and treatments of that disease may be highlighted in other components. These user interactions are designed to increase clinician efficiency, accuracy of understanding, and the appropriateness of decisions to help Veterans reach their health goals faster.

Previous clinical trials show that a user-interface prototype designed according to these principles indeed allows physicians to more quickly and accurately understand Veteran status. Clinicians will use the new user interface to help Veterans understand what is helping or preventing them from accomplishing their health-related goals. These same principles will also be applied to the user experience for Veterans. In short, the new VistA 4 user experience will promote higher quality and more efficient clinical care. Clinicians will spend less time looking at a computer screen and have more time interacting with Veterans, Service members, and their dependents.

The VistA 4 GUI will also incorporate robust CDS and population health management features, leveraging the vast data repository VA has developed over nearly three decades. Analytical modules that allow users to explore many patients at once will be able to be "dropped into" the provider's work environment. Some of these modules will also allow users to enter new observations and orders. Population management capabilities will allow users to manage drug responses or performance measures in panels of patients and explore ways waste can be reduced and quality maximized.

5.2 Care Coordination: Activity Management, Communication, and Veteran Goals

VistA 4 will support care coordination in a wide range of care settings across the continuum of patient care. Care settings include primary care, specialty care, home care, ambulatory clinics, rehabilitation facilities, hospital bed units, and telemedicine. Key aspects of care coordination include multi-disciplinary, team-based, Veteran-centric care, care plans and pathways, and feedback to continually improve the quality of care provided by the healthcare organization. Support for care coordination depends on a few crosscutting functions, including activity and communication management, capture of explicit patient goals, and integration with population health analysis. Care coordination is currently considered to be an ideal model of healthcare delivery. VistA 4 will provide the level of transparency, communication, and collaboration across all care team members to support full implementation of care coordination for Veterans, Service members, and their dependents.

Types of Activity Management

Scheduling is a basic type of activity management that brings clinicians and patients together in the appropriate care setting.

Inpatient pharmacy has established business processes for more explicit activity management: pharmacists dispense medications and nurses administer them to patients according to the prescribed dose and schedule.

VistA 4 will use activity management and multi-disciplinary care plans to efficiently organize care tasks according to best practices while preventing results and tasks from falling between the cracks. Activity management has two parts: resource management and business-process management. Resource management brings together caregivers, Veterans, Service members, and their dependents, material resources, and in the appropriate care settings for diagnostic, therapeutic, or informational tasks. External VA care partners are important members of the care team, so activity management also considers and integrates the activities, resource management and communications with these external care team members.

One Order – Many Activities

When a provider orders a minor procedure for a patient, based on standard care plans, the system can auto generate orders for several departments including lab work, pharmacy medications, procedural supplies, patient education from the nurse and follow-on wound treatment.

Business-process management ensures sequencing of these tasks according to standardized or custom care pathways. The result of sequencing activities for a given patient across multiple clinical disciplines as a care plan makes it clear who is doing what, when, and with what resources.

A robust care-coordination capability will allow users to manage the care plan from multiple perspectives (e.g. Veteran, single provider, team) while providing complete visibility into what other team members are doing. Each team member, including the Veteran, will know what needs to be done by when and how the activity helps meet patient goals. Instead of separate (clinical silos) and possibly conflicting plans, there will be one cohesive care plan for each patient. This single, transparent plan ensures better coordination among Veterans, Service members, and their dependents, and primary care providers, and specialists.

When Separate Care Plans Collide

Different medical specialties and professions often generate conflicting care plans. For example, cardiologists, internists, and nephrologists sometimes generate plans to manage medications in conflicting ways. When all members of the team work from one plan of care, the agenda of various contributors are transparent and, in the end, there is only one plan for the patients.

Communication is vital to team-based care. VistA 4 will provide activity-based communication; linking communications to activities to help VistA 4 manage and integrate them with the care plan. For example, a patient might send an e-mail to a physician about a symptom. The physician calls the patient to discuss the issue and sends a note to the nurse to follow-up after an appropriate time period. Instead of these tasks and activities being logged separately in a free text note into the patient's EHR, the actions are integrated into the care plan (e.g., the computer helps the patient compose a task on the care plan to the physician to assess the symptom in the context of a goal that the symptom interferes with; after assessment the physician tasks the patient on the care plan to change a medication; they physician also assigns a tasks to the nurse on the care plan to provide a follow-up phone call on the patient's symptom linked to a specific patient goal).

Capturing explicit goals is new to EHR systems. Users will record these goals in VistA 4 and track progress to their realization. Goals may be captured in VistA 4 by clinicians through patient interviews, or recorded by the Veteran in the My Health*e*Vet Personal Health Record. These goals will be used to assess effectiveness of treatment from the patient's

Medical Goals

Medical goals can be goals like blood pressure target ranges, or expressions of patient desires, such as reducing pain related to an activity, better mobility, living independently, or just sleeping through the night.

perspective. Where there are multiple conditions, there are often conflicts in evidence-based care pathways. Veteran preferences on goals will be used to reconcile these conflicts.

VistA 4 will enable activity and communication management that supports management of all significant tasks according to an integrated plan of care that all users can see, helping patients reach goals of care more quickly while ensuring that appropriate team members address anomalous results in a timely fashion. Managers will use output from activity management to assess workload and budget to proactively improve efficiency and reduce costs. Researchers and advanced business-intelligence practitioners can conduct comparative effectiveness analysis that identify and promote the best approaches to care.

5.3 Clinical Decision Support

In a medical context, CDS technology presents intelligently filtered knowledge and patient-specific health information to clinicians, staff, patients, and other users at appropriate times to enhance healthcare delivery. CDS encompasses a variety of tools that enhance decision-making in the clinical workflow, including alerts and reminders to care providers and Veterans, Service members, and their dependents. CDS includes clinical guidelines, condition-specific order sets, focused patient data reports and summaries, documentation templates, diagnostic support, and contextually relevant reference information among other tools. These CDS functions are displayed in the GUI to enhance the provider's experience.

Improving Population Health for Veterans and the Nation

VA captures a significant amount of patient data, providing the Department with a unique opportunity to positively influence patient safety and quality improvement initiatives for Veterans, Service members, and their dependents, as well as the overall U.S. population.

Kaiser Permanente, another large healthcare provider, used internal data to identify that the drug Vioxx had an increased risk of cardiovascular events before that information was published. Based on this discovery, the Cleveland Clinic queried its EHR to see which patients were on the drug. Within seven hours, they deactivated prescriptions and notified clinicians via e-mail.

There is ever-increasing medical research showing that the use of accepted and clinically validated therapies, medications, procedures and care guidelines can reduce costs and, in some cases, greatly improve outcomes by reducing duplication and errors in care. From a public health perspective, pervasive use of evidence-based CDS could facilitate consistently delivered care across a larger public health population, possibly reducing the impact of diseases and conditions in a population greater than any one provider, hospital or health system.

It should be noted that the use of CDS does not remove the human clinical decision making that the provider, and the provider alone, must do before treating patients. CDS is purely assistive technology and cannot replace years of clinical training and experience.

VistA 4 will integrate a vast database of clinical information with advanced analytical capabilities to provide CDS based on analysis of thousands to millions of Veterans. Advanced capabilities will result, such as personalized risk identification for hospital admission or infection with antibiotic-resistant bacteria. Large-scale population analytics can also help with an ultimate goal of decision support: by considering guidelines, patient history, and the history of similar patients, the treatment that is most likely to realize relevant goals can be identified. In other words, "What worked best for patients like mine?"

5.4 Medical Device Integration

MDI Reduces Errors and Improves Outcomes

Intermountain Healthcare has employed MDI and interoperability to significantly reduce errors in infusion-pump programming and improve outcomes of patients on breathing machines that integrate with their EHR decision support.

Whereas the above features supporting care coordination satisfy most of the functionality for most clinical care, some settings require special functionality, for example, device integration. Intensive care units have many devices that produce electronic data, e.g., continuous monitoring, that can be controlled electronically. With the interoperability enhancements, standards adoption, and flexible technical platform in place at Product Set 4, VistA 4 will be well positioned to begin integration of these devices so that their data can automatically feed documentation and CDS functions within the system.

Example of End-to-end Device Connectivity and Decision Support

Its 2:00 a.m. and Kevin, a 60 year old Veteran in the Intensive Care Unit (ICU), has a sharp drop in his pulse and blood pressure. The smart devices monitoring his vitals generate an alert to the nurse's station within a few seconds. The nurse practitioner in charge takes immediate corrective action and a signal is sent to the connected Electronically Commutated Motor (ECM) system to document the intervention.

Medical device interoperability is the ability for clinical medical devices to communicate in a consistent, predictable and reliable way, allowing for the exchange of data from other medical devices and with patient data sources and repositories, such as the EHR, in order to enhance device and system functionality. In addition to laying the foundation for device integration and interoperability, VistA 4 will be built with the flexibility to address management and storage of the significant volume of data captured and shared by these devices. Although requirements for integration of specific devices are not yet defined by industry, VA recognizes the significant benefits of medical device integration make a compelling case for early adoption:

- Improved quality of care through reduction of adverse events due to safety interlocks, a means of monitoring and controlling the operation of a medical device;
- Reduced cost of care as a result of reduction in redundant clinical testing;
- Increased clinician productivity due to decreased manual data entry;
- Increased capacity for treatment secondary to shortening length of stay;
- Increased patient safety through reduction of human errors in assessing critical situations, and;
- Connect doctors, in real-time, to patients.

VA Promotes the Adoption of Fully Interoperable Medical Devices

VA is helping overcome barriers to full medical device interoperability by being a signatory to the Medical Device Free Interoperability Requirements for the Enterprise (MD FIRE), promoting the adoption of fully interoperable medical devices and systems in support of patient safety.

Based on studies performed by Healthcare Information and Management Systems Society Analytics, over 90 percent of hospitals surveyed use six or more types of devices that could potentially be integrated with EHRs (such as defibrillators, electrocardiographs, vital signs monitors, ventilators and infusion pumps). At this time, industry adoption of open interfaces and data standards that allow data exchange with medical devices is limited.

VistA 4 will enable MDI as requirements are defined, taking hospital and in home patient care to the next level of care and bringing the clinician closer to the patient while reducing human errors, improving patient safety, and providing a means to store, categorize, and analyze the vast amounts of data sent by individual devices.

5.5 Specialty Clinical Applications

The functionality described for the GUI, decision support, care-management support, enhancements to the pharmacy systems, and medical device integration will be combined to support many specialty workflows. Supported specialty workflows include but are not limited to: women's health, emergency-department care, surgical care, dental care, eye care, dermatology, disability evaluation, consults and referral management, anesthesia documentation, mental health, nutrition care, genomics, intensive care nursing and medicine, and occupational health. The general approach in VistA 4 will be to deliver technical components that require minimal engineering to support specialty workflows. While in some cases not insignificant engineering will be required; in no case will a complete suite of new technical applications be needed. The sections below give examples of approaches to selected specialty workflows.

5.5.1 Women's Health

VistA 4 will update the current Women's Health Management functionality by leveraging current VistA work, the VistA 4 GUI, CDS, and other capabilities to create a full-featured women's health IT solution. Through the foundational VistA 4 functionality described above, VistA 4 will deploy functionality from several Innovations projects including the Abnormal Test Results/Tracking Abnormal Results (ATR/TAR) project, the Notification of Teratogenic Drugs (TDrugs) project, the Breast Care Registry, the Maternity Tracker project. Additionally, these new enhancements will contain and improve the functionality planned for the System for Tracking Women's Health Cancers and Maternity Care, and Safe Prescribing and Reproductive Health–a TDrugs enhancement. The enhancements to the Women's Health capability would expand the gender characterization of Veterans to include aspects of gender identity as well as biological sex. It will ensure that a full set of reproductive health data elements (e.g. LMP, EDD, Menopause status and others) exists in VistA for use across all projects. Data will be able to be viewed by patient, a given provider's panel, PACT team, or all patients. Robust reporting functionality will allow for the building of data cubes and multi-functional analysis. Moreover this platform will have the ability to track and incorporate results of healthcare and diagnostic testing done outside VA into our system.

This enhanced Women's Health Management capability will enable providers on healthcare teams (physicians, nurses, pharmacists, women's health Program Managers, maternity care coordinators, etc.) to track, manage, treat, and communicate with women Veterans to achieve the timely provision of preventive care, management of abnormal tests, diagnosis, and treatment.

5.5.2 Emergency Medicine

A major difference between emergency medicine and other outpatient workflows is the orientation of the EHR around a stream of events instead of summative documentation of an encounter. Activity management and snippet documentation are two features described above that ideally support the stream of assessments and treatments in the emergency department. Activity management and concomitant decision support help clinicians exchange and

document diagnostic and therapeutic procedures through time. The activity management capability also allows front-line clinicians and managers to understand and address bottlenecks in the care process. Snippet functionality allows progressive narrative documentation and then assembly of this stream of documentation into a summative document for review by others after the episode in the emergency department.

5.6 Enhancements to Ancillary Systems: Pharmacy and Radiology

The Pharmacy business owners and users will benefit from the continued incremental enhancements to the existing VistA pharmacy system. These continued enhanced ancillary services capabilities will also enable more robust CDS for clinicians, allowing them to provide improved quality, safety, efficiency, and satisfaction in healthcare for Veterans, Service members, and their dependents. Radiology enhancements will include best practices functionality, such as support for electronic protocols and a dashboard display of the patient's status, facilitating communication between radiologists and technologist.

5.6.1 Pharmacy System

Clinical Information Systems Adoption Best Practices and Lessons Learned

Workflow analysis at the VA/DoD Federal Healthcare Center (FHCC) determined that local pharmacists must process every VA prescription whether it is filled at the window, mailed by Consolidated Mail Outpatient Pharmacy (CMOP) or mailed locally. The analysis resulted in the recommendation to automate the cross-check process so that the pharmacists' time is put to better use, thereby eliminating the undue burden on the pharmacists at FHCC.

Enhancements to the pharmacy systems: Pharmacy Enterprise Customization System (PECS), Medication Order Check Healthcare Application (MOCHA), Pharmacy Product System (PPS), and Clinical Ancillary Services (CAS), will focus on evolving existing functionality. Replacement of existing pharmacy systems with a new solution, the Pharmacy Hospital Information System (PHIS), will be implemented in VistA 5.

The enhancements to the existing Pharmacy system will reduce adverse drug events through improved medication reconciliation tools in the provider GUI, patient safety order checks, and the replacement of locally-maintained files with a nationally maintained drug file, mapped to standardized terminologies. Standardization will make it easier to provide CDS for items that the pharmacy dispenses. Enterprise-wide adoption of a single national file will reduce workload and allow pharmacies to refocus staff time from administrative functions to direct patient care, improving the patient experience. In addition to delivering the above functions, VA will complete IT infrastructure work to improve pharmacy interoperability and provide more robust CDS.

Medication Reconciliation

It is usual for a single patient to have multiple prescriptions for various problems prescribed by multiple physicians in different care settings. Reconciling medications and using CDS will assure patient safety from adverse effects.

Medication ordering CDS, as part of medical ordering support, possesses several rules engines that detect known allergies, drug-drug interactions, drug condition and drug-food allergies, as well as excessive dosages. As VistA 4 matures, the rules engines will factor in age, gender, weight, kidney and liver function of the patient, known contraindications based on known diagnosis, as well as pregnancy and lactation status.

By 2015, VistA 4 will support transmission of electronic prescriptions (ePrescribing) to external pharmacies using the National Council for Prescription Drug Program's

interoperability standard, increasing patient medication options and reducing patient costs for medications by enabling their purchase from lower cost sources.

5.6.2 Radiology

VistA 4 will update the radiology application to transition radiology operations from paper-based to a paper-light practice. These enhancements will address the current practice demand with emphasis on increased efficiency, improved documentation, and enhanced patient safety.

VistA 4 radiology and imaging enhancements will leverage some of the innovative work undertaken at by community VistA users for a new radiology user interface. This GUI may be used as a model user interface for the following radiology functions: enter order, schedule study, register patient, case edit study, protocol study; display status of patients who are in the department; display key management parameters: unscheduled orders, incomplete studies, un-dictated studies.

Key functionalities targeted for the radiology interface include scheduling exams from a list of orders. This user interface will enhance functionality of the scheduling application to allow auto-populating in the radiology application of the scheduled appointment time, eliminating the need for duplicate entry. Additional new capabilities will consist of:

- Ability to assign orders for imaging studies to radiologists so they can be protocoled;
- Select acquisition protocols for ordered and scheduled imaging studies with rationale for selection;
- Communicate imaging instructions to technologists;
- Communicate patient communications from clerk to radiologist and technologist, and;
- Enter radiation dosage.

Radiology and Imaging Clinical Decision Support

Imaging best practice protocols combined with clinical decision support CDS at the time of order entry helps remind providers of evidence-based and local guidelines, reduces unnecessary testing and provides patient safety checks throughout the procedure.

As listed above, VistA 4 radiology will include best practices functionality such as support for electronic protocols and a dashboard display of the patient's status, which will facilitate communication between radiologists and technologists. Incorporating protocols within radiology procedures will ensure that important safety information such as allergies and renal functions are clearly communicated. Radiology CDS capabilities will improve ordering guidelines to follow appropriateness criteria as defined by the American College of Radiologists. VistA 4 Imaging will build upon current image management capabilities to support enterprise image distribution and viewing. Such enhancements include the ability to import studies from external entities, improved image viewing functions, support for structured DICOM reports and integration and tracking of radiation dose metrics. These features will also enable imaging interoperability with our partners, including the DoD.

The VistA 4 Radiology and Imaging System enhancements will improve the efficiency, quality of care and Veteran safety through efficient workflows, timely processing of orders, improved communications among staff, more complete documentation and support for optimal scanning protocols.

These enhancements will benefit clinicians by allowing simultaneous availability of patient images and data while planning and providing care, less time be spent locating images and improved communication among radiology clinicians and specialist.

5.7 Laboratory Information System (LIS)

The target LIS solution for VistA 4 will support interoperability of laboratory data with internal VA systems, DoD, and other healthcare partners. The LIS will include many functions that support the operational business processes of the lab, including specimen receiving, specimen tracking, quality control, testing, results documentation, and results verification, as well as use barcode technology for specimen labeling and positive patient identification. The LIS will leverage standards and interoperability guidelines to exchange orders and results within and across department and commercial reference labs. The selected LIS solution will also provide access to the patient's full EHR for CDS to include, but not be limited to, orders management, results management, reports management, and quality control initiatives, supporting improved outcomes for Veterans, Service members, and their dependents. Planned incremental deployment of the LIS will begin in FY16 at two medical facilities. Following successful deployment at these initial facilities, further deployments will take place at 50 VA medical facilities per year, starting in FY17. By the end of FY19, the LIS will be deployed at all 152 VA medical facilities.

20% of Lab Tests are Re-Ordered

According to the President's Information Technology Advisory Committee, 20 percent of Lab tests are re-ordered because previous studies are often not accessible. Laboratory CDS would define criteria to prevent physicians, particularly those in training, from ordering laboratory tests that may either be incorrect, already completed or unnecessary.

6. Technical Architecture

VistA 4 will use a SOA approach to enable interoperability, innovation, reduce system redundancies and enable key clinical capabilities. This will include a new web-based user interface, a data management services capability, and CDS. VA's SOA approach will ease integration between VistA and envisioned ancillary systems, such as Pharmacy and Laboratory. VistA 4 will ensure that while this information becomes more easily accessible, the right information assurance controls will be in place to restrict access to authorized users. A new messaging middleware solution will be deployed to enable these new capabilities. The deployment environment for VistA 4 will adhere to a "cloud first" policy, involving data center consolidation and a move to virtualization of both back-end and front-end systems.

All architectural diagrams and descriptions shown below represent a potential to-be state. Until the final design is completed to include meeting the critical performance requirements at each and every Veterans Affairs medical facility, the diagrams are illustrative in nature and do not necessarily reflect the final design.

6.1 Data Exchange Approach

The current architecture for real-time interoperable data exchange between VA and DoD has emerged from the joint Secretary of Defense-Secretary of Veterans Affairs memo of February 2013. This memo directed deployment of the JLV to nine VA and DoD sites, as well as providing seven domains of interoperable clinical data. Nearly all of the components identified in **Figure 4** as 'new components and flows' will be replaced with more capable, scalable and extensible components, such as VistA Exchange, and the new VistA 4 user experience in the VistA Evolution program. A key objective of the as-is architecture, which has been successfully achieved, was to ensure clear separation of concerns in system components, enabling iterative development and replacement of those components with minimal disruption.

6.1.1 Current Data Exchange

In the current architecture, seven domains of coded patient data and fourteen domains of non-coded data are aggregated from VA and DoD sources. The coded data is mapped from local vocabularies to National Standard medical terminology code sets such as LOINC, SNOMED-CT and RxNorm. Non-coded data is not mapped, and presented directly to users as it has been in all legacy VA and DoD systems, without identifying correlations of data between the originating systems. In what is currently a manual process, the terminology maps are cached for run-time use by the jMeadows component in the JLV system. jMeadows finds exact match direct correlations for data between DoD and VA data elements for each of the supported domains, and displays the correlated items in the JLV graphical user interface.

Figure 4, below, depicts existing (January 2014) data flows providing interoperable data to point of care applications. This architecture is an interim step toward development of a Generation 3 interoperable health record system, and fulfills the basic data interoperability requirements directed by the Secretaries of Defense and Veterans Affairs for December 2013 delivery.

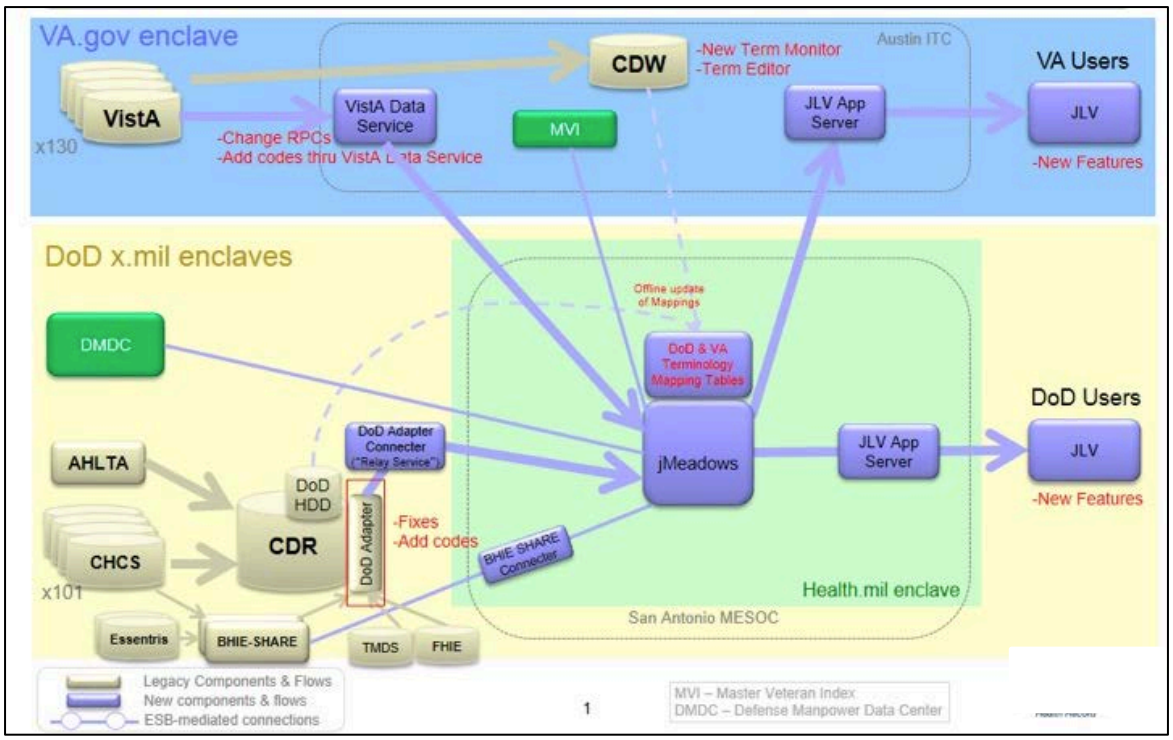

Figure 4. Current Interoperability Landscape Diagram

6.1.2 Target Data Exchange

The goal of DoD/VA interoperability is to achieve real-time data exchange between DoD and VA, to create the virtual patient record spanning all episodes of care in either Department. To achieve this in a scalable, robust manner, the target architecture shown in **Figure 5**, below, makes several evolutionary improvements over the current architecture:

- The current jMeadows data aggregation capability will be replaced with a data federation platform providing standards based integration of semantic enrichment, search and normalization tools;
- The data federation platform will aggregate patient health data using standards based data services developed by the Departments, using documented common interfaces and National Standard code sets as determined by the IPO. This architecture allows the IPO to continue its role in joint standards and governance, but allows the DoD and VA develop, maintain, and manage their own exchange gateways, with the fewest constraints on the independent evolution of DoD and VA EHR systems; and,
- Additional data domains, beyond the seven clinical domains shared in the current architecture, will be shared between VA and DoD health information exchange platforms. Departmental data services will add support for all data domains required for care coordination, transition of care, and other independent or shared VA and DoD workflows requiring the exchange of computably interoperable data with common shared meaning.

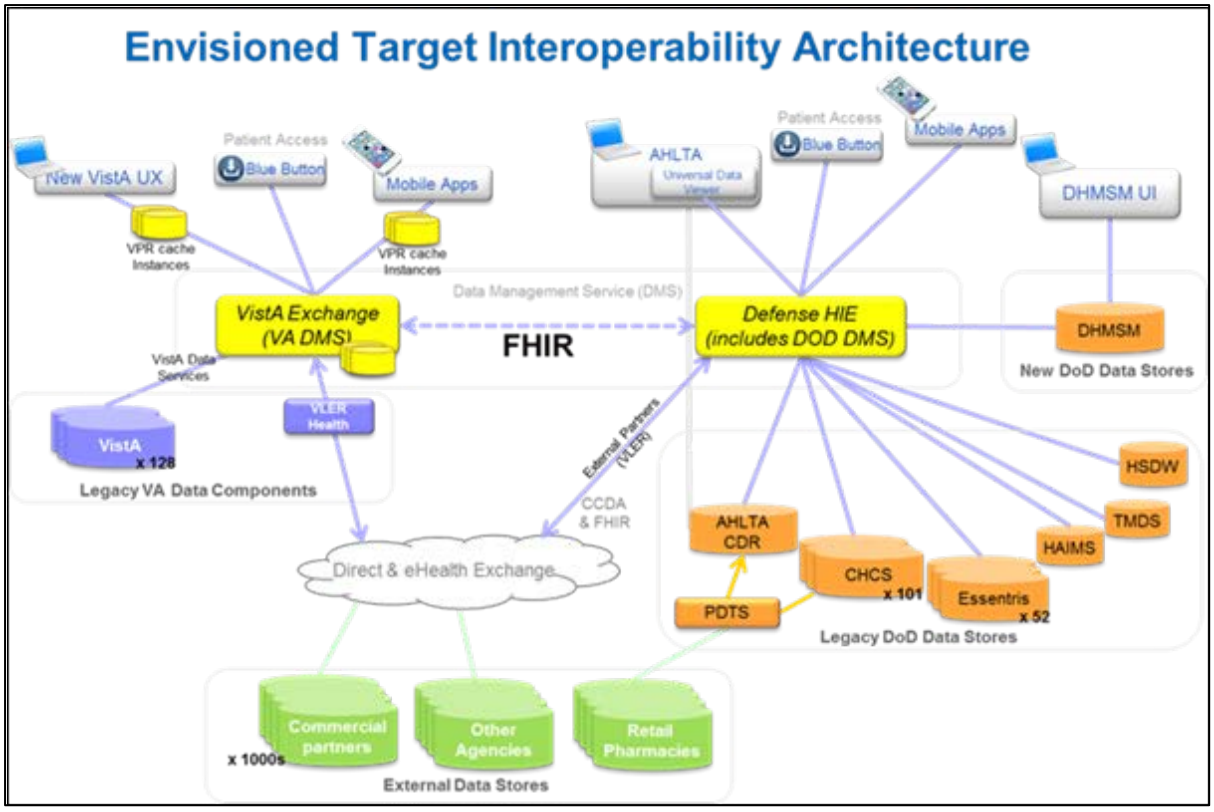

Figure 5. Envisioned Target Interoperability Architecture

The gateways illustrated in **Figure 5**, allow real-time, on-demand requests for patient data from DoD and VA source systems. Once obtained, the data with standardized, computable shared meaning coded to national standards will be processed and made available as a virtual patient record service. Appropriate standards for interfaces and data models for such interdepartmental exchange are being finalized by the IPO, and are based on recommendations of the US HIT Standards Committee. This committee identified the combination of FHIR, JSON, REST, OpenID Connect, Open Authorization 2 (OAuth2), and Transport Layer Security (TLS) as a "safe and appropriate set of standards to use as building blocks for complicated healthcare applications." It should be noted that FHIR is currently undergoing Draft Standard for Trial Use ballot review ending January 2014.

Interoperability with other external providers will be achieved through sending and receiving CCDAs via Direct and eHealth Exchange protocols. The likely mechanism to achieve this is to leverage the existing VLER Health gateway exchange.

6.2 User Experience and the GUI

Most VistA applications use simple, character-based user interactions with several graphical user interfaces provided for some of the clinical applications. This results in limitations in the current system; the character-based applications can be difficult to learn and do not support integrating multiple views into a single workflow. The current GUI provides only limited mechanisms for extension, and the primary clinical interface, CPRS, is not web based. Hence they must be deployed on all client machines. Also they must be deployed as a single unit, leading to long delays as new functionality must be consolidated into a single release.

The user experience will greatly improve the clinician interface with a heavy emphasis on modularity. Modularity is a key to enabling a more dynamic and intuitive interface. To allow for this modularity it must be provided both at the visual component level, i.e. what the user sees, and at the middle tier service level i.e. what logic is executed. It will be necessary to deploy new modules without removing users from the system. The configuration of modules into an integrated experience will be controlled by the role of the user.

The initial approach to deploying the GUI will be through a web-browser-based application. Going forward, an application-local data model with limited local business logic will allow for "zooming" into and out of information detail and dynamically manipulating, including sorting, large amounts of data. A framework is also needed to manage interaction dependencies between modules that provide adequate responsiveness to user gestures. In years after Product Set 1, the VistA technical team will examine approaches using native applications.

Modern JavaScript frameworks will be used by browser-based applications to provide a high level of interactivity and responsiveness that is required by applications used in a clinical setting. JavaScript frameworks provide many foundational user interface components such as tables, graphing capabilities, and image manipulation capabilities that can be leveraged with little modification. Leveraging these capabilities will also allow for a high degree of rapid innovation that will enable the display of health information in the most intuitive way. By placing important logic in the middle tier service layer, the framework will allow for the inclusion of additional types of devices beyond the browser as they become available.

The VistA 4 User Experience will build on nearly two decades of VA and industry experience in cognitive engineering, computer science, user interface design, and data visualization to provide world class information management tools at the point of care.

The three images below represent a clinician's view of patient data in three applications in the VistA 4 'family tree'. The first image, **Figure 6**, is a screenshot of the CPRS, VistA's most important and widely used point of care application in VA today. Only limited patient data from a single local source is displayed in this view.

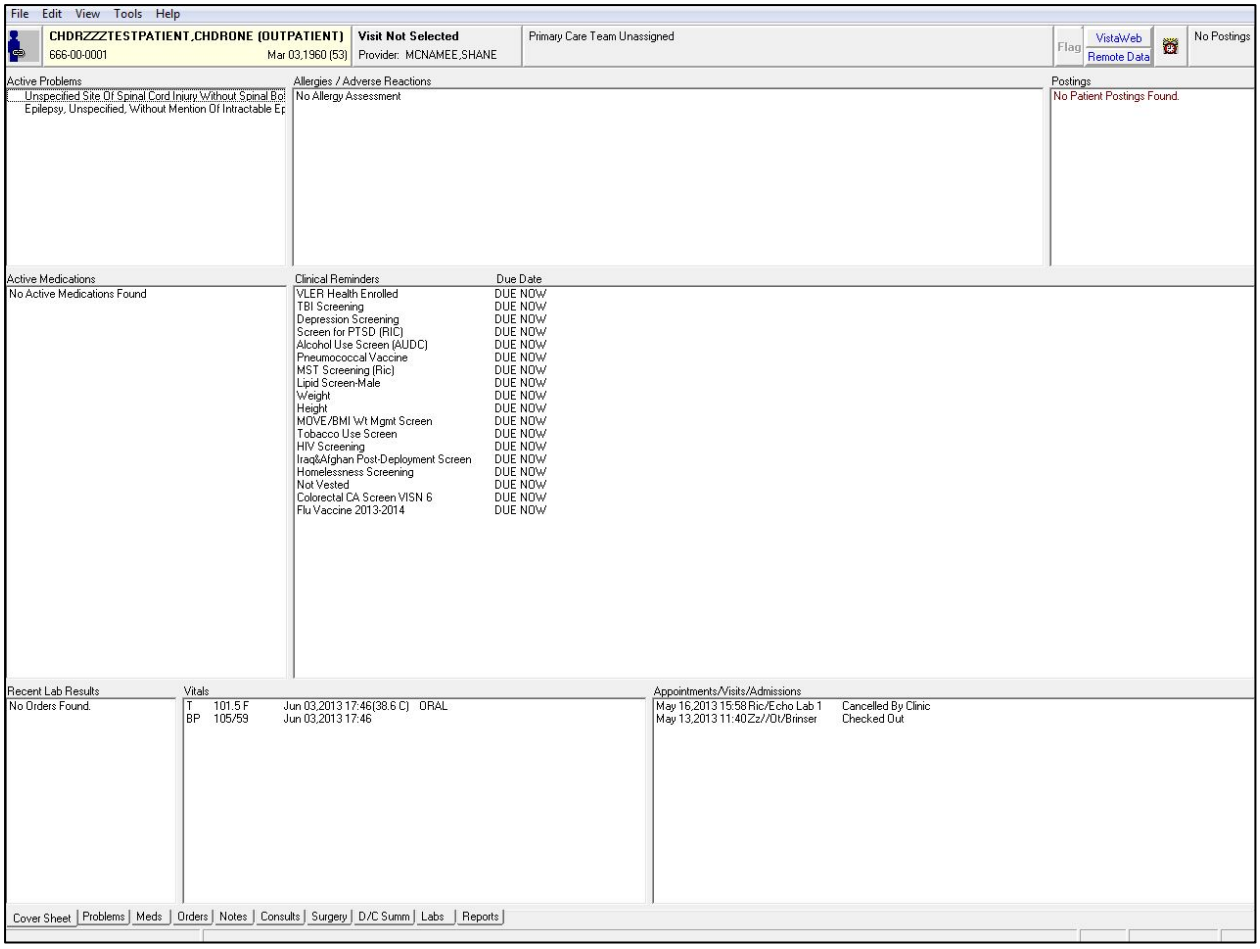

Figure 6. Computerized Patient Record System

In the second image, **Figure 7**, the data for the same patient is displayed in the JLV. JLV provides a complete longitudinal view of a patient record from all military treatment centers and VA locations at which a patient has been seen.

Figure 7. Joint Legacy Viewer

The third image, **Figure 8**, represents a very early VistA 4 user experience prototype, which displays a semantically normalized longitudinal patient record. VistA 4 user experience will also include sophisticated data visualization features which permit clinicians to analyze trends over time for progress toward goals, effectiveness of interventions, and other integrated clinical data which is difficult or impossible to visualize with today's VistA point of care applications.

Figure 8. Early VistA 4 User Experience Prototype

6.2.1 *How SOA Enables User Experience*

Section 7.3.3 described the transition of the VistA 4 product to a SOA based infrastructure. By separating the dependency of the data presentation layer from the information storage layer, the SOA infrastructure will enable an entirely new level of innovation by developers across the VistA 4 product allowing them to focus on the optimum visualization of patient information according to the preferences of the clinical user and in the context of the setting of care.

The use of SOA and its independence from the underlying data infrastructure supports agility and efficiency in development and deployment enabling the stream of enhancements across the VistA 4 product with minimal transitional impact to the user community.

SOA enables a significant capability that could impact the quality, safety and outcome of the Veteran by providing the clinician with a longitudinal view of the patient's clinical information regardless of the military treatment or VA centers where that information was originally collected. As an example in **Figure 8**, above, SOA allows for blood pressure readings for the Veteran to be pulled from multiple episodes and locations into one view.

This blood pressure information can then be displayed in different ways based on the viewing device, clinical user preference and the context of care such as trending graphs, as text in a table or in a chart comparing the current blood pressure value with average and normal ranges.

SOA is an enabler for speed of development, deployment and innovation in providing the needed clinical information to the care giver. VistA 4 users and Veterans, Service members, and their dependents will benefit from an enhanced, intuitive clinical user interface that is tailored to the user role and unique problems and goals of the patient. These enhanced viewing capabilities will make clinically relevant data readily available from across the continuum of care and in the context that the user needs, while not over-exposing them to information overload. All of these attributes will contribute to improved efficiency, quality, safety and health outcomes for the Veteran.

6.3 SOA as an Enabler to Future Systems

VistA 4 is the first major VistA update since the 1990s. The current VA health-related systems has grown substantially over the years, and created a highly distributed software architecture, with complex integration points between VistA and the external systems including DoD, federal, and industry partners, as shown in **Figure 9**. Although, there is very high user satisfaction with VistA in the clinical environment, in order for VA to satisfy current congressional and functional requirements, VA has adopted a SOA based approach with respect to the design of its interoperable and modern EHR.

6.3.1 VistA Current State

The current VistA architecture is an n-tiered architecture that directly supports clinical operations. VistA is based on the MUMPS language, which is a procedural programming language. Presently, VistA leverages multiple and sometimes duplicate applications to fulfill different business objectives. This duplication is a result of the point–to–point nature of the applications, shown in **Figure 9**.

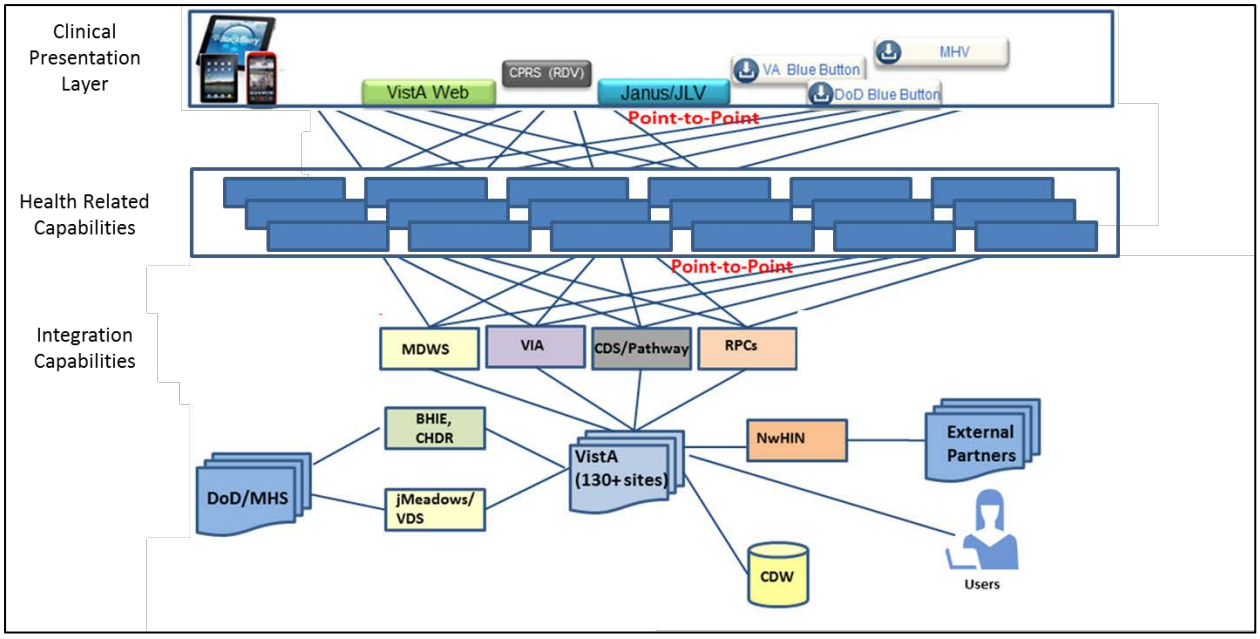

Figure 9. Point-to-Point Applications

In addition, there are about 133 instances of VistA in operation, making it expensive to maintain and difficult to deploy new applications. Applying a common SOA infrastructure will allow for these services to be reconciled into a single set of services by the deployment of Product Set 4, reducing service redundancy and cost thereby allowing for VistA 4 to better serve caregivers and Veterans, Service members, and their dependents. In order to meet the Gartner computer-based patient record criteria, a SOA approach will be taken for VistA 4. VA is planning for the evolution of the VistA from a set of decentralized legacy systems to an integrated, modern SOA environment.

6.3.2 SOA Design

VistA 4 will build upon a SOA approach. SOA is a design paradigm and discipline that reduces redundancy and increases the usability, maintainability and value of software systems. SOA-based designs build on the following architecture principles:

- ***Encapsulation*** advocates exposing a discreet system capability as an autonomous IT asset (that is, a service) that can be used by any application that requires the capability;
- ***Separation of Concerns*** advocates separating different aspect of software system so that each aspect can be developed independently and maintained autonomously;
- ***Loose Coupling*** advocates reducing dependencies between system components and making all remaining dependencies explicit, and;
- ***Business Traceability*** advocates using well defined heuristics to maintain the "line of sight" from business requirements to the system capabilities that support them.

At its most fundamental level, SOA is about "participants", i.e., architectural components, interacting with one another by consuming or providing services. A service is a mechanism to enable access to one or more functions offered by a provider to a consumer via a well-defined, encapsulated interface, in accordance with constraints and policies specified by the service description. This allows the implementation of the service to change without

impacting the consumers of the service. In addition, consumers have the option to utilize different service providers to gain access to a particular function. Characteristics of service consumers and providers are provided in **Figure 10**.

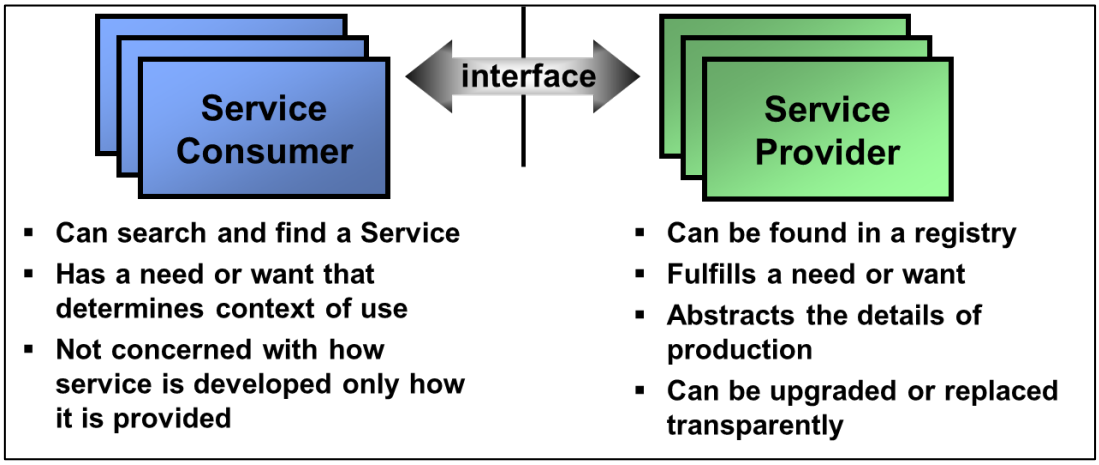

Figure 10. Characteristics of Service Consumers and Providers

Technical interoperability is achieved through the use of a common service layer and SOA infrastructure that supports service discovery, mediated interactions and decoupled transactions, with an enterprise data layer thereby resulting in a more loosely coupled architecture. Messages are now mediated through a common infrastructure rather being sent "point-to-point" between systems. The result of the use of shared services and the common SOA infrastructure is a dramatic simplification of the system infrastructure, as shown below in **Figure 11.**

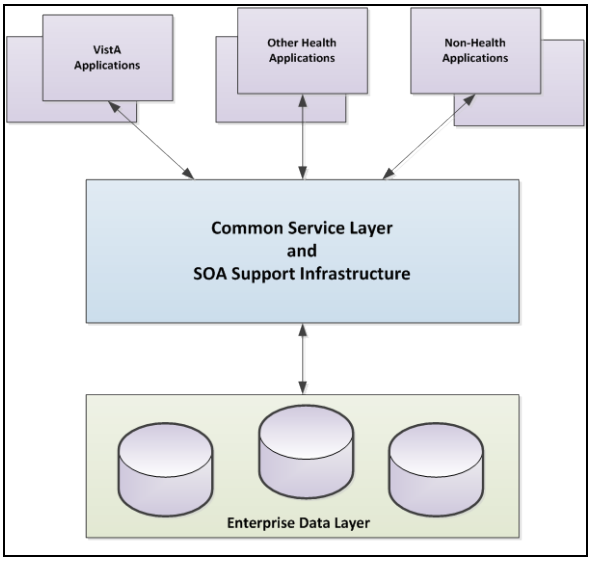

Figure 11. VistA 4 SOA Approach

In summary, the VistA 4 architectural approach leverages the SOA principles of encapsulation, separation of concern, loose coupling and business traceability to ensure the reuse of common capabilities rather than rebuilding them. This results in significant cost savings across the application development lifecycle.

6.3.3 VistA 4 SOA Approach

As shown in **Figure 12**, below, VistA 4 will be implemented using a SOA-based approach through separating the system into multiple independent layers below depicts this layered concept.

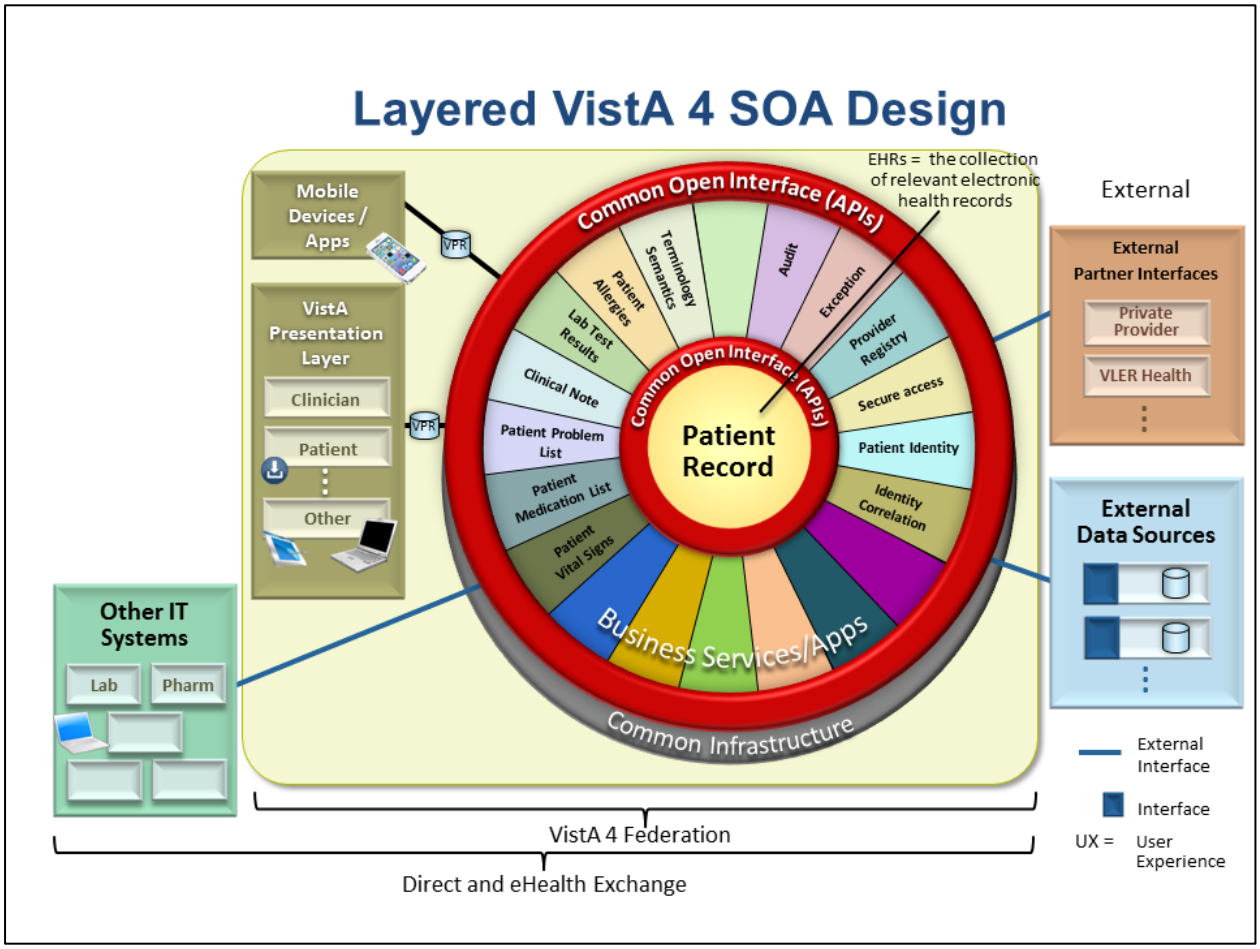

Figure 12. VistA 4 Common Service Design

The VistA 4 Common service design centers around the patient record that will house all the clinical information about a Veteran and be exposed the APIs.

The inner layer shows how the business services and applications, which are built on a common infrastructure, will access information through a common open interface across all these data services. This layer also hosts the non-business specific services that are common to all business applications such as identity correlation e.g., MVI service, which is authoritative source for patient identity and maintains identity data for persons across VA systems (e.g., VistA instances, VistA shadows, Health Data Repository (HDR), Administrative Data Repository, and the Corporate Data Warehouse (CDW).

The Business Services/Apps layer hosts the individual or composite services that can get the clinical data across VA systems, allowing for the information from all the clinical business areas of VistA 4, for instance, Laboratory Test to be served up in a uniform way. These services consume information from across multiple business services to serve a composite functional capability, for instance, verify a Veteran's identity using the MVI and then pull information about their laboratory results, for example. Separation into layers also allows for

the same service to be used by multiple business capabilities, for instance, the Pharmacy business capability can also call on the MVI service to authenticate the Veteran before displaying the relevant information about a patient's prescription.

The presentation layer, which is also part of the VistA 4 federation framework, serves the information from all the clinical capabilities of VistA 4 in a uniform way, resulting in a new user experience. This separation means that there is no longer a need for duplication of work to build, for example one stove-piped system to display laboratory results to the clinician's GUI and a different system to serve the same information to a mobile device. For both the clinician and the mobile user the same mechanism can be used to get the appropriate laboratory information from the clinical capability layer. The presentation layer will configure the display to the device used, allowing users to access their information using any device or system, while minimizing system redundancy.

6.3.4 VistA 4 SOA Design Principles

VistA applications generally have a presentation layer at the top, a services layer in the middle, and a data services layer at the bottom. These applications will use a mixture of application and SOA support infrastructure services to provide information to end users. **Figure 13**, below, shows how the SOA paradigm may be applied to diverse VistA applications using a combination of application and infrastructure services:

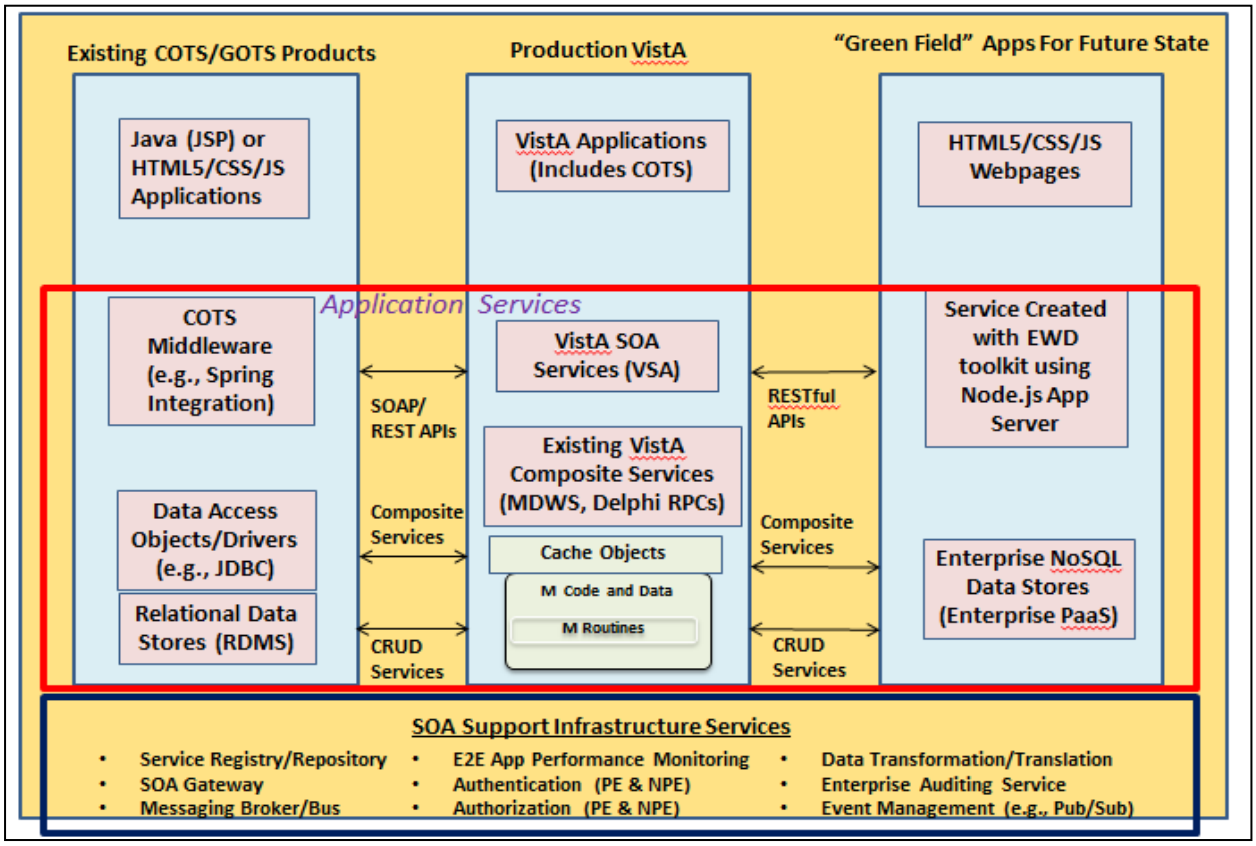

Figure 13. SOA Environment Applied to VistA Using a Mix of Application and Infrastructure Services

The top portion represents an application front-end (aka presentation layer), which is a dynamic website written in the fifth major version of the Hypertext Markup Language (HTML5) and JavaScript, or a VistA application (e.g., laboratory application). These will be

abstracted from business logic that is mediated by the SOA infrastructure services to exchange data to end users. Service providers exchanging data to the service consumers may use data sources such as VistA, traditional relational databases, or persistent NoSQL data stores in an enterprise Platform as a Service (PaaS).

VistA applications which are part of VistA 4 will use common enterprise services to facilitate re-use, achieve economies of scale, and to reduce development and maintenance costs. VA defines these services in two separate categories as follows:

- Application Services
  - CRUD (Create, Read, Update, and Delete) data services (e.g. direct data access services involving CRUD operations for service consumers)
  - Composite data services (e.g. may include a composition of functions that provide data manipulation or to provide aggregate responses to service consumers from multiple data sources
- SOA Support Infrastructure Services
  - Messaging/Enterprise Service Bus (e.g. message exchange transport, service description and discovery, XML parsing)

Enterprise SOA infrastructure services include end-to-end application monitoring, authentication, authorization, auditing, event management, and orchestration. Additional details on the specific attributes for implementing each of the above services for Commercial Off-The-Shelf (COTS)/ Government Off-The-Shelf (GOTS) applications that interface with VistA are described in the draft document entitled Design Patterns for VistA Evolution: COTS/GOTS Application Integration.

In FY 2014, VistA 4 will introduce a basic SOA infrastructure with common services such as Terminology Semantics, Identity Management, MVI, Messaging, Service Registry, System Monitoring, and Protocol Conversion, as depicted in **Figure 14**. The common terminology service will enable semantic interoperability by correlating health standard terminologies. The Identity Management service will provide an enterprise identity management capability to support the various business lines within VA as principally represented by the three administrations. In addition, it will enable VA to associate the DoD person identifier to the VA enterprise identifier for active service members. The MVI will be the authoritative source for patient and beneficiary identity data. It will provide a unique universal identifier for each patient or beneficiary and will store identity data as correlations for each system where a patient or beneficiary is known. Messaging services will provide the ability to reliability exchange messages over the Local Area Network (LAN)/WAN, including routing to specific system based on rules. The Service Registry will provide a registry to capture and document reusable software assets and services that will be discoverable by service consumers. The System Monitor will provide the ability to manage the health of the SOA infrastructure. Protocol Conversion services will provide the capability to convert between different protocols, e.g., File Transfer Protocol (FTP) to Hypertext Transfer Protocol Secure (HTTPS).

Some common data services will also be implemented, including data federation, transformation, and correlation/mapping. Data federation services will provide the ability to aggregate data from various sources across VA, DoD, and partner systems. Translation/transformation services will provide the ability to transform the data from one

format to another, e.g., HL7 message to XML. Correlation/mapping services provide the ability to correlate or map to standard terminology/codes.

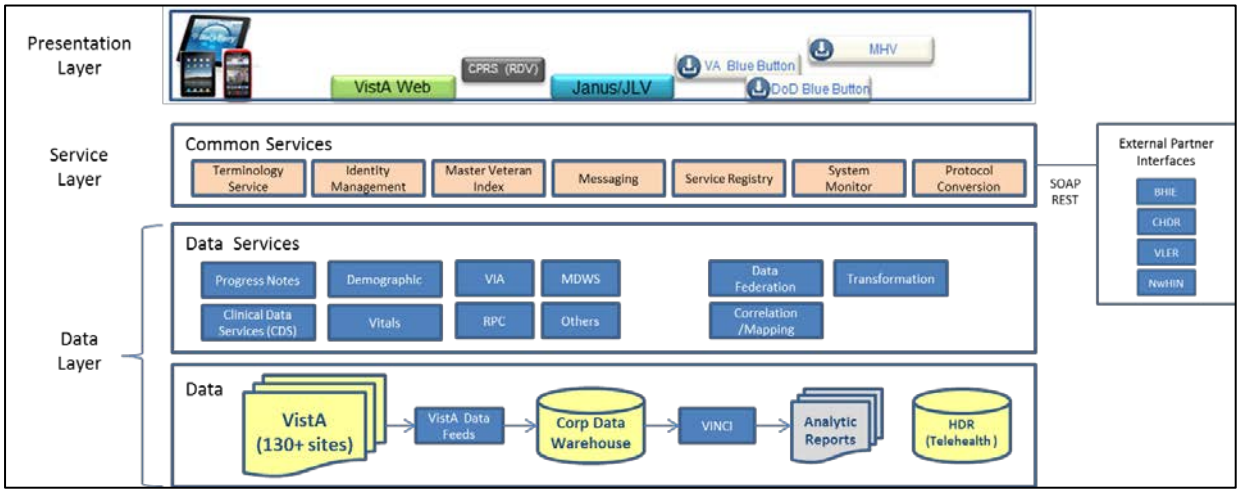

Figure 14. VistA 4 Product Set 1: Technical Architecture – 2014

6.3.5 VistA Target State

In FY 2016, VistA 4 will include data services to support clinical operations and retire duplicate capabilities, such as MDWS, CDS, and others.

Orchestration will provide the ability to create composite service based on CRUD (Create, Read, Update, and Delete) services and rules. A Rules Engine will also be added to provide the ability to capture and expose rules for business processes, event handling and workflow within the SOA infrastructure. Robust Exception Handling services will provide the ability to handle software exceptions and errors.

The target architecture for VistA 4 at Final Increment is shown in **Figure 15** below.

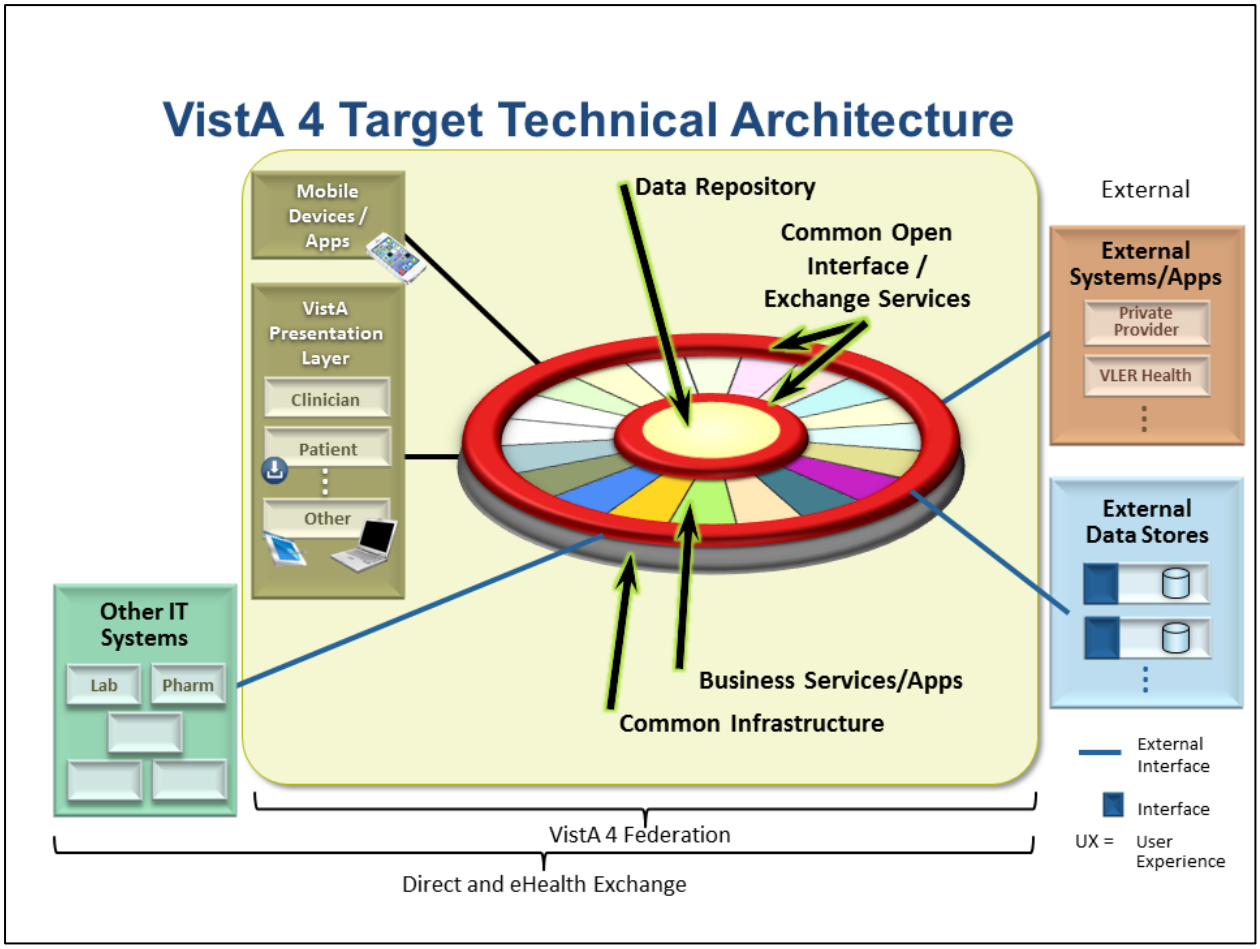

Figure 15. VistA 4 Final Increment: Technical Architecture – 2018

6.3.6 Enterprise Services Vision for VistA 4

The over-arching vision for VistA Evolution relative to the use of enterprise, community and system level services is based on three core concepts:

1. Maximize the return on investment for existing VistA software
2. Improve information security and agile information sharing
3. Enable a smooth transition to next generation software

The lower right hand corner of **Figure 16**, below, shows complex M coded functionality that currently exists in VistA and does not need to be re-written exposed as RESTful web services that new VA code or COTS/OS software applications can use. This re-use will ensure the integrity and consistency of patient health data that must be accessed from both new and existing VA applications during the multiyear evolution of VistA while also enabling faster and less expensive development of new application "front-ends" by leveraging existing VistA application code where appropriate. This single logical data store will include multiple physical databases designed to maximize performance and efficiency.

The left hand side of **Figure 16**, below, depicts the how VA Data Access Services and EHR SOA Suite enterprise shared services will be used to both enable secure and agile information sharing and enable a smooth transition to next generation software. Working in concert, these services will provide an abstraction or service layer that separates VA developed user-facing applications from the data layer in which enterprise data is stored/persisted. This

abstraction enables new applications to be developed in pure HTML5 and JavaScript, using responsive design techniques that ensure they will work on any type of end user device regardless of screen size or operating system. It also significantly reduces the complexity, time and cost of developing a new application by relieving project level programmers of the work associated with developing application specific "back-ends" by providing a single enterprise data store and reusable services by which all data is stored and retrieved.

The "Enterprise Authentication, Authorization and Audit Services" shown in two boxes across the top is a set of enterprise services that will replace kernel level, application specific security mechanisms currently used by VistA. Leveraging a set of enterprise level services built upon modern security protocols including OAuth2 and Direct Client Authentication via Public Key Infrastructure (PKI) over TLS (aka PIV Card Authentication), as well as a single auditing service that is able to track all CRUD transactions executed via Data Access Service (DAS) and EHR SOA infrastructure, this architecture enables COTS applications to be used without custom modification for VA/Government security, VA developed applications to be built without the need to code their own authentication and access control services, and, ensures that in the new environment, VA will be able to make changes to individual security policies at the data or person level, as well as generate audit logs, across the entire VA enterprise.

Combined, this use of enterprise shared services for data access, storage and control will significantly reduce both the cost and complexity of buying or building new VistA applications, while greatly enhancing security and information interoperability/consistency across the VA enterprise.

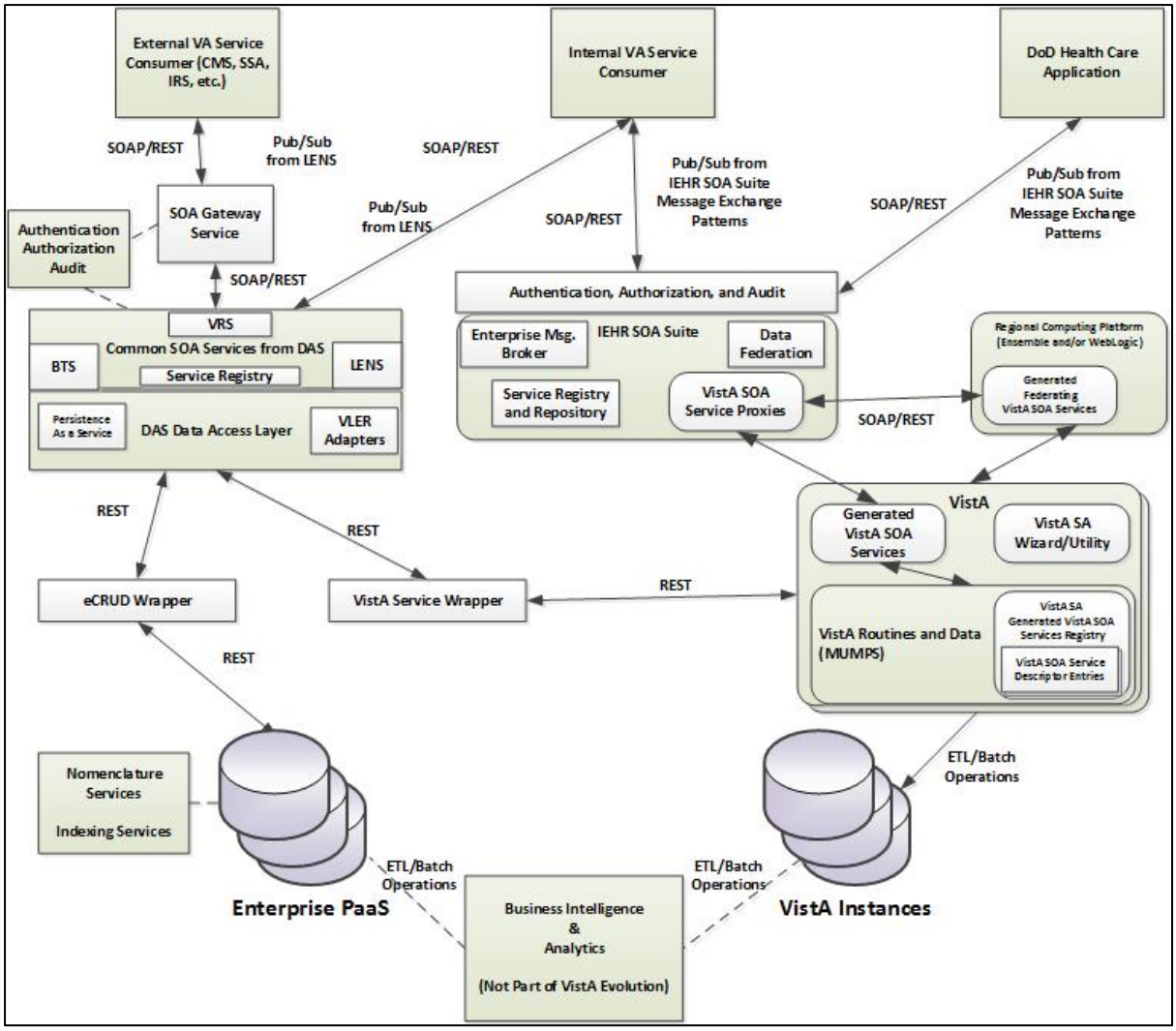

Figure 16. Enterprise Services Vision for VistA 4

6.3.7 VistA 4 Service Assembler: Conceptual Solution

To move to the target state, significant analysis of approaches will need to occur. One proposed approach is outlined below, the VistA Service Assembler. This is at the moment at the conceptual stage.

As shown in **Figure 17**, below, the VistA Service Assembler (VSA) tool and platform will leverage existing VistA application functions and data access methods while eliminating redundantly deployed business logic.

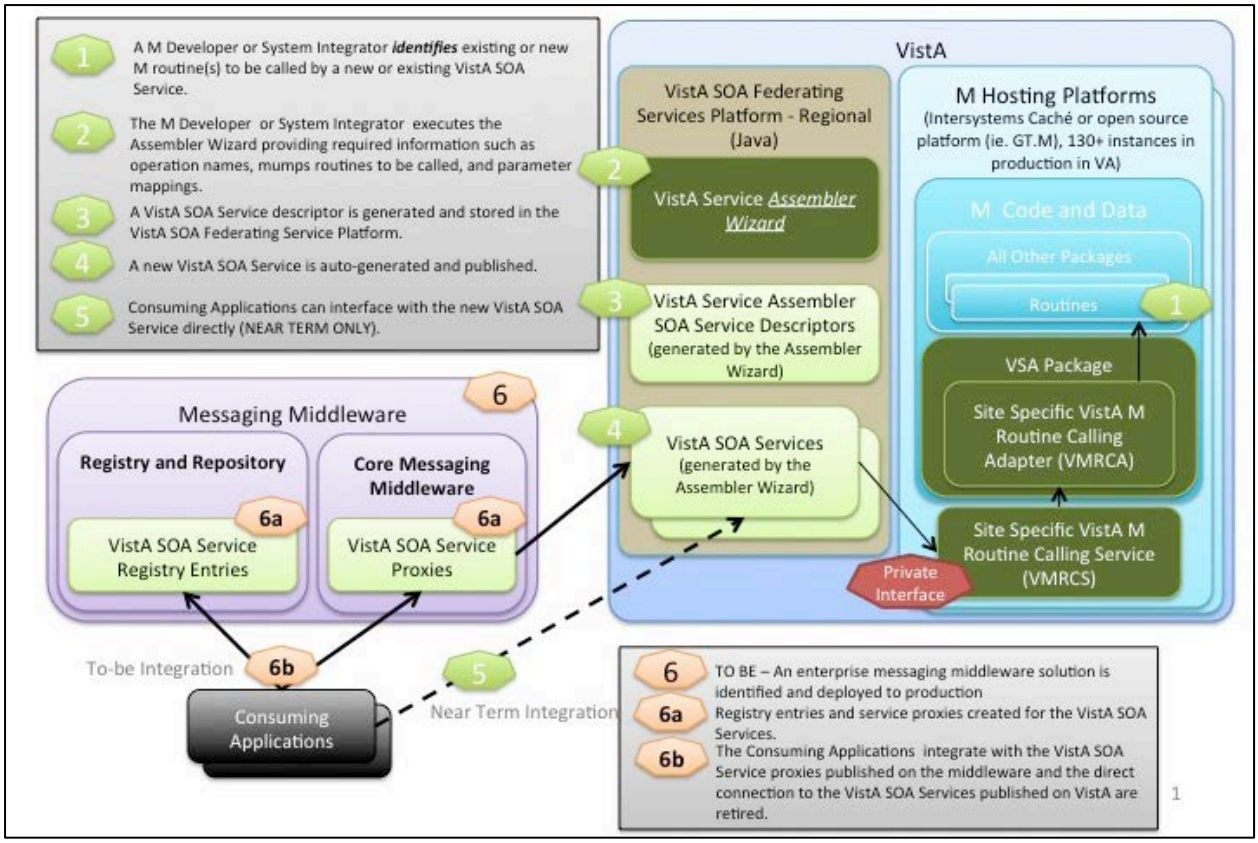

Figure 17. VistA Service Assembler (VSA) High Level

The VSA Tool and Platform facilitates an individual “plug and play” replacement of VistA applications by ensuring all corresponding business logic is positioned within the M-Code environment ‘provider application’, and by exposing SOA services directly and individually from those applications. This positioning of business logic also provides the ability to create “coarse grained” services reducing the overall chattiness. In addition, VSA provides the ability for VistA 4 to expose SOA compliant services directly or more appropriately, through proxies exposed on the VA common SOA Infrastructure.

6.4 VistA Infrastructure

Current and future components of VistA 4 require current and future infrastructure to support it, including data centers, platforms, storage, networks, client technologies, and messaging / middleware. Current and projected infrastructure needs are known for Legacy VistA systems, but are not yet known for future VistA 4 system deployments until the design, requirements analysis, and operational impacts are known and assessed. Infrastructure planning to support VistA 4 and other systems, including future deployments, can be described as an overall plan. This plan supports different deployment options for various needs that VistA 4 new deployments may have. Therefore, this section describes the known infrastructure planning that will support the options that the VistA 4 Product Set 4 deployment will presumably utilize when specific infrastructure needs are known.

As an overall summary, the deployment environment adheres to a “cloud first” policy, with mechanisms and provisions in place to assess the most appropriate cloud deployment option. This can include private cloud offerings or infrastructure/platforms hosted on public clouds, in which case VA standards and policies for virtualized platforms apply and are described.

Supporting this are platform and server configurations and standards and storage configurations and standards. These are all described along with the specific Legacy VistA configurations, which are moving toward VA standards. Legacy VistA and other applications are in the process of migrating to a smaller quantity of data centers, in accordance to data center consolidation policies and plans which are described. The networks supporting these data centers and interconnections between them are described, including the planned changes for the VistA 4 Product Set 4 timeframe. Emerging client technologies may affect VistA 4 designs, and the infrastructure to support this, including future plans, are described. Finally, the messaging and middleware infrastructure needed to support both Legacy VistA and future VistA 4 deployments are described.

6.4.1 Current VA Cloud Initiatives

VA has already leveraged this new technology and currently uses cloud services for multiple offerings related to VistA and VistA 4 deployments. The proposed laboratory solution for the VA Pathology and Laboratory Medicine Service will leverage cloud services. Moreover, the Mobile Applications Environment (MAE) uses cloud services to provide test, development, pre-production and production environments for mobile application development and the Mobile Device Management that allows for enterprise management of mobile devices. Finally, the Agile Integrated Development Environment (AIDE) uses cloud services to support development, unit testing and integration testing of solutions.

The latest cloud effort within VA, which will be available to VistA 4 deployments, is to create an Adaptive Cloud Environment (ACE). This environment provides IaaS capabilities and support services in a standardized orderable environment. This environment supports the computing requirements of multiple new and existing VA information systems by providing processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and virtual networking components (e.g., host firewalls). ACE enables VA to allocate computing, storage, and other services on demand, gaining access to a suite of secure, scalable, and flexible IT infrastructure services as required. ACE has multiple environments for use by VA including environments that meet Federal Information Security Management Act (FISMA) High controls and others that meet FISMA Moderate controls to provide flexibility as required.

At this time, the PaaS project is at full operational release provided through the AIDE effort, and expansion of that environment may leverage ACE. ACE is currently in the contracting process. Furthermore, a subsequent contract will be initiated in order to replace and expand IaaS offerings provided by ACE prior to the conclusion of the initial ACE contract. In addition, cloud brokerage service (software) is scheduled for initial delivery as a part of Product Set 1 in FY 2014 and full delivery as part of Product Set 2 in FY 2015. Cloud brokerage service uses VMWare vCenter, VMWare vCloud Director and Juniper virtual Gateway (vGW) to better govern the provisioning of IT services by acting as a service governor, enabling policy-based provisioning across private and public clouds, physical infrastructure, and multiple hypervisors.

6.4.2 Virtualization

Virtualization of systems is a foundational step to implementing the Federal Cloud First strategy and VA Directive 6517, Cloud Computing Services. VA Virtualization standards are described in One-VA Technical Reference Model v13.8.

Some VA standards that support and enforce the use of virtualization are:

- All internally developed applications shall be designed to run in virtual environments without the need for modification;
- All newly implemented projects and applications must be fully supported on virtualized platforms;
- As existing systems and applications reach the end of their useful life, they are to be migrated to virtualized platforms, and;
- Current non-virtualized projects and applications should be scheduled for virtualization re-platforming as staff and infrastructure resources allow.

These standards have been, and continue to be used for system deployments, including VistA 4 deployments. Although non-virtualized deployments exist (e.g., some legacy VistA systems), through technical refreshes, redesigns, and solution replacements, all deployments will follow the same standards and guidelines to support virtualization.

6.4.3 Virtualization of Database Back End Next Generation

The VistA 4 Product Set 4 platform will include virtualization of the back end servers. The successful evolution of the VistA front end to virtual has demonstrated that the platform is viable, however, front end systems do not access data directly as the back end does. As a result, virtualization of the back end systems requires careful planning and testing. Several options exist for Virtual Machine (VM) access to the Storage Area Network. Selection of the best option is critical and must be addressed with care to ensure data integrity and that performance measures are met.

The current deployment of virtual front-end (vFE) servers includes performance analysis and capacity planning of the virtual infrastructure. Currently, VistA front-end systems migrated into regional data centers are 33% vFE systems, and full virtualization progress is ongoing. These tools, reports, and experience implementing a full vFE for all VistA systems will be leveraged for virtual back-end (vBE) development and deployment. The schedule for these components is being re-assessed, and no definitive dates are available at this time.

6.4.4 Caché Mirroring Enhanced Disaster Recovery

The current disaster recovery implementation for VistA relies on InterSystems Caché Shadow Journal processing which is an asynchronous data replication method. Another capability contained within Product Set 4 includes the technology known as Caché Mirroring. Caché Mirroring on the production back end will introduce asynchronous mirroring to the disaster recovery instances. The asynchronous mechanisms used by Caché Mirroring compared to Caché Shadow Journal provide improvements in maintaining the integrity of the disaster recovery database due to the improved timestamps and checkpoints used by Caché Mirroring. High bandwidth comparison utilities can be modified to a reduced functionality which may free up WAN bandwidth. Caché Mirroring will not be implemented in a VistA production environment until Caché 2014.1 is released to VA by InterSystems and thorough

testing is performed by VA. Once the mirroring feature is fully tested, the Linux database back-end architecture will be re-engineered to migrate from Linux clustering to Caché Mirroring.

6.4.5 Storage

The VistA product is fully deployed to all VAMCs. To prepare VistA for the future, VA is in the process of modifying VistA to open the architecture to enable the system to provide and consume services, allow agile modification, and provide the ability to create, store, and exchange interoperable data according to established industry standards. Because of the value of medical information contained in data for patient care and medical research, data is no longer purged from VistA, requiring a large, flexible storage infrastructure that can expand with VistA while performing within the constraints of a good user experience for response time.

Previous VistA environments were implemented and managed locally at VAMCs. With the consolidation efforts, new VistA storage environments are located at National Data Center Program data centers. These data centers are more robust and provide greater /more consistent administrative functionality to the consolidated VistA environment. By leveraging these data centers, VA is more prepared to meet high availability and disaster recovery scenarios, and provide improved and consistent recovery point objectives/recovery time objectives Service Level Agreements across VHA. The consolidated VistA storage environments of Region 2 and Region 3 are engineered to meet VA TRM requirements.

6.4.6 VistA Data Center Consolidation

VA chartered the NDCP in 2009 to address the OMB Federal Data Center Consolidation Initiative requirements to reduce the federal data center footprint and improve management of IT assets throughout all agencies. In alignment with Federal Data Center Consolidation Initiative Best Practices, VA's objectives for data center consolidation and optimization, used for the VA data center consolidation effort, are:

- Consolidate data centers where possible to increase efficiency and effectively reduce ongoing operational costs;
- Shift IT data center operations to less costly, more efficient, sustainable infrastructures;
- Provide sustainable data center infrastructures with disaster recovery/continuation of operations capabilities that are appropriately sized and commensurate with the requirements of the IT systems being operated;
- Provide scalable data center infrastructures that can be cost effectively adapted to meet future IT system needs;
- Optimize space, IT asset utilization, and processing capacity to minimize environmental impacts and achieve maximum operational efficiencies;
- Provide automated and standardized security hardening of hardware and software platforms across data centers;
- Provide automated and standardized monitoring of data center assets and IT system availability and performance to improve trending capability for predicting future needs and for measuring impacts of change.

Figure 18 below provides a map of the four regional data centers and areas that they support across the VA.

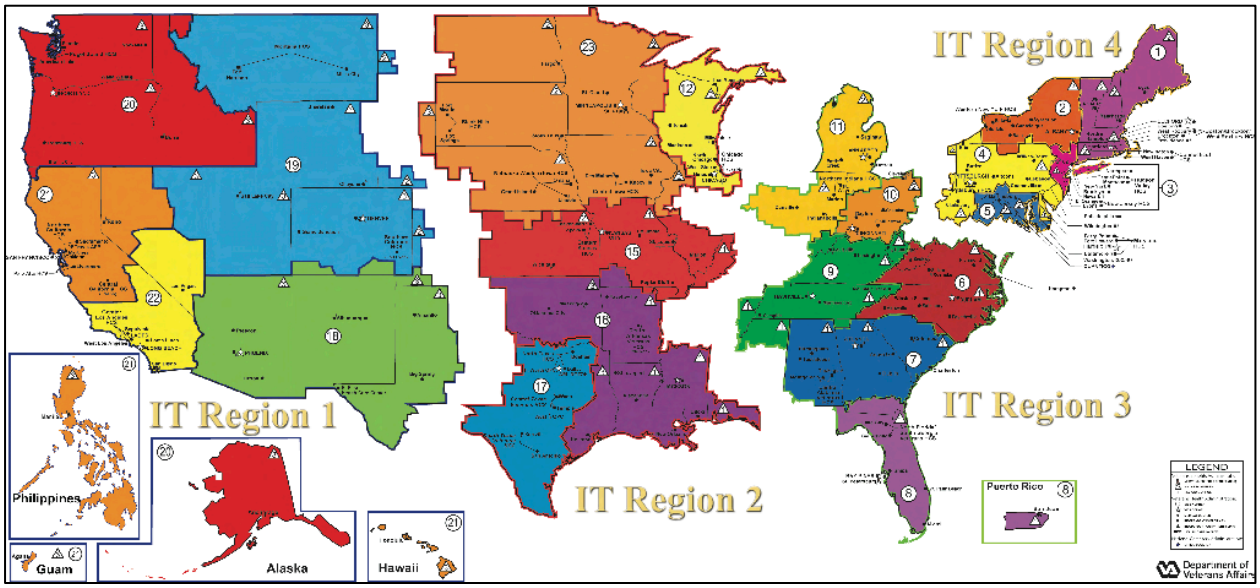

Figure 18. Regional Diagram for Data Center Consolidation

6.4.7 VistA System Data Center Infrastructure Background

VA seeks to continuously improve the data center infrastructure and architecture for VistA while protecting the mission critical health services and functions directly supported by this IT system without interruption. The following timeline, in **Table 1**, depicts the iterative improvements implemented to date aimed at full virtualization of this mission critical system:

Table 1. VistA Data Center Consolidation Timeline Through 2013

	Consolidation Timeline
2004	Commencement of system redesign to a regional infrastructure model for R1/4 VistA
2006	Completion of R1/4 VistA migrations to the regional infrastructure model
2009	Commencement of system redesign to a regional infrastructure model for R2/3 VistA
2010	OMB directive for FDCCI
2011	Change in design direction from a regional infrastructure model to a standardized enterprise infrastructure model for R2/3 VistA as a result of FDCCI Best Practices recommendations and preparation for inter-connectivity with DoD health record systems
2012	Interagency agreement with DoD space hosting services for R2/3 VistA and related systems
2012	Commencement of R2/3 VistA migrations to a standardized enterprise model with virtualized front ends
2013	Commencement of VistA testing in preparation for future migration of all VistA systems to a virtualized platform

Schedules are being re-assessed to meet the timetable identified for Product Set 4 for VistA system migrations to regional data centers. Following a pause in migrations, R2/3 migrations are resuming in FY 2014, and will continue after FY 2014.

6.4.8 Wide Area Network

VA Telecom Enterprise Systems Engineering has proposed and documented a new design called VA Next Gen WAN. This design, scheduled for implementation in FY 2014, will provide a major upgrade to the existing WAN. The business requirements that drive this methodology center around the flexibility necessary to accommodate various eBenefits, Telehealth, VistA, and other business initiatives, coupled with the deployments of various new technologies, such as Voice Over Internet Protocol, Administrative and Clinical Video, IPv6, as well as adherence to several OMB mandates. The focus of the new design is flexibility and a flat architecture that leverages the Multiprotocol Label Switching (MPLS) WAN transport technology presently deployed across VA. The new design will remove the legacy hierarchal core, distribution, and access layers in favor of a single MPLS Virtual Routing and Forwarding "Flat" design.

The proposed One VA architecture implements a fully integrated next-generation WAN architecture that:

- Optimizes VA's current WAN topology around four National Data Centers located in Philadelphia, Chicago, Denver, and Austin (TX);
- Defines two network layers across a common MPLS infrastructure, to ensure WAN performance nationwide and improve security;
- Identifies an essential set of WAN services associated to each network, ensuring availability, capacity and scalability.

The overall simplicity created by the VA Next Gen WAN is a foundational element that allows VA IT to focus on mission-based, value-add services, and avoid duplicative infrastructure. The following figures show the conceptual architecture for the future WAN.

Figure 19, below shows the future VA WAN topology with the One-VA MPLS clouds. One of these clouds uses AT&T as the service provider, and the other uses CenturyLink. As indicated in the diagram, all major nodes and some small nodes (CBOCs, branch offices, etc.), including Veterans Integrated Service Network (VISN) Data Centers, Regional Data Centers, National Data Centers, VAMCs currently connected to Region or VISN WANs, and other large VA sites currently directly connected to the VA Backbone clouds, as well as the four Trusted Internet Connect sites, will be directly connected to these two service provider clouds.

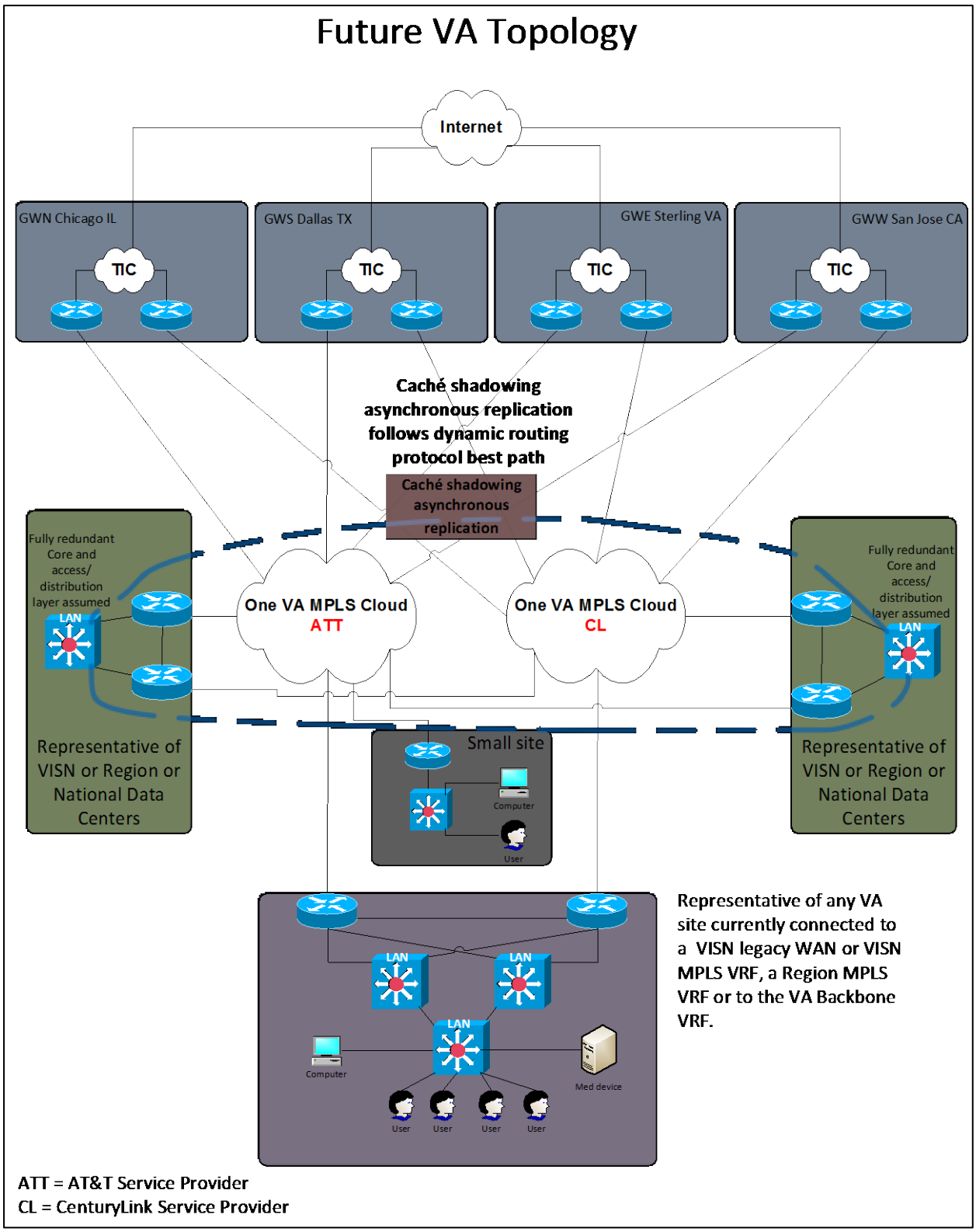

Figure 19. Next Generation WAN topology

6.4.9 WAN Acceleration

The WAN Acceleration infrastructure in VA is currently undergoing an augmentation that will transform it from approximately 22 percent coverage of major facilities to nearly 100 percent coverage of major facilities. The $15M project is adding new equipment onto VA's

WAN infrastructure to optimize the available bandwidth. For the purposes of the project, major facilities were defined to be those with greater than 250 employees.

In October 2012 the installation, configuration and turn-up of the infrastructure completed in the second region. The initial results of this implementation indicate a 50-75 percent data reduction for the traffic that was eligible to be optimized. Implementation efforts continue in the remaining regions and the project is on schedule to complete by September of 2014. Currently, the project is on time and over 75 percent complete with project closure due to complete in September of 2014.

The enhanced infrastructure will enable VA to contain escalating telecommunication costs associated with its increasing business needs while helping to ensure performance of existing critical applications across the WAN.

6.4.10 Target VistA 4 LAN

Data centers are evolving toward architectures in which networks, computer systems, and storage devices act in unison. To achieve this, data centers need an end-to-end architecture that is efficient, adaptable, and scalable. As the VA OIT organization migrates from fragmented, older data centers to more cost-effective and agile ones, they must first develop a sound architecture that can serve as the foundation for their evolution to a next-generation data center. This line of reasoning is what VA has used and will use in the future for the data centers LAN infrastructure and the supporting access LAN infrastructure for client access to those data centers.

The following is a list of targets for future LAN considerations:

- LAN access switches that provide high-speed connectivity, applications, and communications systems that efficiently and securely manage bandwidth-intensive data, voice, video, and wireless applications;
- Application Intelligence to help networks recognize many types of applications and secure and prioritize those applications to provide the best user experience;
- Unified Network Services - combining the best elements of wireless and wired networking allow you to consistently connect to any resource or person with any device;
- 10 Gigabit Ethernet technology and Power over Ethernet technology to support new applications and devices. Power over Ethernet Plus helps ensure compatibility with future versions for deployment of next generation high power devices;
- Nonstop Communications - features such as redundant hardware, and non-stop forwarding and stateful switch over technology to support more reliable connections;
- A higher available failover design for the LAN infrastructure called Multi-Chassis link aggregation used to increase operational efficiency;
- Strengthened controls over wired and wireless access to VA’s network. Secure LAN Access switches that provide end-to-end security using identity-based policy and threat intelligence capabilities, and;
- An open reference framework for programmability and control through an open source software defined network (SDN) solution. Such a framework will maintain the flexibility and choice to allow organizations to easily deploy SDNs, yet still mitigate

many of the risks of adopting early stage technologies and integrating with existing infrastructure investments.

6.4.11 Client Virtualization

Service Delivery and Engineering plans to have VA agree on a particular hardware "block" of technologies that will allow national procurement to effectively commoditize the back end compute, network, storage, and end user devices that go with the paradigm shift of moving from physical personal computers on the floor to datacenter based virtual desktops. The possible long term vision involves hosting desktops in a private hybrid cloud or pure external cloud, where VA no longer buys physical Government Furnished Equipment, but just a set number of "desktop operating system" instances from a service provider.

6.4.12 Messaging / Middleware

In November 2013, VA OIT Architecture Strategy and Design conducted an in-depth review of current messaging approaches, Service Oriented Architecture (SOA) design patterns, and tools (i.e., software) in use by the department with the end goal of reducing the operational cost of the messaging infrastructure, reducing the complexity of the current multiple messaging tools and increasing the reliability, security and stability of message transport both within the department and to external partners. As a result of this review, Architecture Strategy and Design has determined that a SOA based "Messaging Design" pattern and the use of the interagency procured ESB and other interagency procured SOA Suite components (hereinafter referred to collectively as the ESB) will be utilized by the department for VistA Evolution and other projects requiring messaging.

One of the first activities benefiting from this decision may be the transition of the current VistA interface engine (VIE) to the ESB. In 2002, VHA purchased several components of a commercial interface engine middleware suite to provide a common enterprise application messaging platform for the communication of information between clinical, administrative and managerial applications within the Department's VistA. Enterprise application messaging continues to be a mission-critical operation requiring assured message delivery between VistA and both internal and external healthcare applications. At the time of purchase, the adoption and implementation of the VIE met VA's need for an interface engine which could support multiple initiatives, and provide the common messaging platform for the communication of information.

While the need to provide enterprise messaging as described above remains; unfortunately, the current implementation of VIE has reached end of life and requires replacement. The department is assessing a possible solution which is transitioning the end-of-life VIE messaging product to the ESB with initial planning being developed to meet an estimated transition/completion date of March 2017. The ESB will continue to provide that assured communication between the current VIE supported user with little or no modification required by the individual applications that VIE currently communicates with, see Table 2, below. Use of the ESB will allow a phased transition of applications and services to the ESB with immediate roll-back to use of VIE if a problem is identified. The transition of VIE to ESB requires:

- Analysis and forecasting of messaging volumes, growth, and the degree to which applications require advanced capabilities of middleware/messaging and enterprise service bus technologies;

- Physical location of the messaging servers/technologies and the VistA databases with which they communicate must be fully understood in order to successfully locate and transition the current messaging technologies to the ESB with the least impact on existing or future network capacity;
- Current and future network capacity and trend information will remain a variable which must be understood and reviewed at known intervals with metrics collected and reviewed (i.e. capacity planning in order to ensure that the adoption and operation of a messaging/ESB technology does not result in an adverse impact to the network or result in unsatisfactory performance), and;
- The inclusion of the current VIE National Administration team in the transition discussion and activities as the department migrates to the new messaging/ESB to include:
    - Application architecture;
    - Continuity of Operations, Disaster recovery; and,
    - Message persistence to include Recovery Point and Recover Time objectives

Table 2. Applications Requiring Enterprise Messaging Middleware

Clinical Health Data Repository	Laboratory Data Standard Interchange
Claims Processing and Eligibility (CPE)	Master Patient Index
Dental Encounter System	Master Veteran Record
Data Service Interface	Outpatient Pharmacy Automation Interface
DynaMed—Includes Integrated Funds Distribution, Control Point Activity, Accounting and Procurement	Patient Appointment Information Transmission
Dynamic-Inventory Management	Remote Order Entry System
Electronic Contract Management System (eCMS)	Text Integration Utilities
Enrollment System Redesign	Veterans Enterprise Terminology Service
Federal Procurement Data System	Veterans Transportation Service (VTS)
Health Data Repository (HDR)/Interim Messaging Strategy	VistA HL7 Package
HDRII/Clinical Data Services	Ward Drug Dispensing Equipment
Home TeleHealth	

Note: Shaded applications are currently supported by the VIE message which processes approximately 12 million messages per day

6.5 VistA Standardization

Standardizing VistA across the approximately133 VA VistA instances is a delicate balance of maintaining existing clinical processes and workflow, while gaining the enterprise-wide interoperability at the heart of VA's EHR vision. The effort to standardize VistA across the VA Enterprise is being implemented in 10 increments, geographically grouping sites together.

The VistA Standardization effort completed Increment 4, consisting of the 74 iEHR Core VistA products at the two Product Set 1 deployment sites and seven other sites, and is on track to complete Increment 5 by the end of February 2014. Using overlapping increments to

assure full use of resources in a cyclical process, initial work has begun on Increments 6 and 7. Increments 5 through 10 will complete an increment every two months to complete the foundational Standardization for all 133 VAMC VistA instances in CY2014. Finally, VistA Standardization has successfully taken place at the two Product Set 1 deployment sites, which are comprised of a group of CBOC users at the Hampton VAMC, in Hampton, VA and Audie L. Murphy VA Hospital STVHCS, in San Antonio, TX.

VA utilizes automated tools to identify variance between instances of VistA and the standardized version of VistA throughout the VA's network of health centers. VistA developers work with each site to remediate the variance in a manner that does not disrupt clinical services. A waiver process for valid outliers uses a joint VHA/OIT Waiver Committee. This waiver process also catalogues all VistA variance for future reference by enterprise-wide endeavors.

6.6 Security

The implementation of VistA 4 will meet or exceed all Federal information security requirements and will utilize approved VA Office of Information Technology ProPath System Development Lifecycle (SDLC) process and the VA Office of Information Security's Software Assurance (SwA) Program. These will improve both patient identity security and information system security. Additional security will be achieved through VA's Information Security Continuous Monitoring (ISCM) and Information Security Risk Management (ISRM) programs to manage information system risk as called for in NIST SP 800-137 guidance.

VistA 4 will enhance patient data security by using improved Technical Controls, which will include SwA, ISCM, ISRM, and data encryption, both in transit and at rest.

6.6.1 Security Requirements and Policies

The implementation of VistA 4 will meet or exceed all Federal information assurance requirements including:

- FISMA;
- Health Insurance Portability and Accountability Act (HIPAA);
- Applicable National Institute of Standards and Technology standards and special publications;
- VA Directive and Handbook 6500, Managing Information Risk: VA Information Security Program; and,
- Risk Management Framework for VA Information Systems – Tier 3: VA Information Security Program respectively.

The E-Government Act, Pub. L. 107-347, 116 Stat. 2899 (2002), recognizes the importance of information and information systems to the economic and national security interests of the United States. Title III of the E-Government Act, FISMA, tasked all Federal agencies with the responsibility of developing, documenting, and implementing agency-wide information security programs, and providing risk-based information security for the information and information systems that support their operations and assets.

The transformation of the current VistA system to the VistA 4 system will utilize approved VA OIT System Development Lifecycle, obtain appropriate VA OIT management Authorization to Operate through the Assessment and Authorization process prior to implementation within VA, and will be continuously monitored to ensure that the security controls and security posture remains effective throughout its lifecycle.

In addition to following Certification Program Office and Assessment and Authorizaiton processes to support FISMA compliance in accordance with VA Handbook 6500.3 as described above, there have been notable recent security-related enhancements to VA systems development processes that VistA 4 will benefit from, compared to the current system. These enhancements are specific to building security into application source code during the development of applications at VA, to increase the level of confidence that software developed for use at VA is free from vulnerabilities. There are two areas where recent security-related enhancements to VA systems development processes have been made:

1. The first area is ProPath; which is a set of process maps that help make standard, repeatable systems development processes at the VA easier, and

2. The second area is the establishment by the Office of Information Security of an agency-wide Software Assurance Program.

ProPath is mandatory – made so by the VA CIO on December 12, 2011 in a memorandum. Security-related enhancements, which have been made to ProPath include systems development product build processes activities BLD-2 (Perform Product Component Test) and BLD-9 (Complete Security Controls Assessment). Updates to BLD-2 make performing code reviews a regular activity during development. Updates to BLD-9 make passing an independent code review a requirement to obtain an Authority to Operate, in addition to any other NIST 800-53 compliance requirements.

The overarching goal of the Software Assurance Program is to increase the level of confidence that software developed for use at VA is free from vulnerabilities. Recent program activities include working with OIT to make the aforementioned enhancements to ProPath. Recent activities also include the augmentation of Network and Security Operations Center Assessment and Authorization reviews with source code reviews. Another recent example is taking first steps to deploy secure software development tools (specifically, static analysis tools) agency-wide so that code reviews can be performed during development.

NIST Special Publication (SP) 800-53 Revision 4, Recommended Security Controls for Federal Information Systems, contains a list of security controls that are recommended for protecting Federal information systems based on the system's Federal Information Processing Standards 199 security categorization.

Security controls are implemented to protect information systems. The selection and employment of appropriate security controls for an information system are important tasks that can have major implications on the operations and assets of VistA 4.

Security controls are the management, operational, and technical safeguards or countermeasures prescribed for an information system to protect the confidentiality, integrity, and availability of the system and its information as defined below:

- Management Controls: The security controls (i.e., safeguards or countermeasures) for an information system that focus on the management of risk and the management of information system security;

- Operational Controls: The security controls (i.e., safeguards or countermeasures) for an information system that are primarily implemented and executed by people (as opposed to systems), and;

- Technical Controls: The security controls (i.e., safeguards or countermeasures) for an information system that are primarily implemented and executed by the information system through mechanisms contained in the hardware, software, or firmware components of the system. Because this document is capturing the design of the VistA 4 system, the technical controls will be discussed and expanded on in the following section.

6.6.2 Technical Controls

The federal laws, regulations, and policies that establish specific requirements for the confidentiality, integrity, or availability of the data processed, stored, transmitted, and received by VistA 4 are represented in the NIST SP 800-53 eighteen control families listed below in **Table 3**.

Table 3. Security Control Classes, Families, and Identifiers

IDENTIFIER	FAMILY	CLASS
AC	Access Control	Technical
AT	Awareness and Training	Operational
AU	Audit and Accountability	Technical
CA	Security Assessment and Authorization Management	Management
CM	Configuration Management	Operational
CP	Contingency Planning	Operational
IA	Identification and Authentication	Technical
IR	Incident Response	Operational
MA	Maintenance	Operational
MP	Media Protection	Operational
PE	Physical and Environmental Protection	Operational
PL	Planning	Management
PM	Program Management	Management
PS	Personnel Security	Operational
RA	Risk Assessment	Management
SA	System and Services Acquisition	Management
SC	System and Communications Protection	Technical
SI	System and Information Integrity	Operational

Specifically related to the Service Oriented Architecture and web services aspects of VistA 4 following NIST guidance (SP800-95) the following security actions will be considered:

- Replication of Data and Services to Improve Availability - Since Web services are susceptible to Denial of Service attacks, it is important to replicate data and applications in a robust manner. Replication and redundancy can ensure access to critical data in the event of a fault. It will also enable the system to react in a coordinated way to deal with disruptions;

- Logging of Transactions to Improve Non-repudiation and Accountability - Non-repudiation and accountability require logging mechanisms involved in the entire web service transaction. As of early 2007, there are few implemented logging standards that can be used across an entire SOA. In particular, the level of logging provided by various Universal Description Discovery and Integration (UDDI) registries, identity providers, and individual web services varies greatly. Where the provided information is not sufficient to maintain accountability and non-repudiation, it may be necessary to introduce additional software or services into the SOA to support these security requirements;
- Threat Modeling and Secure Software Design Techniques to Protect from Attacks - The objective of secure software design techniques is to ensure that the design and implementation of web services software does not contain defects that can be exploited. Threat modeling and risk analysis techniques should be used to protect the web services application from attacks. Used effectively, threat modeling can find security strengths and weaknesses, discover vulnerabilities, and provide feedback into the security life cycle of the application. Software security testing should include security-oriented code reviews and penetration testing. By using threat modeling and secure software design techniques, web services can be implemented to withstand a variety of attacks;
- Performance Analysis and Simulation Techniques for End to End Quality of Service (QoS) and Quality of Protection - Queuing networks and simulation techniques have long played critical roles in designing, developing and managing complex information systems. Similar techniques can be used for quality assured and highly available web services. In addition to QoS of a single service, end-to-end QoS is critical for most composite services. For example, enterprise systems with several business partners must complete business processes in a timely manner to meet real time market conditions. The dynamic and compositional nature of web services makes end-to-end QoS management a major challenge for service-oriented distributed systems;
- Digitally Sign UDDI Entries to Verify the Author of Registered Entries - UDDI registries openly provide details about the purpose of a web service as well as how gain acess. Web services use UDDI registries to discover and dynamically bind to web services at run time. Should an attacker compromise a UDDI entry, it would be possible for requesters to bind to a malicious provider. Therefore, it is important to digitally sign UDDI entries so as to verify the publisher of these entries, and;
- Enhancement of Existing Security Mechanisms and Infrastructure - Web services rely on many existing Internet protocols and often coexist with other network applications on VA's network. As such, many web service security standards, tools, and techniques require that traditional security mechanisms, such as firewalls, intrusion prevention systems, and secured operating systems, are in effect before implementation or deployment of web services applications.

6.6.3 Web Service Security

VA understands that because a web service relies on some of the same underlying HTTP and web-based architecture as common web applications, it is susceptible to similar threats and vulnerabilities. Web services security is based on several important concepts, including:

- Identification and Authentication - Verifying the identity of a user, process, or device, often as a prerequisite to allowing access to resources in an information system;

- Authorization - The permission to use a computer resource, granted, directly or indirectly, by an application or system owner;
- Integrity - The property that data has not been altered in an unauthorized manner while in storage, during processing, or in transit;
- Non-Repudiation - Assurance that the sender of information is provided with proof of delivery and the recipient is provided with proof of the sender's identity, so neither can later deny having processed the information;
- Confidentiality - Preserving authorized restrictions on information access and disclosure, including means for protecting personal privacy and proprietary information, and;
- Privacy - Restricting access to subscriber or relying party information in accordance with Federal law and organization policy.
- All of the above will be thoroughly addressed in the new design making improvements, where possible, over the legacy VistA system.

VA also understands the importance of secure messaging and that web services rely on the Internet for communication. Because the typically used Simple Object Access Protocol (SOAP) was not designed with security in mind, SOAP messages can be viewed or modified by attackers as the messages traverse the Internet. There are several options available for securing Web service messages:

- HTTP over SSL/TLS (HTTPS) - It is trivial to modify a Web service to support HTTPS, because SOAP messages are transmitted using HTTP;
- XML Encryption and XML Signature - These XML security standards developed by the Worldwide Web Consortium allow XML content to be signed and encrypted. Because all SOAP messages are written in XML, web service developers can sign or encrypt any portion of the SOAP message using these standards, but there is no standard mechanism for informing recipients how these standards were applied to the message, and;
- WS-Security - WS-Security was developed to provide SOAP extensions that define mechanisms for using XML Encryption and XML Signature to secure SOAP messages.

Each secure messaging option has its own strengths and weaknesses and VA will implement the best options based on the risk analysis performed balanced against needs and performance.

The VA will target the implementation to be modeled after the industry-standard web services stack as shown below in Figure 20:

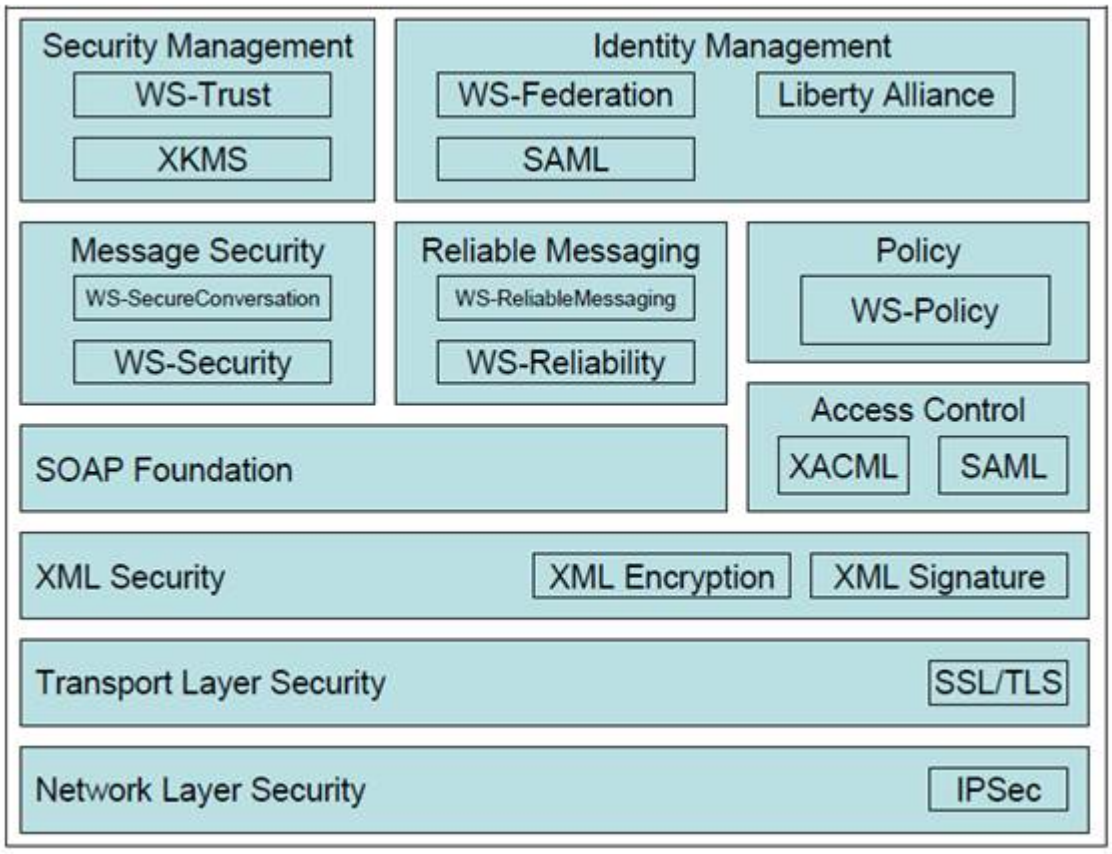

Figure 20. Industry-standard Web Services Stack

Standards at the network, transport and XML security layers are used to secure messages as they are transmitted over the network. The security standards IPsec, SSL/TLS (Secure Sockets Layer/Transport Layer Security), XML Encryption and XML Signature each operate on SOAP messages at a different level.

Above the XML Security layer, there are two types of standards: standards built on top of SOAP and standalone standards. Message security standards WS-Security and WS-SecureConversation define how to use XML Signature, XML Encryption and credentials to secure SOAP at the message layer while reliable messaging standards define the protocols and constructs necessary to ensure that messages will be received. The access control standards are not unique to web services; eXtensible Access Control Markup Language (XACML) can define the access policy for any system and Security Assertion Markup Language (SAML) can be used to define assertions in any environment. The policy layer's WS-Policy defines a grammar to communicate the policy requirements of a web service.

Security management specifications define other web services to manage credentials such as PKI certificates within the SOA. Identity management standards take advantage of access control standards, policy standards and SOAP standards to offer services for distributing and managing user identities and credentials within the SOA.

VA understands that when resources are made publicly available, it is important to ensure that they are adequately protected. Usually, web services are intended to be accessible only to authorized requesters, requiring mechanisms for access control. To perform access control, web services need to identify and authenticate one another. Several different methods are

available, including transport layer authentication, token authentication via the WS-Security specification using SAML assertions or other tokens, and the SOAP authentication header. Authorizations for web services are often done through custom implementations, but the XACML is an Organization for the Advancement of Structured Information Standards (OASIS) standard available for performing authorization decisions, eliminating the time and cost associated with developing and testing a custom solution.

Ultimately the best of breed practices for implementing and securing SOA/Web Services will be deployed by the VA throughout the lifecycle of the VistA 4 product.

6.7 Decision Support

A variety of mechanisms are in place within the current VistA systems to provide decision support capabilities. Clinical Reminders are the primary example. The reminders package provides a mechanism by which a site may define criteria to query patient data and generate reminders of suggested interventions. Order checking and order menus also provide mechanisms to assist the clinician in creating orders for a patient. Notifications alert the clinician to emerging and changing information.

There are limitations inherent to the current VistA Decision Support capability, as the existing decision support mechanisms within VistA operate on data within that particular VistA instance. Decision support, therefore, becomes limited to data obtained within a specific facility, rather than working against a more complete patient-oriented record. Each of these decision support packages must operate against the idiosyncratic representations of patient data from various other VistA packages. Also, there are very limited capabilities for sharing new logic between sites exist.

A frame-based system strongly influenced by HL7 Medical Logic Modules will provide the main "hook" for decision support modules. A frame implements a unit of logic which may be configured to be triggered by one or more events. These events may range from new data values to very specific user interactions. A frame may implement logic internally or call out to an external service. Examples of external services that may be called include the HL7 InfoButton Manager or OpenCDS decision support modules.

The Virtual Patient Record (VPR) provides a patient-centered, as opposed to facility-centered, view of a patient. Patient data may be consolidated from any number of data sources and transformed into a consistent data model. The lack of rigid specifications for the structure and content of patient data is accounted for as much as possible. The VPR allows data to be transformed into other representations for calling out to other services.

6.8 Health Management Platform

The Health Management Platform (HMP) is the software product that has been in development by the Health Informatics Initiative (hi^2). hi^2 is a major transformational initiative that was conceived to shape the future of VHA clinical information systems by promoting and fostering open, transparent communication among healthcare providers and software development teams through shared responsibility and accountability. The purpose of the initiative was three-fold: (1) assist with VHA's transition from a medical model of care to a patient-centered model of care through development of IT software modules; (2) build a sustainable collaboration between VHA and OIT to deliver timely and quality software

solutions; and (3) cultivate and invest in VA's workforce. hi^2 is now transitioning from being a major initiative to assuming an integral and foundational role as part of VistA Evolution.

HMP is built on a new extensible service oriented architecture that allows new systems to interface with legacy systems at multiple levels. HMP will provide user interface modularity and flexibility, reusable services such as ordering services, data extraction services, and search across all patient records. This modularity and service-based approach will allow for gradual replacement or reengineering of legacy components without affecting the entire system, and without impact to users.

HMP is a key part of VistA Evolution that will be delivered in Product Set 1. **Table 4**, below, lists the Product Set 1 capabilities that will be put into production, and will become the foundation from which future VistA Evolution development occurs.

Table 4. HMP capabilities that will be released in FY2014 and FY2015

Functionality	Description
Product Set 1: HMP Capabilities Planned for FY2014 Release	
Search	Search provides functionality to enter text and search for that text across both unstructured data such as progress notes as well as structured data such as lab results, vitals and medications. Search yields results for the entered search text across all domains within the patient record, including but not limited to: laboratory results, medications, vitals, demographics, allergies/reactions, radiology reports, consults, documents, orders, problems, surgical procedures and clinical observations. Clicking on a search results provides context aware details, including graphing of numerical search items (e.g., a lab result), the medication review module or textual documents with the search results highlighted within those documents. Clinically significant search terms are supported such as LOINC lab groupings, therapeutic drug class, and patient domain searches such as problems and tasks.
Medications Review	Medications review combines disparate data domains to create a more clinically relevant medication view. This view contains details including all order history for that specific medication, spark lines which provide a visual comparison of refill and dosing history, links to InfoButton, total daily dosage, and renew due date to streamline outpatient medication review. Under development for medications review are the capabilities to take specific actions on medications, assign tasks related to the patient and provide administrative data for inpatient medications.
InfoButton	Context-aware InfoButtons that provide patient-specific, evidence-based information related to laboratory tests and medications.
User/Patient Context Management and Single Sign-on	HMP TF may be launched as a standalone browser-based application or from the CPRS tools menu. To assure timely access to HMP TF functionality and to avoid patient safety risks associated with unintended display of the wrong patient's data, HMP has implemented a context management suite that provides support for patient selection/switching between CPRS and HMP.
User Interface (UI) framework capabilities required to support clinical capabilities	Use of HMP TF by clinicians in clinical settings requires development of a suite of services that enables management of the HMP framework and assures context continuity, including the Patient Selection module, Patient Bar module, Authorization and Subscription Utility (ASU) features that enable/restrict display of sensitive documents and data, and integration of a *help* module that provides timely access to context aware help.
Product Set 1: HMP Capabilities Planned for FY2015 Release	
Enhanced platform modularity / integration	HMP TF provides a platform that is modular and enables software contributions from other software development teams both within and outside the VA. The baseline modularity framework and plug-in capabilities are in test, and we plan to complete a layout manager allowing for configurable dashboards, and definition of OSGi extension points as integration points are identified. We also plan to create documentation sufficient to facilitate engagement of development partners.
Crisis Notes, Warnings, Allergies/Adverse Reactions and Advance Directives	HMP includes access to patient alert information and supporting data which is referred to in CPRS as CWAD. The baseline module is currently in test, and we will continue to enhance the module based on end user feedback from HMP pilot sites.

(CWAD) and Patient Record Flags	
Task functionality (TF)	HMP TF includes the ability to create patient tasks, share these tasks among clinical teams and prioritize tasks amongst patients. The baseline functionality is in test, and we plan to continue development of the functionality to include features that support creation, assignment, and linkages to medications as well as tracking of tasks associated with individual patients. The search functionality will also include searches of tasks.

HMP development under VistA Evolution will provide tremendous opportunities for partnering with other important development efforts. Combining the extensive knowledge and experience of the HMP team with other sources of complementary development expertise will ensure rapid evolution of the HMP product into a full, modernized EHR that achieves the goals identified for a new user experience.

6.8.1 InfoButtons

InfoButtons are an example of a current HMP capability that will be evolved through collaborative development under VistA Evolution. InfoButton implementations involve middle-tier software whose function is to process an InfoButton query and return a response containing links to relevant clinical content, similar to vendor implementations in EHRs. Today, an open source prototype version of InfoButton developed by VHA is available through OSEHRA. This is limited in scope to support the HMP and hence is not integrated with the current CPRS system.

Enhanced InfoButton capability development is currently underway at the University of Utah, under IPA from VHA for "InfoButton Query Responder." The Query Responder functionality will provide the ability to display content developed by VA or DoD, in addition to the licensed external content. The InfoButton Query Responder must be capable of: receiving an InfoButton query which is compliant with the HL7 standard, identifying content relevant to the query, assembling the resulting responses, and passing them back to the invoking application. The messaging entailed must be compliant with the HL7 InfoButton standard, for example: the OpenInfoButton open source product, available from OSEHRA.

In addition the InfoButton Manager requires a database that describes available knowledge sources using attributes defined in the HL7 standard as well as indication of availability under license to individual sites. This database must be user-configurable as for example: The LITE tool supported by the National Library of Medicine.

Other work to support InfoButton implementations includes extension of network connectivity and additional server platforms for InfoButton Query Responder, support for common web service protocols and ports, the user interface, the middle tier InfoButton Manager, and the knowledge sources.

6.9 Meaningful Use

The OMB issued a memorandum on September 17, 2010 requiring that selected federal agencies, including the VA, achieve five HIT Principle Processes by the end of FY 2012. Included in these HIT Principle Processes is the requirement to become Meaningful Users of CEHRT. It further specified that federal entities with HIT investments and activities become Meaningful Users by meeting the defined MU criteria, or demonstrating the process to meet those criteria in their systems regardless of eligibility for HIT incentive payments. The

memorandum required that recipient agencies respond with clear plans for incorporating the identified policy and technology principles by FY 2012.

6.9.1 ONC 2014 Edition Certification

VA has committed to achieving MU as defined by the American Recovery and Reinvestment Act (ARRA) of 2009 and cannot meet that commitment without implementing the EHR enhancements required for certification. The ONC establishes the certification criteria EHRs must meet to be certified. ONC periodically releases editions of the EHR certification criteria and VA is currently seeking certification of the 2014 Edition criteria in both ambulatory and inpatient settings. MU demonstration is a staged approach, where two years of MU demonstration occur in each stage before moving to the next stage.

Ultimately, the VistA 4 technology will comply with ONC's certification criteria to support demonstration of MU by VA providers and hospitals. While CPRS/VistA in its current state meets some of the certification criteria, such as computerized provider order entry and maintaining medication and medication allergy lists, many certification criteria require software development (i.e., "certification gaps"). Several examples are electronic prescribing and health information exchange of a structured summary of care record. Many certification gaps exist and must be met before VA can certify its EHR and before VA providers and hospitals can begin MU demonstration. Some of the certification gaps align with the VistA 4 capabilities shown in **Appendix C: VistA 4 Capability Descriptions, Development Work, and Value by Fiscal Year**. However, some certification gaps are exclusive to C/MU and are listed at the end of **Table 7** in **Appendix C: VistA 4 Capability Descriptions, Development Work, and Value by Fiscal Year**.

As Is: The CPRS GUI and VistA currently meets the 2014 Edition certification criteria shown below, which are needed for MU Stages 1 and 2 demonstration.

1. 170.314(a)(1) Computerized Provider Order Entry
2. 170.314(a)(6) Medication List
3. 170.314(a)(7) Medication Allergy List
4. 170.314(d)(1) Authentication, Access Control, & Authorization
5. 170.314(d)(3) Audit Reports
6. 170.314(d)(4) Amendments
7. 170.314(d)(5) Automatic Logoff
8. 170.314(d)(6) Emergency Access
9. 170.314(d)(8) Integrity
10. 170.314(a)(2) Drug-drug, Drug-allergy Interaction Checks
11. 170.314(a)(4) Vital Signs, BMI, & Growth Charts (growth charts, which we don't meet, are optional)
12. 170.314(a)(10) Drug-formulary Checks
13. 170.314(g)(4) Quality Management System

To Be: Going forward, VA will implement and deploy these initial capabilities shown below that are needed for 2014 Edition certification and MU Stages 1 and 2 demonstration.

1. 170.314(d)(2) Auditable Events & Tamper Resistance
2. 170.314(d)(7) End-user Device Encryption
3. 170.314(a)(3) Demographics
4. 170.314(a)(5) Problem List
5. 170.314(a)(8) Clinical Decision Support
6. 170.314(b)(1) Transitions of Care: Receive, Display, & Incorporate Data
7. 170.314(b)(2) Transitions of Care: Create & Transmit CCDA
8. 170.314(b)(7) Data Portability
9. 170.314(c)(1) Clinical Quality Measures: Capture and Export
10. 170.314(c)(2) Clinical Quality Measures: Import and Calculate
11. 170.314(c)(3) Clinical Quality Measures: Electronic Submission
12. 170.314(a)(11) Smoking Status
13. 170.314(b)(3) Outbound Electronic Prescribing (if VA actually intends to send outbound prescriptions, will also need to contract with an e-prescribing network, such as Surescripts);
14. 170.314(e)(1) View, Download, Print and Transmit to 3rd Party
15. 170.314(e)(2) Clinical Summary (ambulatory only)
16. 170.314(a)(14) Patient List Creation
17. 170.314(a)(15) Patient-specific Education Resources
18. 170.314(b)(4) Clinical Information Reconciliation
19. 170.314(b)(5) Incorporate Lab Tests & Values/Results
20. 170.314(d)(9) Accounting of Disclosures
21. 170.314(f)(1) Immunization Information
22. 170.314(f)2) Transmission to Immunization Registries
23. 170.314(f)(3) Syndromic Surveillance
24. 170.314(a)(17) Advance Directives (inpatient only)
25. 170.314(f)(4) Transmission of Reportable Lab Tests & Values/Results to Public Health Agencies (inpatient only)
26. 170.314(g)(2) Automated Measure Calculation
27. 170.314(g)(3) Safety-enhanced Design
28. 170.314(a)(16) Electronic Medication Administration Record (inpatient only)
29. 170.314(e)(3) Secure Messaging (ambulatory only)
30. 170.314(a)(9) Electronic Notes
31. 170.314(a)(12) Image Results
32. 170.314(a)(13) Family Health History (although it appears this will be done sooner for VistA 4)
33. 170.314(b)(6) Transmission of Electronic Lab Tests & Values/Results to Ambulatory Providers (inpatient only)

The VA intends to certify the nine ambulatory and 16 inpatient clinical quality measures listed below.

Ambulatory

1. NQF0018 Controlling High Blood Pressure
2. NQF0022 Use of High-Risk Medication in the Elderly
3. NQF0028 Tobacco Use and Screening
4. NQF0034 Colorectal Cancer Screening
5. NQF0059 Diabetes HbA1C Control
6. NQF0064 Diabetes LDL Management
7. NQF0418 Preventive Care and Screening for Depression
8. NQF0419 Documentation of Medications
9. NQF0421 Preventive Care and Screening for BMI

Inpatient

1. NQF 0495 ED-1: Emergency Department (ED) Throughput – Median time from ED arrival to ED departure for admitted ED patients
2. NQF 0497 ED-2: Emergency Department Throughput – admitted patients – Admit decision time to ED departure time for admitted patients
3. NQF 0440 Stroke-8: Ischemic or hemorrhagic stroke - Stroke education
4. NQF 0436 Stroke-3: Ischemic stroke – Anticoagulation therapy for atrial fibrillation/flutter
5. NQF 0437 Stroke-3: Ischemic stroke – Thrombolytic therapy
6. NQF 0438 Stroke-5: Ischemic stroke – Antithrombotic therapy by end of hospital day two
7. NQF 0439 Stroke-6: Ischemic stroke – Discharged on statin medication
8. NQF 0142 AMI-2: Aspirin prescribed at discharge for AMI
9. NQF 0639 AMI-10: Statin prescribed at discharge
10. NQF 0441 Stroke-10: Ischemic or hemorrhagic stroke – assessed for rehabilitation
11. NQF 0496 ED-3: Median time from ED arrival to ED departure for discharged ED patients
12. NQF 0371 VTE-1: Venous thromboembolism (VTE) prophylaxis
13. NQF 0527 SCIP-INF-1: Prophylactic antibiotic received within 1 hour prior to surgical incision
14. NQF 0453 SCIP-INF-9: Urinary catheter removed on postoperative day 1 (POD1) or POD2 with day of surgery being day zero
15. NQF 0147 PN-6: Initial antibiotic selection for community-acquired pneumonia (CAP) is immunocompetent patients
16. NQF 0528 SCIP-INF-2: Prophylactic antibiotic selection for surgical patients

6.9.2 ONC 2017 Edition Certification

Once 2017 Edition criteria are released, any required changes needed to the above criteria will be made and new criteria developed and certified by the end of September 2017.

6.10 External Collaborations/Enabling Innovations

The open source and standards community has much to contribute to the future development of VistA and it is in the interest of VA to build off of their contributions to create enhanced functionality and interoperability, standards adoption, and a more flexible technical architecture. The partnerships across the VA, DoD, and the community of health IT industry innovators, health systems, universities, and open source providers shall create a common vision of what needs to happen and create a community that will drive VistA's Open Source codebase modernization, which is the core of VA's approach to the development of VistA 4 and interoperability. The plan to achieve this goal is to develop a common understanding between VA, DoD, and the community stakeholder triangle through discussions, proofs of concepts, and pilots. The practical goal is to greatly reduce the time for VA to create and execute a plan for VA HIT modernization and to increase the quality of that plan.

VA is committed to the open source initiative. In June of 2011, VA began an open source Initiative for VistA. The Secretary of VA, the Honorable Eric Shinseki, announced an open source strategy "to engage the public and private sectors in the rapid advancement of our EHR software". This strategy is central to the care we deliver to our Veterans, Service members, and their dependents, as well as our joint EHR collaboration with the Department of Defense." Since this this new change in direction the VA has taken considerable steps to promote external collaborations and innovative activities with the external community including:

- Establishment of a VA Open Source Tiger team;
- Establishment and participation in the Open Source Electronic Health Record;
- Creation of new policy in the form of VA Directive 6402 to re-enforce VA's dedication to external collaboration and innovation with the external community;
- Use of Open Source certification of VA code base for the 74 core VistA packages;
- Creation of two new Program Offices dedicated to the promotion of external collaboration with the open source and open standards as well as private health systems provider communities.

6.10.1 VA Open Source Tiger Team

During the open source Tiger Team activities, VA successfully adopted parts of the open source HealtheMe product through MyHealth*e*Vet. VA is currently actively pursuing pilots for the VA intake of additional open source contributions. Two products that have been certified by OSEHRA are actively seeking funding for active project teams to move them forward through the remainder of the VA intake process.

6.10.2 Founding of the Open Source Electronic Health Record Alliance

Under the Freedom of Information Act, VistA has always been available from VA as "public domain" software. To date, VistA has been implemented to some extent by many non-VA healthcare facilities, including international healthcare entities. With its widespread use, there is a considerable community of VistA developers across the world that can collaborate to enhance VistA. In 2011 VA helped to establish the OSEHRA to:

> *"Build and support an open source community of users, developers, service providers, and researchers engaged in advancing electronic health record software and related*

health information technology." OSEHRA's mission includes the creation of a vendor-neutral community for the creation, evolution, promotion and support of an open source Electronic Health Record. This community will operate with the transparency and agility that characterize open source software initiatives. This entails not only the development of a community of software experts, clinicians, and implementers, but also a robust ecosystem of complementary products, capabilities and services."

Through this establishment, VA encouraged an ecosystem to promote open development of VistA and encourage collaborative innovation with some of the best minds in government, industry and academia. This collaboration and commitment to innovation is anticipated to pioneer new software developments that can address the unique challenges of future iterations of VistA.

6.10.3 VA Policy Creation and Open Source Certification

As a part of VA Directive 6402 the VA announced that all current VistA software supported at the national level will be certified by OSEHRA.

"The VistA code set will be certified and stored by the custodial agent Open Source Electronic Health Record Alliance (OSEHRA). This partnership with OSEHRA is a key element of VA's effort to innovate in the Electronic Health Record software arena, including both VistA and our joint effort with the Department of Defense (DoD) to merge the agency's systems to support common clinical processes and implement an Integrated Electronic Health Record (iEHR) as directed by the Executive Branch. This move towards an iEHR requires rigorous and consistent software configuration at all VAMCs."

6.10.4 Collaboration with OSEHRA Workgroups

VA has also taken steps to collaborate with the open source community by initiating and/or engaging in various OSEHRA workgroups. OSEHRA workgroups are defined for the purpose of collaborating around a specific topic. There are many workgroups that VA is participating in for the purpose of defining requirements for a functional capability. Clinicians, informaticists and developers engage to define and potentially build a product that will meet the needs of the open source community at large. VA is positioning itself to play a strong role in this community and as a result will be able to take advantage of the many community contributions. As VA embarks upon modernization of its VistA software, the VA will leverage community contributions as well as collaborate with the open source community. The VA will do this by openly sharing VistA roadmap artifacts, seeking community input, jointly defining requirements, and producing world-class software that will enhance the care of Veterans, Service members, and their dependents worldwide.

6.10.5 VA Established the Open Source and Open Standards Community IT Engagement Program

The Open Source and Open Standards Community IT Engagement Program (CITE) supports the reengineering and refactoring of VistA EHR components and assembling the core capabilities for VistA 4 in a market context. VHA OIA wishes to accelerate the market for open, extensible, modular EHRs, which is expected to lower costs and increase quality of EHR components in the future. Moreover, VHA OIA recognizes that it needs to draw on the rapidly improving the HIT market to maintain functional parity as the VistA 4 product is developed. The goal of this effort is to support VHA & OIT executive management team and

their goals and objectives preparing the VA for the next generation of VistA by acting as a conduit for information exchange between VHA, OIT, and the community as outlined in **Figure 21**, below.

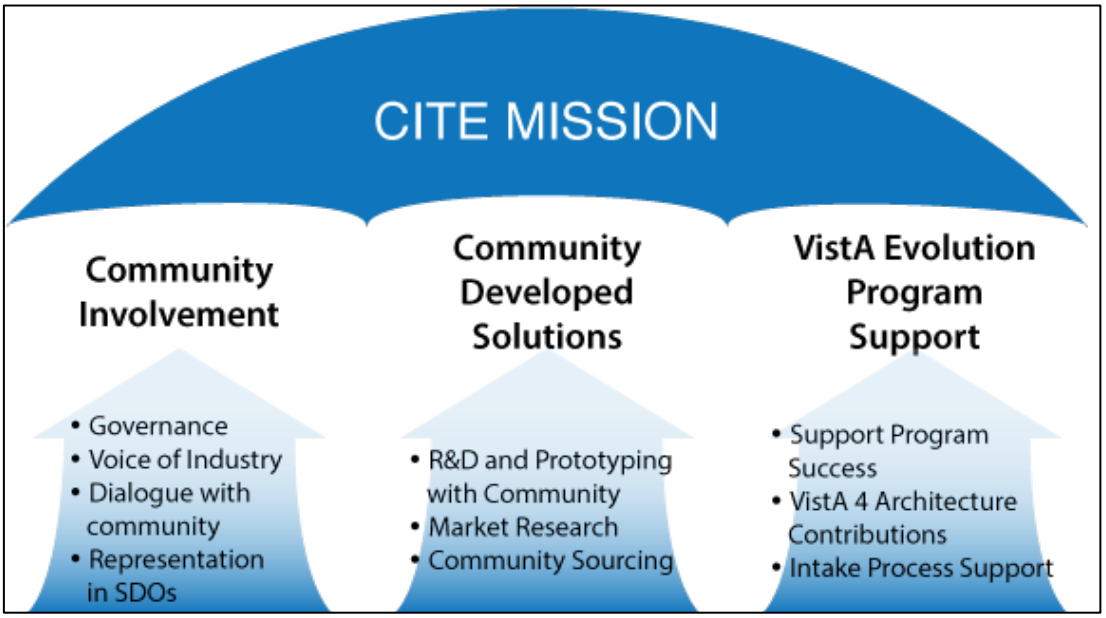

Figure 21. Information exchange between VHA, OIT, and the community

The CITE Mission focuses on the following:

1. Community Involvement: Engage in meaningful dialogue with the community on the future direction of interoperable open electronic health solutions.
2. Community Developed Solutions: Prepare the marketplace to respond to the future iterations of VistA.
3. Support the success of the VistA Evolution Program and VistA 4: Identify best practices with open standards and technologies, and incorporate open source products and services from the community back into VA.

Table 5, below, shows the activities that will be undertaken by CITE.

Table 5. CITE Activities

CITE Effort	Description
Intake Pathways	In coordination with the VHA's Strategic Investment Management Office's Open Source Office, develop a high-level plan, with the Office of Information and Technology and VistA Evolution stakeholders, for the expedited integration, development, and testing of non-OIT developed code into the VA VistA Enterprise Standard. It is anticipated that this effort will enhance quality of patient care and decrease the lifecycle development cost to the enterprise.
Communication and Engagement Strategy	Create and execute a communication and community engagement strategy including an Industry Day event, targeted at Standards Development Organizations, Open Source Community and Health Systems innovators. Provide bi-directional external VE updates and

	collaboration opportunities. Create tIndustry Day for members of the outside community to learn about the VistA Evolution Program, and invite them to bring solutions and services to the VA.
Market Research	Provide organizational and domain support in the evaluation of Community developed solutions, technologies or services as outlined by the VistA Evolution Program product development road map.
Voice of Industry Workgroup	Develop "Voice of Industry" collaboration resource where industry informatics thought leaders provide best practice domain insight and share industry lessons learned with the VA VistA Evolution Program leaders. This resource will ensure community innovation efforts are evaluated as part of the VE program.
Governance Guidance	Obtain key guidance from OGC to define an engagement protocol for approaching the "Community". Ensure compliance with the Federal Acquisition Regulation , Corporation Control Act , and Federal Advisory Committee Act. Provide a reference guide for utilizing Collaborative Research and Development Agreements (CRADA).

6.10.6 VA Established the Open Source Management Office

The goal of the Open Source Management Office is to support VHA's engagement with the Open Source community, enabling collaboration with OIT and community experts towards the development of world-class healthcare software that will empower clinicians to better serve our Veterans, Service members, and their dependents. The Open Source Management Office works closely with the Community IT Engagement Program to address topics and issues to enable VistA 4 to achieve Product Set 4 deployment.

7. Allied Projects

The VA organization has several strategic OIT initiatives that are planned for implementation which span Product Set 1 through Product Set 4's timeframe. During this timeframe other complementary and collaborative technologies will be identified that will support and advance VA's mission. The VistA Evolution Program's development and implementation team will work collaboratively with these projects to minimize the duplication of resources, functionality and infrastructure and ensure that the expected benefits are maximized. Consistent with the VistA 4 product, industry standards will be adopted across these allied projects to ensure interoperability, consistent user workflows and satisfaction.

VistA 4 will work with allied projects to minimize duplicative development efforts and confusing user workflows. As of August 2013, the following planned technical projects and activities that will be considered as Allied Projects and incorporated into the collaborative planning approach:

- Historic Clinical Data Mapping and CDW support: Federation of VA and DoD clinical health data by mapping VA data to clinically endorsed standards at the appropriate data level and use of the Health Data Dictionary and CDW. Enhance the CDW technical architecture to improve the clinical data analytics support;
- Cross VA/DoD Clinical Patient Data Viewer: Deployment of the JANUS JLV GUI to five VA polytrauma rehabilitation centers and two associated Military Treatment Facilities (MTF);
- VistA Standardization Project: The VA will attain compliance to the standard VistA instance for the 74 VistA products determined by the IPO/VHA. In FY 2014, the next seven Product Set 1 deployment sites will be standardized in Q1, followed by the rest of the VAMCs in Q2 through Q4. This standardization provides a uniform and interoperable foundation for VistA 4 rollout and is also tightly integrated with the open source custodial agent, OSEHRA. This enterprise standardization of VistA enhances the VA's ability to utilize open source, as well as decreases implementation, challenges and support costs associated with the roll-out VistA 4 enterprise enhancements, and;
- Other Allied Projects: While not yet known, VistA 4 will also coordinate with other Allied Projects that are identified such as mobile applications, Bar Code Medical Administration (BCMA), and MyHealtheVet.
- Health Medical Platform: The HMP is the software product that has been in development by the Health Informatics Initiative (hi2). hi2 is a major transformational initiative that was conceived to shape the future of VHA clinical information systems by promoting and fostering open, transparent communication among healthcare providers and software development teams through shared responsibility and accountability.

8. Principles

8.1 High-level, Long-term, Health Promoting Goals

The VistA 4 initiative must be shaped by a number of core principles, each of which is a critical success factor:

- The implementation of technology within the VA's health systems must result in seamless integration, regardless of the physical location of the information, its perceived ownership, or the organizational structure involved;
- VA's strategic technology decisions must integrate customer needs (clinicians and Veterans, Service members, and their dependents) and the organization's internal processes to drive improvements;
- VA's IT management processes must be totally integrated from the idea stage through final implementation to ensure the delivery of higher added value outcomes for customers;
- VA must maintain a creative attitude in all its informatics efforts – thinking in long-term ways, being flexible, confronting obstacles boldly, thinking broadly, and setting bold targets. The emphasis must be on long-term solutions;
- VA must move from individual technology acquisitions to the concept of technology assimilation. Design must emphasize a total systems point of view, and not just collections of capabilities;
- VA program management must value agility, responsiveness, and rapid innovation – from the response time for the user at the point of care to the ability to rapidly modify its Information Management /IT resources in response to changes in clinical practice and integrate new technology as it becomes available;
- VA must identify those system elements for which adherence to standards and standardization is essential and required (such as data definitions, data models, and data exchange) and be flexible in those elements where it is not;
- VA's information system design must provide the infrastructure and services to promote rapid development of modular functionality and allow end user optimization of personalized configuration to meet their needs and workflow;
- The VA's systems must increasingly be oriented to provide access for Veterans, Service members, and their dependents, and meet their needs through their modality of choice;
- VA should evaluate open source options when planning new technology to address unfulfilled needs, to accelerate development and reduce cost and complexity.

8.2 VistA 4 Key Dependencies and Constraints

8.2.1 Dependencies

The following external dependencies have been identified at this time.

- Stakeholders are able to contribute at predefined involvement points as identified in project plans and schedules;
- A suitable integrated test environment is available (copy of a production account that includes VistA and interoperability components) for functional and performance testing of each project. Because development of an identity management system is outside program scope, the identity management service provided by VA MVI Index will be utilized. It will serve as the identity interface to the DoD's Identity Management Service;
- An enterprise messaging solution must be deployed in support of VistA 4 messaging requirements;
- Supporting technology resources (toolsets, network resources, development/test hardware and platform software and environments) will be available on schedule in the development, test and production environments;
- Supporting infrastructure resources (security, performance testing, architecture, software distribution mechanisms, etc.) will be available on schedule in the development, test and production environments;
- Supporting network infrastructure will allow VistA 4 to meet performance metrics.

8.2.2 Constraints

- Applications must support and comply with the OneVA EA;
- Applications must comply with Section 508 Compliance criteria;
- VistA 4 must comply with IPO interoperability requirements;
- VistA 4 must meet statutory and regulatory requirements such as MU;
- Development will follow Project Management Accountability System (PMAS), tailored appropriately.

In general, the VistA Evolution Program will support the attainment of the overarching VistA 4 product requirements, aspirations and preferences outlined in **Table 6**.

8.3 Requirements, Aspirations, and Preferences

Table 6. Non-Technical Requirements, Aspirations, and Preferences for VistA 4

Domain	Requirements, aspirations, and preferences
Management	**Agile**: Require gated Agile methodology based on user stories or feature development, as appropriate to the task. **Transition:** Aspire to an orderly transition that supports incremental improvements to legacy platforms until the new platform demonstrates viability. Resource business process re-engineering and change management. **Sourcing**: Prefer open-source solutions that have robust development and user communities, especially those with commercial support. Secondarily prefer propriety technologies with robust user communities that contribute to improved technology and content, next open source and then proprietary solutions without broad use.
Technical	**SOA**: Aspire to a limited set of components and services in a service-oriented architecture (SOA) that can be reused and configured to address a wide spectrum of functionality. **Standards**: Require new components to have consistently implemented, well maintained

Domain	Requirements, aspirations, and preferences
	standards, and adequately specified APIs and service interfaces. Prefer nationally recognized open standards with broad community support. In critical areas, standards compliance remediation will be undertaken to ensure interoperability, quality, and safety. **Design**: Require compatibility with VA SOA Design Principles where applicable.Obtain ONC EHR certification.
Informatics Design	**User Experience (UX)**: Require a UX that facilitates accurate understanding of the patient's health and healthcare, appropriate decisions for interventions, and efficient execution of healthcare activities; require adherence to ONC EHR certification criteria relating to user-centered design. Minimize the number of user-interfaces in simultaneous use, e.g., CPRS plus new GUI. **Clinical Decision Support (CDS)**: Require knowledge-based systems to create and use well coded, well maintained structured data and relationships and potentially other knowledge artifacts that can be maintained independently from specific solutions **Data**: Require transactional acquisition of well-coded data from the point of care or during health related activities that can be used for measurement and improvement of healthcare processes

9. Summary

Successful implementation of this Product Roadmap will deliver a modernized, interoperable EHR, VistA 4. The evolution of VistA will establish seamless, electronic sharing of interoperable healthcare data with DoD, and other healthcare partners, in a real-time, computable manner, using existing data standards, with the objective of achieving one unified, lifetime health record for each Veteran, Service member, and their dependents. The open source, open standard, and SOA-based approach will reduce risk and cost, and increase quality and speed of HIT acquisitions and deployments. The modernization of VistA will improve quality, safety, efficiency, equity, and satisfaction in healthcare for Veterans, Service members, and their dependents.

10. Appendix A: Acronyms

Acronym	Description
ACE	Adaptive Cloud Environment
AIDE	Agile Integrated Development Environment
API	Application Program Interface
C/MU	Certification/Meaningful Use
CAS	Clinical Ancillary Services
CBOC	Community Based Outpatient Clinic
CCDA	Consolidated Clinical Document Architecture
CCR	Continuity of Care Record
CDC	Centers for Disease Control
CDS	Clinical Decision Support
CDW	Corporate Data Warehouse
CEHRT	Certified Electronic Health Record Technology
CLIM	Common Logical Information Model
CMS	Centers for Medicare & Medicaid Services
COTS	Commercial-Off-The-Shelf
CPOE	Clinician Pharmacy Order Entry
CPRS	Computerized Patient Record System
CQM	Clinical Quality Measures
CTS	Common Terminology Services
CVX	Codes for Vaccine Administered
DHCP	Decentralized Hospital Computer Program
DHMSM	DoD Healthcare Management System Modernization
DICOM	Digital Imaging Communications in Medicine
DoD	Department of Defense
EA	Enterprise Architecture
EHR	Electronic Health Record
ePrescribing	Electronic prescriptions
ESB	Enterprise Service Bus
FDCCI	Federal Data Center Consolidation Initiative
FHIR	Fast Healthcare Interoperability Resources
FISMA	Federal Information Security Management Act
FY	Fiscal Year
GOTS	Government Off The Shelf
GUI	Graphical User Interface
HDR	Health Data Repository
HEC	Health Executive Council
HHS	Health and Human Services
Hi2	Health Informatics Initiative
HIPAA	Health Insurance Portability and Accountability Act

Acronym	Description
HIT	Health Information Technology
HL7	Health Level 7
HMP	Health Management Platform
HRF	Human Readable Form
HSP	Health Standards Profile
HTTPS	Hypertext Transport Protocol Secure
IAF	Interoperability Alignment Framework
ICIB	Interagency Clinical Informatics Board
ICU	Intensive Care Unit
IEEE	Institute of Electrical and Electronics Engineers
iEHR	Integrated Electronic Health Records
IT	Information Technology
JLV	Joint Legacy Viewer
JSON	Java Script Object Notation
LAN	Local Area Network
LIS	Laboratory Information System
LOINC	Logical Observation Identifiers Names and Codes
M-Code	Massachusetts General Hospital Utility Multi-Programming System Code
MD FIRE	Medical Device Free Interoperability Requirements for the Enterprise
MDI	Medical Device Integration
MOCHA	Medication Order Check Healthcare Application
MPLS	Multiprotocol Label Switching
MU	Meaningful Use
MVI	Master Veteran Index
NDAA	National Defense Authorization Act
NDF-RT	National Drug File – Reference Terminology
O&M	Operations and Maintenance
OASIS	Organization for the Advancement of Structured Information Standards
OAuth2	Open Authorization 2
OIT	Office of Information and Technology
OMB	Office of Management and Budget
ONC	Office of the National Coordinator
OSEHRA	Open Source Electronic Health Record Alliance
PACT	Patient Aligned Care Teams
PECS	Pharmacy Enterprise Customization System
PHIN	Public Health Information Network
PHIS	Pharmacy Hospital Information System
PMAS	Project Management Accountability System
PPS	Pharmacy Product System
PRE	Pharmacy Reengineering
QoS	Quality of Service

Acronym	Description
QRDA	Quality Reporting Document Architecture
REST	Representational State Transfer
RPC	Remote Procedure Call
RxNORM	Normalized naming system for generic and branded drugs
SAML	Security Assertion Markup Language
SDN	Software Defined Network
SDO	Standards Development Organizations
SLA	Service Level Agreement
SMART	Security Management and Reporting Tool
SME	Subject Matter Expert
SNOMED	Systematized Nomenclature of Medicine
SNOMED CT	Systematized Nomenclature of Medicine - Clinical Terms
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SSL/TLS	Secure Sockets Layer/Transport Security Layer
STVHCS	South Texas Veterans Health Care System
SwA	Software Assurance
TLS	Transport Layer Security
UDDI	Universal Description Discovery and Integration
UX	User Experience
VA	Department of Veterans Affairs
VAMC	Veterans Affairs Medical Center
vBE	Virtual Back End
VFE	Virtual Front End
VHA	Veterans Health Administration
VIE	VistA Interface Engine
VISN	Veterans Integrated Service Network
VistA	Veterans Health Information Systems and Technology Architecture
VistA 4	The next iteration of the Veterans Health Information Systems and Technology Architecture
VLER	Virtual Lifetime Electronic Record
VSA	VistA Service Assembler
WAN	Wide Area Network
XACML	Extensible Access Control Markup Language
XML	Extensible Markup Language

11. Appendix B: Reference/Bibliography

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12. Appendix C: VistA 4 Capability Descriptions, Development Work, and Value by Fiscal Year

Table 7. Capability Descriptions, Development and Delivery Year, Development Work, Value and Metric

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
VistA Standardization	2014	2014	Certify 74 VistA application routines in production at Product Set 1 deployment sites	Enable the future use of open source opportunities with OSEHRA and easy cost effective modification.	Issue a certification of standardization or wavier for temporary variation.
	2014	2015	Certify 74 VistA application routines in production throughout enterprise	Enable the future use of open source opportunities with OSEHRA and easy cost effective modification.	Issue a certification of standardization or wavier for temporary variation.
Immunizations (IHS RPMS, VA Innovations Sandbox, and OpenCDS implementations)	2014	2014	Complete work to modernize VistA immunization file to include Codes for Vaccine Administered (CVX) codes, Centers for Disease Control (CDC) nomenclature of vaccines, Manufacturer, Lot #, (expiration date optionally), Vaccine Information Statement version date, and date provided to the patient. For C/MU, the following data elements are required for the Immunization Information criterion. - Vaccine Administered: - Date/Time Start of Administration - Administration Notes - Administered Amount - Substance Lot # - Substance Expiration Date - Substance Manufacturer Name	User interaction to the modernized file structure.	100% of vaccines captured and stored in CVX format at Product Set 1 deployment sites.

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
			- Route - Administration Site - - Ability to revise or delete all of information listed above for a patient in the event some or all was entered in error.		
	2014	2015	Deploy read/write/exchange with decision support for vaccines capability for coded immunizations data and that is integrated into UX. Bidirectional immunization sharing (C/MU standard of Health Level Seven (HL7) 2.5.1 Implementation Guide for Immunization Messaging, Release 1.4.).	Patient can exchange data with community, resulting in patient-centric immunization history. The modernized immunization data is exchangeable with the external community, so a patient vaccine record is patient-centric and not facility or department (VA/DoD) centric. Providers have more complete data and more easily provide appropriate immunizations.	MU Stage 1: Performed at least one test of certified EHR's ability to submit electronic data to immunization registries and follow-up submission if the test is successful. MU Stage 2: Successful ongoing submission of electronic immunization data to an immunization registry or immunization information system for the entire EHR reporting period (MU).
Laboratory	2014	2014	Laboratory expects to pursue open competition to secure an evolved LIS product in 2014. The LIS will address practice guidelines currently not met, data and standardization, and support the interoperability of laboratory health data and information between VA and DoD and external partners. Standardization and site preparation as well as business governance structure can be achieved at the Product Set 1 deployment sites in 2014.	The improved clinical functionality provided by the laboratory capability will result in increased productivity within the laboratory environment, significant improvements and expansion of interfacing capabilities on a variety of platforms including instrumentation and reference laboratories, as well as data exchanges between VA & DoD.	Demonstrate lab standardization at the Product Set 1 deployment sites. MU Stage 1: More than 40% of all clinical lab test results ordered by the provider/hospital who results are either in a positive/negative or numerical format are incorporated in the EHR MU Stage 2: Same as

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
				Furthermore, with the business standardization of laboratory files and processes, more appropriate ordering of laboratory requests by clinicians will be an additional benefit. Ultimately, patient care will be delivered in a safer and higher quality environment across the enterprise.	above except more than 55%.
	2014	2014	Alpha site deployment of current LOINC (lab result name) tables.	Supports development of updated CDS rules	Demonstrate system ability to display of LOINC tables at alpha sites
	2014	2015	Enterprise deployment of current LOINC tables with updating capability (to retain current versioning of LOINC)	Meets MU criteria for laboratory data exchange and reduces terminology mediation requirements with clinical partners.	Demonstrate system ability to display Logical Observation Identifiers Names and Codes (LOINC) tables enterprise-wide (100% of sites).
	2016	2019	Enterprise-wide deployment will be completed.	Standard laboratory system across VA enterprise.	Following successful LIS deployment at 2 VA medical facilities in 2016, the LIS will be deployed at 25 VA medical facilities every 6 months, starting in 2017.
Search (hi2 and VA Informatics and Computing Infrastructure (VINCI) innovations, Lucene)	2014	2014	Deploy basic search capability based on text strings to search structured and text data that accesses longitudinal record from all sources. Develop concept-bases searchers using natural-language-processing techniques.	Provides functionality to enter text and search for that text across both unstructured data such as progress notes as well as	MU Stage 1: N/A. MU Stage 2: Enter at least one electronic progress note created, edited, and signed for more

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
				structured data, such as lab results, vitals, and medications. Related to the Electronic Notes C/MU criterion for MU Stage 2. Search yields results for the entered search text across all domains within the patient record.	than 30% of unique patients with at least one office visit/admitted to the inpatient ward or emergency department. The text of electronic notes will be searchable (MU) and may contain drawings and other content.
	2014	2015	Deploy more robust searches that include concepts and auto-complete.	Enable more sensitive and specific searches. Search suggests auto-complete terms as they are entered. It will also have the ability to filter by specific domains.	Demonstrate system ability to perform auto-completion.
InfoButtons (VA innovations project, open-source solutions at other care systems)	2014	2014	Deploy buttons next to laboratory test, conditions, problem lists, and medications that, when clicked, take the user to Web-based content corresponding to the adjacent laboratory test, condition, or medication. Deploy case-specific links in the "clinical GUI" to knowledge relevant to task (e.g., medication review), object (e.g., medication), and patient (e.g., gender, age) as defined by the HL7 standard.	Clinicians have rapid access to information about laboratory test, conditions, and medications. EHR Cert/MU: InfoButtons (CDS and Patient-specific Education criteria; high priority)	Clinical Decision Support: 1. MU Stage 1: Implement one CDS rule. 2. MU Stage 2: Implement five CDS interventions related to four or more clinical quality measures at a relevant point in patient care. Absent four measures, the CDS interventions must be related to high-priority health conditions. Patient-specific Education Resources: 1. MU Stage 1 and Stage 2: More than 10 percent of all unique patients seen by

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
					provider/admitted to the inpatient ward or emergency department are provided patient-specific education resources identified by InfoButton technology (MU).
	2014	2015	Deploy InfoButton functionality available in non-"read only" components of the user interface (e.g., ordering dialogs).		Demonstrate system ability to link order dialogues to InfoButtons and display pertinent information.
Medication Review	2014	2014	Deploy Medication Review capabilities, which will combine disparate data domains to create a more clinically relevant medication view. This will align with the standards developed in patient medication information in the VHA Essential Medication Information Standards Directive.	This view contains details including all order history for that specific medication, spark lines which give a visual representation of refill history, links to InfoButtons, total daily dosage, renew due date, and relevant actions such as discontinue or renew. This functionality contributes to medication reconciliation and patient medication information management.	Demonstrate system ability to display enhanced medication data in UX.
	2014	2015	Develop additional functionality to be determined by clinical users as part of the agile development process.		
Radiology Protocols (Radiology Protocol Tool and Recorder [RAPTOR] innovation	2014	2014	Deploy national server that is scalable to enterprise.		Demonstrate functional deployment of national server.

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
project)					
	2014	2015	Deploy in production environment at the Product Set 1 deployment sites and four additional pilot sites.	Allows for electronic protocoling for radiology examinations.	Demonstrate system ability to generate radiology protocol during radiology ordering process.
Annotation (alpha release of VINCI Chart Reviewer)	2014	2015	Deploy pilot functionality with capability to "highlight" spans of text and structured data with a virtual pen and indicate that the collection of annotations correspond to a classification (such as a diagnosis).	Allows rapid data capture for and auditing of historical data used to make determinations of service connection and level of disability.	Demonstrate system ability to provide chart annotation with correspondence to appropriate classification.
	2014	2015	Deploy simple interfaces that display machine highlighting of data based on natural language processing.	Provides automatic data assembly to support diagnosis and disability evaluations that make these findings faster and more accurate.	Demonstrate system ability to automate highlighting of data.
	2015	2016	Deploy more robust interfaces and information finding that address condition-specific guidelines.	Enables providers to more easily determine whether criteria for condition are met.	
Structured data capture (Adapt innovations project and HI contract work)	2014	2015	Deploy data-capture templates for select conditions, including family and military history coded data sets. Deploy a structured data entry form ("Smart template") for Family Health History integrated with CPRS that is capable of gathering coded data from the point of care and storing it in a patient centric data centric store. Deploy a structured data entry form ("Smart template") for Burn Pit Exposures integrated with CPRS that is capable of gathering coded data from the point of care and storing it in a patient centric	Allows capture of semi-structured data for family history, military history, and disability benefits qualifications, among many other types. Capture smoking status data per the Systemized Nomenclature of Medicine (SNOMED) standard. EHR Cert/MU - Directly addresses family history.	Templates: MU Stage 1: More than 50% of all unique patients 13 years old or older seen by provider/admitted to the inpatient ward or emergency department have smoking status recorded as structured data (MU) MU Stage 2: Same as above except >80%.

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
			data centric store.	HL7 v3 Clinical Genomics, Pedigree or SNOMED CT July 2012/US Ext. March 2012 release. Record at least one parent, child, and one sibling for EHR Cert/MU. Structured data capabilities help address numerous other criteria.	Data Entry: MU Stage 1: N/A MU Stage 2: More than 20% of all unique patients seen by provider/admitted to the inpatient ward or emergency department have a structured data entry for one or more first-degree relatives (MU).
	2015	2016	Deploy editor for data sets corresponding to conditions, etc. Add semantic reasoning to automate data capture.	Allow customizations of templates. Speeds capture of coded data in the course of work.	Demonstrate system ability to customize templates based on condition via semantic reasoning
Population Health Modules (Uses applications developed by hi2 and services by VINCI)	2014	2015	Deploy capability to display in VistA 4 user interface read-only modules that use high-throughput analytical routines to process and present data from the Corporate Data Warehouse (CDW). Start work on integration of ordering. Develop population health functionality at the POC using local data	Provides safe way to pilot read-only decision support at point of care. Initial modules support antibiotic stewardship and hospital infection surveillance. Clinical decision-support; Timely electronic access to health information. The infrastructure to support population analytics regardless of data origin (i.e., can flexibly support consumption of VHA or DoD data) Meets EHR Cert/MU for syndromic surveillance (This criterion requires: HL7 2.5.1 and specific	Demonstrate system ability to display CDS related to ideal antibiotic selection via analysis of CDW data. Demonstrate system ability to place order from population health module. MU Stage 1: Performed at least one test of EHR's ability to provide electronic syndromic surveillance data to public health agencies and follow-up submission if test is successful (MU) MU Stage 2: Successful ongoing submission of electronic

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
				Public Health Information Network (PHIN) messaging guide for syndromic surveillance and an associated addendum and conformance clarification.)	syndromic surveillance data to a public health agency for the entire reporting period (MU)"
	2014	2015	Deploy capability to display in VistA 4 user interface read-only modules that use high-throughput analytical routines to process and present data from the Corporate Data Warehouse (CDW). Start work on integration of ordering. Develop population health functionality at the POC using local data	Provides safe way to pilot read-only decision support at point of care. Initial modules support antibiotic stewardship and hospital infection surveillance. Clinical decision-support; Timely electronic access to health information. The infrastructure to support population analytics regardless of data origin (i.e., can flexibly support consumption of VHA or DoD data) Meets EHR Cert/MU for syndromic surveillance (This criterion requires: HL7 2.5.1 and specific Public Health Information Network (PHIN) messaging guide for syndromic surveillance and an associated addendum and conformance clarification.)	Demonstrate system ability to display CDS related to ideal antibiotic selection via analysis of CDW data. Demonstrate system ability to place order from population health module. MU Stage 1: Performed at least one test of EHR's ability to provide electronic syndromic surveillance data to public health agencies and follow-up submission if test is successful (MU) MU Stage 2: Successful ongoing submission of electronic syndromic surveillance data to a public health agency for the entire reporting period (MU)"
	2015	2018	Deploy ordering ability to change care directly from	Creates seamless workflows for clinicians	Demonstrate ability to change care from population

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
			the population user interface. Deploy additional modules. Expansion of the system to include write-back functionality including limited types of orders and note entry. Scaling of the system to additional sites and to additional use cases, including visual data analytic tools for custom defining patient cohorts and analyzing selected performance & outcome metrics. Adaptation of existing tools to DoD data and use cases.	and increases probability of compliance with recommendations. Clinical decision-support; Timely electronic access to health information; to some extent, CPOE and electronic notes in patient records. Tools for population analytics that are data agnostic, operating seamlessly on both VHA and DoD data, providing same functionality for both settings.	health module.
Secure Messaging (Virtual Lifetime Electronic Record (VLER) Health prototype)	2015	2016	Deploy provider to provider messaging within the user interface	Demonstrate secure messaging requirements for MU.	MU Stage 2: A secure message was sent using the electronic messaging function of by more than 5 percent of unique patients seen by a specific provider (MU).
	2015	2017	Deploy creation of metadata that allow secure messages to be linked to the context of care in which they were created to which they pertain and integrate in UX.	Help providers more easily read and understand communications that are presented in context of workflow.	Demonstrate ability to link secure message to context of care
Inferencing (Agency for Healthcare Research and Quality (AHRQ) and HI prototypes)	2014	2015	Develop and integrate infrastructure for semantic-web reasoning and populate knowledge bases for NDF-RT, patient goals, and observations.		Demonstrate system ability to populate specified knowledge bases.

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
	2015-2016	2016-2017	Deploy sophisticated UX that shows longitudinal and cross-sectional relationships of complex data. Help clinicians quickly generate assessments and plans with a few clicks based on orders.	Based on randomized controlled trial, increases speed of charting and increases accuracy of diagnoses.	Demonstrate system ability to display longitudinal and cross-sectional relationships of complex data in UX
Activity Management (No identified prototype)	2014	2015	Integrate resource management services and create task-communication protocols		Demonstrate system ability to create task-communication protocol.
	2015	2016	Deploy task management services that allow any team member or patient to task others according to protocols; capability to automatically assemble care plans	Greatly facilitates team management	Demonstrate system ability to task team members and auto assemble care plans based on protocols.
	2016	2017-2018	Integrate task management with scheduling	Provide seamless management of resources for virtual and physical interactions with patients.	Demonstrate system ability to integrate task management with scheduling.
Medication Reconciliation (AHRQ- and ONC-funded prototypes)	2014	2015	Display interactive medication lists from longitudinal record and allow copying of results into text document. This will align with the business needs and requirements as outlined by the Patient Centered Medication Information Management/ Medication Reconciliation NSR #20100914.	More robust medication reconciliation that aligns with VA business needs. Adds automatic measuring capability to the current VHA Medication Reconciliation Quality Indicators	MU Stage 1 and 2: Demonstrate that the provider/hospital performs medication reconciliation for more than 50% of transitions of care in which the patient is transitioned into the care of the provider/admitted to ED/hospital (MU).
	2015	2016	Use semantic reasoning and knowledge bases to link medications to conditions and goals of care. Reconciled medications are automatically updated in VistA.	Full reconciliation of medications to conditions and goals of care.	Demonstrate system ability to link medications to a condition and/or a goal of care
ONC-SHARP Apps (Integrate prototyped	2014	2015	Deploy Disease Monographs that bring together laboratory, pharmacy, and other information on	Helps clinicians more rapidly understand patient	Demonstrate system ability to deploy integrated disease

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
tools)			common diseases.	status and make decisions.	monograph.
	2015	2016	Mature platform and deploy other applications.	Provides a platform for others to add functionality to UX.	Demonstrate platform functionality with ability to iteratively add apps
Pharmacy	2014	2015	Continue to deliver Pharmacy Reengineering (PRE) functionality while migrating to the new interoperable Pharmacy system. PRE has a schedule of components to be delivered for FY 2014 through FY 2016. Provide an interoperable Pharmacy system to share information with DoD. Deliver Maximum single dose checks, enhancements to current MOCHA order checks, total daily dose checks, Pharmacy Product System-National v2 (RxNorm data to standardize interoperable medication terminology, real time updates), Pharmacy Enterprise Customization System v6 (enhanced customization for order checks). Acceptance of eprescribed prescriptions through NCPDP interoperable standard.	Interoperability with DoD Facilitate ePrescribing through the adoption of NCPDP standards and use of RXNorm terminology. Improved CDS for medication ordering and fulfillment will support meaningful use.	Meet timetable for delivery of functional PRE components for FY 2014 – FY 2016. Demonstrate system ability to perform maximum single dose checks and daily dose checks. Demonstrate ability to transmit pharmacy order from VA system to DoD system.
	2014	2015-2018	Pharmacy Re-engineering Project will deliver functionality that provides standardized terminologies nationally and locally, and CDS as a phased in migration to the overall VA Pharmacy Solution.		Demonstrate system ability to capture pharmacy data in standard terminology at the Product Set 2 deployment sites by 2015
Medical Information Bus (MIB)	2014-2015	2015-2016	Integrate open-standards MIB that connects medical devices for ICU monitoring, ventilation, and imaging to VistA 4, stores appropriately reduced data in VistA 4, and uses the data for computerized decision support.	The MIB-VistA 4 integration will allow providers to view device data in the context of other EHR information for more efficient workflows, It will	Demonstrate system ability to capture device data through MIB.

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
				also allow these data to work into decision support and improve quality of care.	
ePrescribing	2014	2015	Deploy ePrescribing functionality based on open source solutions.	Meets EHR Cert/MU criteria Improves capability of reconciling medications filled outside the VA.	MU Stage 1-Providers: More than 40% of all prescriptions written by the provider are transmitted electronically (MU). MU Stage 1-Hospitals: N/A MU Stage 2-Providers: More than 50% of all permissible prescriptions, or all prescriptions, written by the provider are queried for a drug formulary and transmitted electronically (MU) MU Stage 2- Hospitals: More than 10% of hospital discharge medication orders for permissible prescriptions (for new, changed, and refilled prescriptions) are queried for a drug formulary and transmitted electronically (MU).
EHR Certification/ Meaningful Use – Criteria Supporting Meaningful Use Stage 1 Demonstration	2014	2015	Demographics-Preliminary Cause of Death (inpatient only): In case of mortality in VA hospital; no required vocabulary standard.	All listed meet EHR Cert/MU criteria to support MU Stage 1 demonstration by VA providers and hospitals (first priority for this effort).	MU Stage 1: More than 50% of all unique patients seen by the provider/admitted to the inpatient ward or emergency department have demographics recorded as structured data (MU) MU Stage 2: Same as above except more than

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
					80%.
	2014	2015	View, Download, Print and Transmit to 3rd Party: A consolidated Clinical Document Architecture (CDA) that relies heavily on vocabulary standards that will likely require mapping in some cases; changes to MHV; logging when patient/authorized representative views, downloads, or transmits the CCDA.		More than 50% of all patients who request an electronic copy of their health information are provided it within 3 business days (MU) MU Stage 1 and Stage 2-Providers: More than 50% of all patients seen by provider are provided timely online access (within 4 business days) to their health information (MU) MU Stage 1 and Stage 2-Hospitals: More than 50% of all patients discharged from inpatient/ED have information available online with 36 hours of discharge (MU) MU Stage 2 (add'l measure)-Providers & Hospitals: More than 5% of all patients seen by provider/discharged from inpatient/ED actually view, download, or transmit to 3rd party their health information.
	2014	2015	Clinical Summary (ambulatory only): Formatted to CCDA standard and in Human Readable Form (HRF); ability to customize data included in the summary; tracking date/time provided to patient.		MU Stage 1: Clinical summaries provided to patients for more than 50 percent of all office visits within 3 business days (MU) MU Stage 2: Same as

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
					above but summary must be provided within 1 business day.
	2014	2015	Patient Lists: Electronically and dynamically select, sort, access, and create lists by date and time for each one and one combination of the following: problems, medications, medication allergies, demographics, lab tests/values/results, and patient communication preferences-ambulatory only.		Patient List: MU Stages 1 & 2: Generate at least one report listing patients of the provider/hospital with a specific condition (MU) Reminders: MU Stage 1-Providers: More than 20% of all patients 65 years or older or 5 years old or younger were sent an appropriate reminder MU Stage 2-Providers: More than 10% of all patients who had two or more office visits with the provider in past 24 months before reporting period were sent a reminder, per patient preference when available.
	2014	2015	Advance Directives (inpatient only): Electronically record whether a patient has an advance directive (must be recorded in a way that can be queried for MU reporting).		MU Stages 1 & 2: More than 50% of all unique patients 65 years old or older admitted to the inpatient ward or emergency department have an indication of an advance directive status recorded as structured data (MU).
	2014	2015	Transitions of Care-Receive, Display, Incorporate Transition of Care/Referral Summaries: Receive with Direct and display in HRF all of the following: Continuity of Care Document (CCD), Continuity Care Record (CCR),, and CCDA; e-incorporate		MU Stage 1: The provider/hospital that transitions or refers their patient to another setting of care or provider of care

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
			medication, medication allergy, and problem list data from a CCDA. NOTE: For data incorporated from non-VA provider, must also generate CDS alerts/reminders as part of the CDS criterion. Also, data incorporation likely to be closely related to Clinical Information Reconciliation criterion shown below.		provides a summary of care record for more than 50% of transitions of care and referrals (MU) MU Stage 2 (3 measures): 1. Same as Stage 1 above. 2. The provider/hospital that transitions or refers their patient to another setting provides a summary of care record for more than 10% of such transitions/referrals either by: (a) Electronically using certified EHR, or (b) Where recipient receives the summary via facilitated exchange, such as NwHIN Exchange 3. Provider/hospital must satisfy one of the following: (a) Conducts one or more successful electronic exchanges of a summary with a recipient using EHR different than the sender's (b) Conducts one or more successful tests with CMS designated test EHR.
	2014	2015	Transitions of Care-Create and Transmit Transition of Care/Referral Summaries: Create and transmit CCDA with Direct; data mapping needed; provide ability for providers and hospitals to initiate the transmission of the CCDA to a non-VA provider.		Same as above.

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
	2014	2015	Incorporate Lab Tests and Values/Results (ambulatory required, inpatient optional): Electronically receive and incorporate in accordance with (IAW) HL7 Version 2.5.1 Standards & Interoperability (S&I) Framework Lab Results Interface and minimum LOINC v2.40 June 2012. Display required test report information. NOTE: Must generate CDS alerts/reminders as lab data is incorporated.		More than 40% of all clinical lab test results ordered by an authorized provider for patients admitted to the inpatient ward or emergency department during the EHR reporting period whose results are either in a positive/negative or numerical format are incorporated as structured data (MU).
	2014	2015	Transmission of Reportable Lab Tests and Values/Results (Inpatient only): Requires HL7 2.5.1 Electronic Lab Reporting to Public Health, Release 1 implementation specifications with errata and clarifications, minimum SNOMED July 2012 and March 2012 US Extension and LOINC v.2.40 June 2012.		MU Stage 1: Perform at least one test of capacity to provide electronic submission of reportable lab results to public health agencies and follow-up submission if the test is successful (unless none of the public health agencies has the capacity to receive the information electronically), except where prohibited (MU) MU Stage 2: Successful ongoing submission of electronic reportable laboratory results from certified EHR to a public health agency for the entire EHR reporting period.
	2014	2015	Clinical Quality Measures: Electronically record required data elements for each selected measure where either recorded with or mapped to required vocabulary which is primarily SNOMED; ability to		Objective is incorporated directly into the definition of a meaningful EHR user and eliminated as an

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
			generate generate Quality Reporting Document Architecture (QRDA) Category I (patient-level) data files; electronically calculate at least 9 ambulatory and 16 hospitals measures; create and export QRDA Category III (aggregate measure results) data files. Plan is to report from CDW using open source tool popHealth. HOWEVER, there will likely be data elements that need to be added to CPRS/VistA for inpatient measures and extensive vocabulary mapping is needed to create QRDA files. Contract awarded 7/26/13 will result in reference implementation on non-VA hosted environment that will need to be replicated on VA server.		objective (MU) MU Stages 1 & 2-Providers: Requires providers to submit to CMS clinical quality measure data calculated by the certified EHR for 9 ambulatory measures MU Stages 1 & 2-Hospitals: Same as above except for 16 inpatient measures.
	2014	2015	Data Portability: CCDA represents patient's most current clinical information as represented in the EHR, not what is included in a previously generated CCDA if CCDAs aren't run on a daily basis.		N/A (certification requirement only).
	2014	2015	Automated Measure Calculation: Electronically report all MU measures that report a percentage, such as % of patients seen by provider with all demographic data recorded. Likely to be data elements that must be added to report this data, such as the date/time a clinical summary provided to a patient regardless of how it was provided. ALL measure logic must be developed by working with domain SMEs (e.g., how do we identify a transition of care and a referral and exclude internal referrals/consults). Once logic is written, need to determine from where/how reports will be generated. Options are OABI from Clinical Data Warehouse (CDW) or Health Management Platform (HMP). Must be able to periodically run reports for individual providers and entire hospitals to monitor performance since these reports determine if they meet MU demonstration criteria.		N/A (certification requirement only).
	2014	2015	Safety-Enhanced Design: Apply user-centered design (UCD) and provide summative usability		N/A (certification requirement only).

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
			testing report information for the following: CPOE, Drug-Drug/Drug-Allergy Interaction Checks, Medication List, Medication Allergy List, CDS, Electronic Prescribing, Clinical Information Reconciliation, and Electronic Medication Administration Record.		
EHR Certification/ Meaningful Use – Criteria Supporting Meaningful Use Stage 2 Demonstration	2015	2017	Electronic Medication Administration Record (inpatient only): Use assistive technology providing automated information to e-verify the five "rights" before administering medications and e-record date/time when medication is administered. .	All listed meet EHR Cert/MU criteria exclusive to MU Stage 2 demonstration by VA providers and hospitals (second priority for this effort).	MU Stage 2: More than 10% of medication orders created by authorized providers on the inpatient ward or in the emergency department for which all doses are tracked using eMAR (MU).
	2015	2017	Image Results: Electronically indicate to a user the availability of a patient's images and narrative interpretations (relating to the radiographic or other diagnostic test(s) and enable electronic access to such images and narrative interpretations.		MU Stage 2: More than 10% of all tests whose result is one or more images ordered by the provider during the EHR reporting period are accessible (MU).
	2015	2017	Transmission of Electronic Lab Tests and Values/Results to Ambulatory Providers (inpatient only): Same required standards as Incorporate Lab Tests and Values/Results criterion. "Focuses on the proper implementation of the lab results interface specification. How or by what means the lab test report gets to [an ambulatory provider] is not currently within the scope…and in part is likely dictated by other regulatory requirements, such as the Clinical Laboratory Improvement Amendments (CLIA) rules."		MU Stage 2: More than 55% of all clinical lab tests results ordered by the provider whose results are either in a positive/negative or numerical format are incorporated as structured data Hospital labs send structured electronic clinical lab results to the ordering provider for more than 20% of: (a) The electronic lab orders received, or (b) The lab orders received.

Capability (Maturity)	Devel. Year	Deliver Year	Functionality and infrastructure work	Value of functionality	Performance Metric
	2015	2017	Optional-Cancer Case Information (ambulatory only): Electronically record, change, and access cancer case information.		Demonstrate ability to access and update cancer case information.
Women's Health Management Functionality	2014	2017	Improved healthcare management capabilities for clinicians treating women Veterans and Service members.	Improved patient experience for women Veterans and Service members.	Improved functionality in the following areas: the Abnormal Test Results/Tracking Abnormal Results (ATR/TAR) project, the Notification of Teratogenic Drugs (TDrugs) project, the Breast Care Registry and the Maternity Tracker Innovations projects, as well as enhancements to System for Tracking Women's Health Cancers and Maternity Care, and Safe Prescribing and Reproductive Health – a TDrugs Enhancement. The enhancements to the Women's Health capability would expand the gender characterization of Veterans to include aspects of gender identity as well as biological sex.

13. Appendix D: Care Coordination Description

Care coordination is a key element of Patient-Centered Medical Home/Patient Care Aligned Care Team for the purposes of improving quality, safety, efficiency and cost-effectiveness of care.

The National Quality Forum (NQF) has endorsed the following definition and framework for measuring care coordination.

> "Care Coordination is a function that helps ensure that the patient's needs and preferences for health services and information sharing across people, functions, and sites are met over time. Coordination maximizes the value of services delivered to patients by facilitating beneficial, efficient, safe, and high-quality patient experiences and improved healthcare outcomes. "

Although the concepts and activities of care planning, care management, and care coordination are tightly related, they are neither interchangeable terms, nor equivalent activities, as shown below in **Figure 22**. Care management and care planning activities support and inform the larger superordinate goal of care coordination.

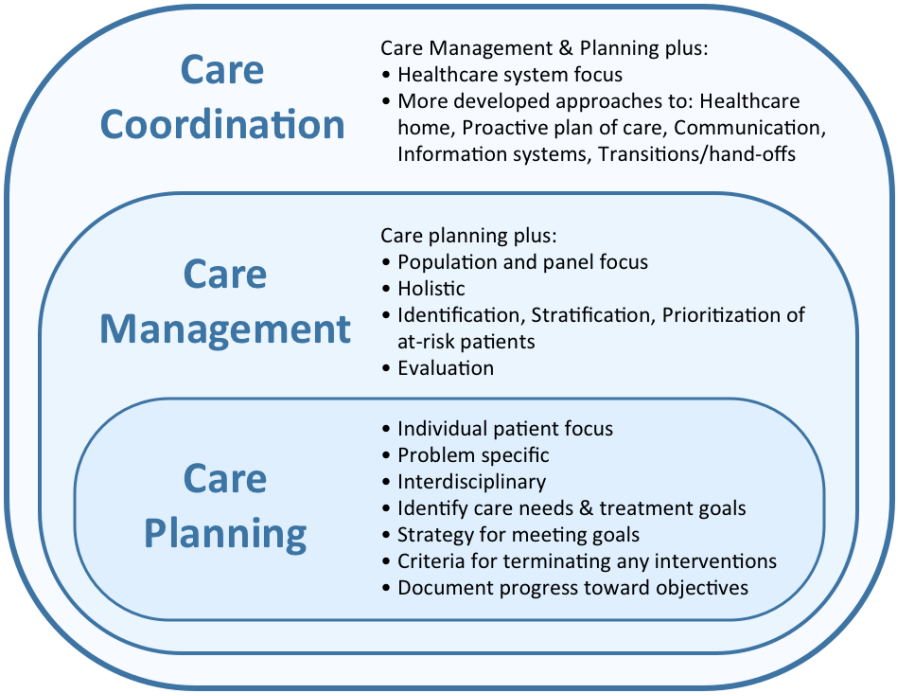

Figure 22. Relationship of Care Planning, Care Management, and Care Coordination

14. Appendix E: EHR Certification and Meaningful Use (C/MU)

The Office of Management and Budget issued a memorandum on September 17, 2010 requiring that selected federal agencies, including the VA, achieve five HIT Principle Processes by the end of FY 2012. Included in these HIT Principle Processes is the requirement to become Meaningful Users of CEHRT. It further specified that federal entities with HIT investments and activities become Meaningful Users by meeting the defined Meaningful Use (MU) criteria, or demonstrating the process to meet those criteria in their systems regardless of eligibility for HIT incentive payments. The memorandum required that recipient agencies respond with clear plans for incorporating the identified policy and technology principles by FY 2012.

The VA has committed to achieving MU as defined by the American Recovery and Reinvestment Act (ARRA) of 2009 and cannot meet that commitment without implementing the EHR enhancements required for certification. ONC establishes the certification criteria EHRs must meet to be certified. ONC periodically releases editions of EHR certification criteria and the VA is currently seeking certification of the 2014 Edition criteria in both ambulatory and inpatient settings. MU demonstration is a staged approach, where two years of MU demonstration occur in each stage before moving to the next stage, where requirements become more difficult to achieve.

Ultimately, the VistA 4 technology will comply with ONC's 2014 Edition EHR certification criteria to support demonstration of meaningful use by VA providers and hospitals. While CPRS/VistA in its current state meets some of the certification criteria, such as computerized provider order entry and maintaining medication and medication allergy lists, many certification criteria require software development (i.e., "certification gaps"). Several examples are electronic prescribing and health information exchange of a structured summary of care record. While incorporation of the foundations will occur in CY2014 for meeting two of the certification gaps (i.e., smoking status and preferred language), many other certification gaps exist and must be met before VA providers, and hospitals can begin MU demonstration. Some of the certification gaps align with the VistA 4 capabilities shown in **Appendix C: VistA 4 Capability Descriptions, Development Work, and Value by Fiscal Year**; however, some certification gaps are exclusive to C/MU and are listed at the end of the table in that section.

15. Appendix F: VistA Standardization List of Applications

Product / Application	Category
Admission, Discharge, Transfer (ADT) / Registration	Clinical Services
Computerized Patient Record System	Clinical Services
Adverse Reaction Tracking	Clinical Services
Authorization/Subscription Utility	Clinical Services
Clinical Reminders	Clinical Services
Consult/Request Tracking	Clinical Services
Health Summary	Clinical Services
Problem List	Clinical Services
Text Integration Utilities	Clinical Services
Text Integration Utilities Group Notes	Clinical Services
Laboratory	Clinical Services
Anatomic Pathology	Clinical Services
Electronic Data Interchange	Clinical Services
Emerging Pathogens Initiative	Clinical Services
HOWDY Computerized Phlebotomy Login Process	Clinical Services
Point of Care	Clinical Services
Universal Interface	Clinical Services
VistA Blood Establishment Computer Software	Clinical Services
Clinical Lexicon	Clinical Services
Nutrition and Food Service	Clinical Services
Patient Care Encounter	Clinical Services
Pharmacy	Clinical Services
Automatic Replenishment/Ward Stock	Clinical Services
Bar Code Medication Administration	Clinical Services
Bar Code Medication Administration Backup Utility	Clinical Services
Benefits Management	Clinical Services
Consolidated Mail Outpatient Pharmacy	Clinical Services
Controlled Substances	Clinical Services
Drug Accountability/Inventory Interface	Clinical Services
Inpatient Medications	Clinical Services
IV Medications	Clinical Services
Unit Dose Medications	Clinical Services
National Drug File	Clinical Services
Outpatient Pharmacy	Clinical Services
Pharmacy Data Management	Clinical Services
Pharmacy Prescription Practices - Retired	Clinical Services
Standards & Terminology Services	Clinical Services
Data Standardization	Clinical Services
Terminology Services	Clinical Services

Product / Application	Category
VistA Imaging System	Clinical Services
Core Infrastructure	Clinical Services
Document and Ancillary Imaging	Clinical Services
Document Imaging	Clinical Services
Ancillary Imaging	Clinical Services
Vitals/Measurements	Clinical Services
Current Procedural Terminology	Administrative - Financial Services
Decision Support System	Administrative - Financial Services
Diagnostic Related Group Grouper	Administrative - Financial Services
Enrollment Application System	Administrative - Financial Services
Event Capture	Administrative - Financial Services
Hospital Inquiry	Administrative - Financial Services
International Classification of Diseases, Clinical Modification	Administrative - Financial Services
Electronic Signature	HealtheVet/Enterprise
Pharmacy Medication Order Check Healthcare Application	HealtheVet/Enterprise
VA Enrollment System	HealtheVet/Enterprise
Administrative Data Repository	Repositories
Duplicate Record Merge	Infrastructure
FileMan (VA)	Infrastructure
Common Service/Identity Management Service	Infrastructure
Health Level Seven (VistA Messaging)	Infrastructure
Health Level Seven Optimized (VistA Messaging)	Infrastructure
Kernel	Infrastructure
Kernel Toolkit	Infrastructure
Kernel Authentication & Authorization for Java 2 Enterprise Edition	Infrastructure
List Manager	Infrastructure
MailMan	Infrastructure
Master Patient Index/Patient Demographics	Infrastructure
Remote Procedure Call Broker	Infrastructure
Security and Other Common Services Program	Infrastructure
VistA Data Extraction Framework	Infrastructure
VistALink	Infrastructure