

# 21 The Health Service Data Warehouse Project at the Air Force Medical Service (AFMS)

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The Air Force Medical Service (AFMS) works in close coordination with the Assistant Secretary of Defense for Health Affairs, the major air command surgeons, the Departments of the Army, Navy, and other government agencies to deliver medical services for more than two million eligible beneficiaries. Beneficiaries include active duty, family members, and retirees, during both peacetime and wartime.

The AFMS consists of approximately 38,000 officers, enlisted and civilian personnel, plus an additional 15,000 members assigned to the Air Force Reserves and the Air National Guard. The AFMS has an annual budget of approximately \$5.4 billion and runs 75 military treatment facilities, including 16 hospitals and medical centers.

## Vision and Mission

The AFMS's vision is to provide quality, world-class healthcare and health service support to eligible beneficiaries anywhere in the world at any time. The AFMS's mission is to provide seamless health service support to the United States Air Force (USAF) and combatant commanders. The AFMS assists in sustaining the performance, health, and fitness of every airman. It promotes and advocates for optimizing human performance for the war fighters, including the optimal integration of human capabilities with systems.

The AFMS operates and manages a worldwide healthcare system capable of responding to a full spectrum of health requirements. This ranges from providing care in forward-deployed locations to comprehensive preventive care.

## The AFMS Office of the CIO

Under the direction of the AFMS Surgeon General, the AFMS Office of the CIO (OCIO) manages the strategic vision, implementation, delivery, and interdependence of all AFMS information management (IM) and information technology (IT) programs, including clinical information systems and healthcare informatics. Informatics responsibilities include portfolio and program management, budgeting, and stakeholder leadership, as well as oversight of project execution.

The OCIO addresses daily tactical challenges born of multiple concurrent projects to modernize the AFMS's information management and information technology. The OCIO is focused on creating next-generation capabilities and infrastructure while ensuring business continuity.

Efforts are currently under way to reshape the OCIO, bringing in new skill sets and creating an infrastructure and architecture that can support the AFMS for the long term.

## AFMS's Modernization Challenges

The AFMS already meets many "meaningful use" mandates and has done so for years. But to operate more efficiently and cost effectively, the AFMS's IM/IT infrastructure must become modernized and integrated. Among AFMS's key challenges are

- **Data integration**—The AFMS has had electronic capabilities since the 1990s and has used electronic health records (EHRs) since the early 2000s. The amount of data that the AFMS has is astounding. Currently the AFMS receives 400 different data feeds and near real-time data from 101 sites around the world. These data feeds include roughly eight million transactions each day.

However, data acquisition and integration has been developed organically and on a solution-by-solution basis, without alignment to any common standards or platforms. Data has been siloed in a wide range of legacy systems, some of which are difficult or impossible to support due to a lack of resources, documentation, or skill sets.

The lack of data centralization and data integration limits the value of the data and creates significant costs to maintain the databases and legacy systems. A few years ago, the AFMS decided that it had to modernize its data infrastructure to centralize and integrate its data.

- **Information deliverables**—Users of AFMS data sometimes feel they lack access to important data or must spend a significant amount of time finding, acquiring, improving, and personally integrating data to build the information artifacts they need. Not all information is delivered in a user-friendly way, it may take too long to access, and it is often designed just for a single-solution purpose. In addition, there is a lack of capacity (both technological and resource capacity) to support what customers want or need. As a result, many key consumers must be turned away to seek out other solutions.
- **Economies of scale**—Current tools lack the capabilities that are needed to quickly answer queries and create presentation-quality deliverables. The complexity of data has long and steep learning curves. The variety of technologies employed in data integration prevents economies of scale and hinders the development and institutionalization of standards and best practices.
- **Lag times from idea conception to realization**—Currently the total lag time from an idea for an analytical undertaking until a final output can take three to five years, sometimes longer. This long lag occurs as data has to be aggregated, resources are allocated, development and testing occur, information assurance (the government's term for data security) is performed, and implementation takes place.
- **Creating a skilled workforce**—A key part of modernization is growing a next-generation workforce that has the technical skills to use the data that is available.
- **Strategic alignment**—The OCIO faces the challenge of ensuring that all vendors, contractors, and key AF resources are aligned to a consistent, clear, and widely communicated IM/IT strategy and are empowered to succeed in the missions the AFMS has tasked them with.

## **Analytics at the AFMS**

As with many large organizations, the ability to leverage data from disparate systems to provide usable information for operational and analytical reporting is an ever-growing challenge. Along with the general data explosion that has occurred, the healthcare industry has the unique challenge of standardizing data across health systems to enhance “point-of-care” delivery and use data for research analytics.

For over a decade, the AFMS has provided business intelligence (BI) services via two separate offices: the Health Informatics Division (HID) and the Health Informatics Suite (HIS). By providing registries and action lists, the HID enables clinicians to manage their complex and chronic patient population for effective disease management. The HIS develops solutions to assist the Healthcare Integrator (HCI) with initiatives such as provider schedule management, cost of care, and business planning.

# The Health Service Data Warehouse Project

The Health Service Data Warehouse Project (HSDW) was driven by the challenges and pain points described previously. These challenges dictated the need for this data warehouse project to follow the approach of data infrastructure first and information delivery second, which focuses data integration resources on modernizing the HID's data acquisition and processing functions.

This "urban renewal" effort enhanced the HID's capabilities with the implementation of best-of-breed data integration software and more robust data architecture and infrastructure designed to scale for future growth and needs.

Previous attempts to modernize the AFMS's information assets focused heavily on consolidation and virtualization without focusing on data integration. While the colocation of database assets is important, it's equally (if not more) important to devote the time and resources to truly integrate the data. Without focused modeling and integration of the data, the organization will simply have all of its redundant information assets in one place without realizing economies of scale and the benefits of having one source of information.

The most critical factors for this project were

- **Data acquisition and transformation**—Previous data-acquisition processes used disparate technologies, were often antiquated, performed poorly, and were undocumented. Key knowledge workers to support the code have departed the HID, and the mix of technology skills required to sustain the current operations is too varied, increasing resource cost and hindering the creation of common technology standards. The solution involves transformation of the enterprise's data-acquisition processes to a centralized, completely integrated data warehouse.
- **Management**—Historically, business rules, metadata, and system documentation have not been centrally managed. HID capacity issues and varied technology have retarded the documentation process. Change management has frequently not been formalized, creating a moving target when process remediation projects are undertaken. And formal service level agreements for batch windows, performance, and system/data availability have not existed. In creating the HSDW, managerial processes have been revised to address each of these issues.
- **Information delivery**—Delivery of information has consisted largely of relatively static "push reports" or creations from analysts derived from hands-on data scripting and SQL Queries. Self-service BI has not existed. Along with the HSDW, the AFMS is creating specific data marts for various purposes (like the patient-centered medical home) and has created a portfolio of dashboards.

## Implementation

A key to the success of the HSDW was having a champion in the organization who articulated a vision for BI and evangelized that vision. It shows the importance of having strong leadership support.

The HSDW implementation process took 12 months and consisted of the following steps:

- Requirements
- Design
- Development

- Test and Configuration
- Deployment
- Sustainment

Any data warehousing or BI project requires the right talent throughout the project life cycle. The key role facilitating the disparate groups involved in implementation is the analysts who bridge the invested parties: business, clinical, and technical. The many roles involved in the implementation process include a DW/BI lead; a work streams and requirements coordinator; lead and senior information architects; data modelers and analysts; SAS BI architects and developers; an SAS Center of Excellence lead and administrator; code and GUI developers; extract, transform, and load (ETL) architects, admins, and developers; and training, metadata documentation, and subject matter experts.

## Results and Benefits

From a technology perspective, the architecture that has been developed is flexible enough to support both simple queries and complex analytics. The data now available can be accessed in near realtime. Users can analyze summary data and granular details.

The HSDW acquires, integrates, and stores the data once so that they can be repurposed. The logical components of a mature data architecture that support enterprise data warehousing and business intelligence include

- **Integrated HSDW**—Data are modeled and related according to business process and workflow.
- **Data marts**—Data are contextualized and accessible in a user-friendly form.
- **Operational data store (ODS)**—Data are persisted in near real-time for operational needs. This has the added benefit of streaming, which limits periodic batch extractions of significant size.
- **Data presentation/reporting**—There is a first tier of canned reports, charts, and tables to support simple users with frequent and recurring artifacts (SAS Enterprise Business Intelligence (EBI)).
- **Advanced analytics**—This includes a multitier BI tool capable of servicing complex queries and ad hoc data exploration and analysis (SAS EBI).

In addition to these technical benefits, having integrated data will enable clinical improvement, increase the satisfaction of users, and lower costs by reducing manual support time for disparate databases. It will also lead to greater efficiency through automation and will serve as a valuable asset for clinical research.

## Lessons Learned

- In the AFMS, convincing all of the stakeholders to give up their information assets was a two-year process that eventually required an executive directive. An organization cannot underestimate the sensitivity associated with giving up control of data.
- Tool and technology selection becomes much easier when you realize that the talent acquisition to use the tool and/or technology is much more difficult.
- “Cyber warfare” will be a major technological trend to overcome.
- You can never do enough project planning, but too much planning is a threat to stakeholder perseverance, especially when they just gave up their information.

- The biggest mistake in planning occurred during the deployment of the HSDW's historical data load. This process exposed critical gaps within the existing architecture and infrastructure in the areas of role augmentation, storage capacity, and performance.

## Next Steps

The focus of the HSDW on data acquisition, integration, and storage is critically important. However, to realize the full potential of data integration, the AFMS is focusing on data presentation, visualization, and delivery. The following actions are under way to deploy the "next level" BI to the AFMS:

- Using Informatics.
- Developing and delivering a platform for measuring clinical quality.
- Standing up an analyst-friendly SAS capability that allows analysts to focus on analysis rather than coding or data acquisition/integration.
- Developing a baseline for analyzing and delivering meaningful clinical research on de-identified data sets. Also, developing plans to support public/private access to data for research purposes.
- Providing intuitive user-friendly access to providers and managers to measure and improve their own performance.
- Creating reusable, repeatable processes and best practices around BI, and creating a BI Center of Excellence for sharing and developing AFMS-focused methodologies.
- Developing infrastructure and adopting new technologies to meet growing data, data warehouse, and BI needs.
- Integrating additional data into the HSDW.