



Amalga Unified Intelligence: One New Solution to Many Old Problems

WHITE PAPER

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EXECUTIVE SUMMARY

In the past, it was sufficient for hospitals to care for patients and bill payers for their services. But in today's highly regulated, rapidly changing, and increasingly competitive and cost-controlled environment, this is no longer enough. Issues such as quality, outcomes, consumerism, and high levels of attention to the cost and value of care have placed demands on hospitals to capture and analyze unprecedented amounts of data about their clinical and financial performance.

For healthcare organizations to survive and prosper in today's environment, they must be able to leverage the data from their transaction systems through the use of analytics to create actionable information about their organizations and operations. This combination will allow them to achieve the highest possible levels of clinical, operational, and financial performance.

This white paper examines Microsoft's new Amalga Unified Intelligence System (UIS) 2009 solution, which is based on a flexible, agile technology architecture designed to address many of the information needs of healthcare provider organizations. Amalga UIS' functionality includes the ability to:

- Automate the collection and integration of all enterprise data and images from multiple sources
- Transform data into usable formats for analysis
- Store and archive all data and images in their original source form to preserve historical integrity and provide an audit trail
- Conduct analyses that produce information to support individual, team, and organizational goals
- Present information in a timely (near-real-time), actionable form to end users

Amalga UIS supports a wide variety of business intelligence and clinical intelligence needs at all levels of the healthcare enterprise. Amalga UIS provides an infrastructure for both storing and archiving a wide variety of information not only for its own use but also for use by other analytics applications an organization may choose to implement. This capability forms what Microsoft calls "unified intelligence." Therein lies Amalga UIS' key strength. In our view, Amalga UIS' capabilities place it in a unique category among analytics products. It can serve as an integral component of a healthcare provider organization's overall analytics strategy and architecture, complementing, rather than competing with, traditional business intelligence and clinical intelligence solutions.

SITUATION OVERVIEW

As the information needs of healthcare provider organizations grow, so has the importance of IT in achieving those goals. While paper reports and silos of information may have sufficed for healthcare organizations in the past, today's complex provider organizations must deliver dynamic analytical capabilities, data transparency, and ubiquitous availability of information to diverse stakeholders.

The implementation of electronic medical record (EMR) applications has been the primary focus of healthcare provider organizations over the past five years. These applications have led to the creation of comprehensive stores of detailed, patient-specific clinical information in digital format. Although investments in EMR and related clinical applications, which are designed to automate workflows and organize patient clinical data, are essential, they merely lay the foundation for the IT-enabled operational and clinical process improvements that Health Industry Insights sees as forming the next wave of provider IT investment. A key component of this next wave will be the business intelligence and clinical intelligence applications that combine data from clinical, financial, and other applications to form the basis of both clinical and operational decisions. Such applications unlock the true value of hospitals' EMR investments and are essential to providing the insights hospitals need to ensure that tangible operational, financial, and clinical benefits from those investments are realized.

Analytics Applications Serve a Variety of Needs and Constituencies

In a hospital setting, diverse clinical, financial, and administrative stakeholders require access to a wide variety of financial, operational, and clinical information. This data typically resides in multiple, independent application "silos," including financial management, payroll, and revenue cycle management systems; clinical systems such as computerized physician order entry (CPOE) and EMR; departmental systems such as pharmacy, dispensing, laboratory

management, radiology, and picture archiving and communication systems (PACS); and administrative systems such as facilities management and human resources and homegrown, ad hoc, independently developed applications. This list is by no means exhaustive, but it serves to illustrate the complexity of a typical hospital's application portfolio.

The data in these sources typically resides in disparate formats and may have limited availability and inconsistent parameters for access and retrieval; yet to be effectively analyzed, this information must be collected from these individual source systems and controlled by security and privacy safeguards that protect the rights of both patients and providers. This complexity is further amplified by the fact that many of these applications are packaged products supplied by a variety of third-party independent software vendors (ISVs) and run on a diverse set of technology platforms.

For example, if a hospital wants to address workforce management issues related to the staffing or quality of a particular nursing unit, it may need to consider billing and financial systems for patient census and charge information, clinical systems that record patient clinical data and status, and human resources systems that house data on staff capabilities, qualifications, work assignments, and payroll data. Pulling together the data from all of these systems into a data warehouse and applying analytical tools that allow users to look at the problem from a broad perspective, over multiple time periods, is a challenge for most provider organizations.

Hospitals frequently approach this problem by introducing centralized data stores in the form of clinical data repositories (CDRs), as well as other forms of data marts and warehouses to manage operational and financial data, and a wide array of point-to-point interfaces to bring data into these repositories. Many hospitals have begun to deploy business intelligence technology for performance management, benchmarking, balanced scorecard analyses, profitability, and cost and productivity analysis.

But while central data stores may be created, the information in them is too often static, prone to rapidly becoming outdated, and frequently managed by rigid data models that are not readily extensible. This limits not only the amount of contextual information available about the data but also its timeliness, diminishing its value for organizational problem solving. The processes and tools used to access these data repositories are also principally retrospective in their focus and fail to facilitate real-time or near-real-time analyses. To meet the demand to support real-time decision making, analytic capabilities are now being embedded into transactional systems as well. These features are often referred to as "workflow decision support" or "clinical decision support." Collectively, these capabilities have led to the definition of a new term in the area of analytics — "operational business intelligence" (OBI).

Amalga UIS facilitates real-time OBI, supports many functions associated with traditional business analytics tools, and also provides significant retrospective analytic capabilities in its own right. So as leading hospitals begin to address their requirements for business intelligence and clinical intelligence applications, they have begun to realize that these needs cannot be satisfied with a single, monolithic approach. Just as they have sought multiple, specialized system solutions to meet their transaction processing needs, they are now seeing multiple approaches as necessary to meeting their diverse analytics requirements.

What's Unique About Unified Intelligence?

Definition and Architectural Approach

With the introduction of its Amalga UIS product, Microsoft has coined the term "unified intelligence" to describe an approach to information management and analytics that combines technology for agile data exploration through a structured but flexible data repository. Amalga UIS 2009 brings together all of a hospital's data in one place, in real time or near real time, allowing for use and reuse of the data as it is applied to the hospital's ongoing operations and strategic projects.

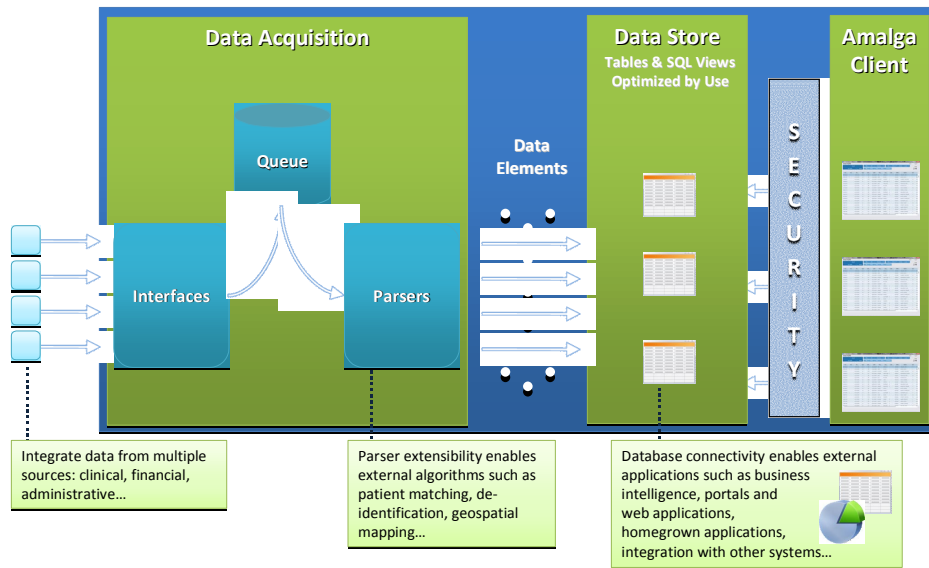
Amalga UIS' unified intelligence environment depends on open access to data that resides in the healthcare organization's systems but does not rely on specific data types or interface methodologies. Data types that are used in Amalga UIS environments include structured, discrete data; unstructured text, images, and documents; as well as contextual information about the data that assists in both data integrity verification and analysis.

How Amalga UIS 2009 Works

Amalga UIS creates a centralized data store using a defined but flexible process. Data is first collected from multiple data sources, preferably as real-time, transactional data flows, although more static, batch data flows can also be utilized. Existing interfaces are simply redirected to deliver an additional copy of their messages to Amalga UIS. These data flows can be in a variety of HL7 and non-HL7 formats. Once the data arrives, it is queued by Amalga UIS for processing. A time- and date-stamped copy of the data in its original form can be permanently stored in an archive queue, while a copy of the data is fed into Amalga UIS' parser, a key component of the product's architecture. Parsed data elements are then fed into Amalga UIS' data store, a user-defined security model is applied, and the Amalga UIS client applications make data available to authorized end users consistent with the access rights defined in the security model. An overview of Amalga UIS' architecture is shown in Figure 1.

FIGURE 1

How Amalga UIS Works



Source: Microsoft, 2009

The Amalga UIS data store mirrors the structure of the incoming data in order to store it quickly and accurately, without loss of contextual information. The data store uses both tables and SQL views, and data is denormalized with fewer joins to optimize performance. When one data stream needs to be parsed multiple ways for different uses, Amalga UIS is able to logically duplicate data while keeping all copies synchronized in the data store. Integrity is maintained by sending all the incoming data through the parsers, where denormalization and data duplication can be accomplished, while a permanent copy of the original source input is stored in Amalga UIS' archive. The structure of the derived data store is optimized by use, although customers have the ability to modify the structure of the data store to meet their specific needs.

Amalga UIS' extensible parser is key to the agility of the data store. The parser uses a variety of script-based processes and Web services to break incoming data into individual elements before moving them to the data store. It can parse multiple streams in parallel while differentiating the processes by the type of data stream being addressed. The parser can be configured to call external services such as patient mapping algorithms, deidentification algorithms, geospatial mapping tools, and terminology and dictionary management, among other services. Third-party applications such as master patient index tools can also be run in concert with the parser applications.

Amalga UIS' unique architecture enables users to derive value quickly from their investment, rapidly building comprehensive logical data stores. Because Amalga UIS also retains the archive of original, time/date-stamped data, time-series analysis is also enabled. Amalga UIS' security model is applied on top of the data store to ensure compliance with security and privacy regulations for data that is viewed through the client. Amalga UIS' strength lies in the flexibility by which it acquires, and incorporates, data into its data model.

Unified Intelligence Versus Traditional Business Intelligence and Data Warehousing

Data warehouses, and the business intelligence applications that exploit their content, are typically built around data models that rely on batch processes to add new data to the repository and are updated and summarized only periodically. While most business intelligence processes embedded in data warehouses work effectively for static reporting, such as scorecards that trend performance over time or retrospective compliance reporting such as that required by The Joint Commission (formerly the JCAHO), they do not meet the needs of ongoing operational intelligence or timely access to information. This time lag between the events that created the information and its availability for analysis limits the application of analytic tools to problems in real time and fails to accommodate the needs of provider organizations, particularly clinicians, for real-time data.

In traditional data warehouses, the data model is predefined and designed with the outcome in mind, capturing only the data that makes sense for specific, predefined purposes. While data warehouse design tools have evolved to facilitate more rapid changes to the underlying data model, these changes still take time to implement and the schema must be painstakingly modified if either available data or information needs to be changed.

The business intelligence applications found in traditional data warehouse implementations also rely on a less flexible front-end presentation layer that delivers preconfigured reports and dashboards to end users. Although this may facilitate predefined drill-down, sorting, grouping, and graphing capabilities, these business intelligence applications typically do not truly allow users to explore data at will in order to get the information they need.

The fixed data models characteristic of data warehouses are designed for specific, predefined uses, which can limit the warehouses' ability to store different types of data and contextual information, particularly the ability to incorporate and analyze unstructured data types, such as text and image files. In order to use data, it is generally necessary to understand the structure and source of the data as well as the data's content, context, and relationships. If this contextual information is lost, it is easy to misuse the information.

In contrast, unified intelligence does not rely on batch processes to build summary tables and preconfigured reports, and it works with real-time or near-real-time, as well as retrospective, data. Unified intelligence is built on the concept of flexibility and adaptability in the underlying data structure, allowing a wider variety of questions to be posed, and answered, in real time, using a wide range of data types and sources.

Amalga UIS is designed to capture all source data and data types without compromise. In fact, Amalga UIS customers are encouraged to capture all the data from existing data sources, regardless of whether they know, a priori, if they will use it or not.

THE ROLE OF UNIFIED INTELLIGENCE IN TODAY'S HEALTHCARE ENVIRONMENT

Today's healthcare organizations are faced with a plethora of challenges in managing information. The information environment is complex; information is typically siloed; and the vendor-supplied IT systems that meet their operational, transaction processing needs frequently fail to satisfy higher-level, analytic requirements. At the same time, data standards may be either lacking or inadequate for many data types and applications.

For these reasons, organizations have moved to strategies such as business intelligence, data warehousing, and unified intelligence that apply various methodologies to decouple information strategies from systems strategies and allow them to apply best practices in information management to their information strategy. While business intelligence and data warehousing both accomplish the goal of decoupling information from transactional systems, they do not provide the advantages of unified intelligence when it comes to data integration and the use of real-time information for operational business and clinical decision making.

Unified intelligence benefits the IT organization by reducing the burden of implementation and maintenance, providing rapid implementation of new data sources, and providing users with self-service tools for reporting. The ability of Amalga UIS to accept practically any incoming data stream lessens the burden of implementation by allowing implementers to use existing processes and data sources as is, redirecting existing interfaces, files, and even network packets for parsing and inclusion in the data store. The same process works for adding more data sources as the user's needs evolve, lessening ongoing maintenance when new systems are incorporated. Amalga UIS also provides easy-to-use tools that allow non-IT end users to explore data, create their own views, and find the information they are looking for without assistance from IT or the delays typically associated with such assistance.

It is clear that healthcare organizations, both in the United States and throughout the world, can expect continued and rapid changes in their operating environments, reimbursement models, and reporting requirements. Even amid these changing requirements, Amalga UIS' flexible data architecture can provide the ability to rapidly incorporate new data elements, which will give hospitals the ability to incorporate new operational and reporting needs with a minimum of effort and expense.

As demonstrated by the case studies that follow, the business benefits of on-demand access to real-time information for end users are compelling and include both immediate and future productivity improvements and revenue enhancements. The flexibility of data storage and retrieval offered by unified intelligence solutions also has the potential to affect future productivity and cost savings as the requirements of healthcare organizations evolve.

THE EXPERIENCES OF EARLY ADOPTERS

In the course of our analysis of Microsoft Amalga UIS and its functionality, we examined case studies of its implementation at two very different healthcare organizations:

- St. Joseph Health System (SJHS) (www.stjhs.org) is a Catholic healthcare system established in 1982 and headquartered in Orange, California. SJHS has 14 hospitals, three home health agencies, and multiple physician groups located in both California and Texas. SJHS' 14 hospitals have a total of 3,607 beds, ranging in size from 40 to over 850 beds.
- The Wisconsin Health Information Exchange (www.whie.org) (WHIE) is a nonprofit organization sponsored by the National Institute of Medical Informatics to support development of a health information exchange (HIE) in southeast Wisconsin. WHIE now has more than one year of patient history data online, with 13 hospitals contributing to the exchange and 5 emergency departments (EDs) making use of the data.

It should be noted that both of the early adopters interviewed have not yet migrated to Amalga UIS 2009. That said, what did we find?

St. Joseph Health System: In Pursuit of Perfect Care

The Business Imperative

At SJHS, CIO Larry Stofko was faced with growing concerns from his chief executive and chief medical officers about the health system's current and future abilities to leverage information for both "great

hospitals and great community care." One of the drivers was the need to start aggregating data from all of SJHS' hospitals and other facilities, as well as across the community and full continuum of care.

SJHS' goal is that "all patients will receive 'Perfect Care,'" which it defines as zero failures in care delivery, and the organization felt that access to a comprehensive, consolidated view of patient information as quickly as possible would facilitate this goal. Sources included the full spectrum of inpatient, outpatient, and ancillary data, both historical and current. Eventually SJHS plans to even incorporate "opted in" patient-reported data.

From the CEO's perspective, it was important to have a business intelligence platform that could not only answer today's questions but also facilitate the organization's ability to answer questions it could not verbalize now, but might in the future; one that would correlate data while allowing the company to harvest information to respond to the healthcare needs of its patients and medical staff.

After examining several different solutions and approaches, SJHS selected Microsoft Amalga UIS in August 2007. The basis of its decision was the need for a free-flowing approach to data aggregation and not the structured approach offered by traditional data warehouse and business intelligence platforms. The technology and streamlined implementation process provided advantages for SJHS and allowed it to get immediate results by avoiding a lengthy, expensive up-front process to build an enterprise data model. Amalga UIS' architecture allowed SJHS to use existing interfaces and data feeds and simply point them toward Amalga UIS, resolving differences in format and performing data integrity checks as the data flowed in.

The Implementation

SJHS had a fairly uniform application portfolio, with all but one of its 14 hospitals operating on Meditech-supplied systems. Although the systems were not identical, with 8 different instances for the 14 hospitals, the Meditech standard still provided some degree of uniformity. The Meditech systems had varying degrees of advanced clinical functions in place; all of the hospitals use PACS systems, while 40% use nursing documentation, CPOE, and electronic medication administration in varying stages of adoption. SJHS had been an IT leader in the past, with a front-end physician portal in place that allows, for example, its physicians to check labs and discharge summaries remotely. Over the course of its Amalga UIS implementation, SJHS plans to upgrade this portal to Amalga Web, adding single sign-on and context management capabilities and moving toward social networking capabilities that help to build community among its staff and physicians.

Providing a real-life example of Amalga UIS' rapid implementation process, Stofko explained that the first organizational demonstration of Amalga UIS used live validated information from the hospitals. SJHS took delivery and installed the first elements of Amalga UIS software in January 2008 and was live in six months with 49 interfaces and over 100,000 transactions per day of production-quality data feeding through Amalga UIS.

To accomplish this, the team organized an interdisciplinary team of 40 stakeholders who built use cases based on the data, defined the functionality needed, and worked on the details of the security model. The implementation was done in four stages:

- **Phase 1: Data integrity.** The data that was assembled in phase 1 included patient demographics, lab results, diagnostic reports, dictated reports, and history and physical examination findings from inpatient medical records, as well as discharge summaries, claims, procedures, diagnosis-related groups (DRGs), inpatient medications, charges, billing, and payments. In addition, the data from the Allscripts TouchWorks ambulatory EMRs of 150 physicians in closely aligned practices was included — adding the problem and medication lists for some ambulatory patients to Amalga UIS' repository. SJHS' philosophy was to "grab as much information as possible" — storing whatever data and contextual information it could gather and recognizing that it could not fully anticipate all of the information it might need for the questions it might want to answer in the future.
- **Phase 2: Development of use cases.** The use cases for the Amalga UIS implementation spanned both clinical intelligence and business intelligence functionality. For example, human resource data was added from its PeopleSoft HRIS to the repository, which will allow workforce planning functionality to be added.
- **Phase 3: Security model.** The security model was developed to ensure that role- and item-based security allow controlled, role-based user access to information while protecting patient privacy. The security model is designed to support multiple types of users, including both senior administrative users and users accessing data at the individual patient level.
- **Phase 4: Rollout.** As of the publication of this paper, Amalga UIS has been rolled out to about 40–60 users at SJHS, including executives, administrative staff, and clinicians. Another 40–60 users are expected to be added in the next six months. A broader rollout is planned for the summer of 2009, using the Web-based access features of Amalga UIS to expand the user community to 3,000 users, including clinical office staff.

Accomplishments

At SJHS, Amalga UIS has begun to provide a unified intelligence platform that allows it to ask questions of its data and apply the answers to everyday business problems and patient care in real time. The early benefits of Amalga UIS include:

- Providing a complementary solution to an existing third-party decision support system, helping to augment its decision support and insurance contract assessment capabilities
- Supporting quality initiatives for case audits and readmission analysis
- Leveraging a third-party quality initiative database alongside Amalga UIS' real-time data and internal benchmarks
- Supplementing numerous marketing databases, as it is now able to use Amalga UIS for its own real-time product line assessments and patient profiling and to augment national marketing statistical databases
- Incorporating third-party geospatial capabilities into Amalga UIS to provide previously unavailable marketing analysis, including mapping hospital and emergency department admissions and zip codes across closely located facilities in Orange County

In addition to the previously mentioned benefits, SJHS cited some specific examples of single instances in which cost savings have been seen from Amalga UIS. While this was not a goal for the system, SJHS expects to see, and quantify, financial benefits in the future.

SJHS' road map for Amalga UIS includes continued integration of nonclinical systems, mapping a wider variety of financial and administrative data into the data architecture. It is also looking at ways to incorporate additional clinical data, such as PACS images, in order to allow loosely affiliated physicians who don't have full PACS access to view images in Amalga Web. SJHS is also looking at incorporating data from specialty systems at individual hospitals into Amalga UIS.

As part of its community-building efforts, SJHS plans to tie Amalga UIS information into Microsoft's HealthVault, putting patient health record (PHR) information directly into the hands of patients or their responsible parties, leveraging future enhancements to Amalga UIS that Microsoft plans to make, including connectivity to HealthVault.

Wisconsin Health Information Exchange: Connecting Communities

The Business Imperative

At WHIE, Executive Director Kim R. Pemble is challenged by the opportunity to assist community health systems in the Milwaukee region with managing their health information in ways that deliver higher-quality, safer, and more efficient care. WHIE has evolved from the vision of two local physicians who convened the exchange's first meeting in the fall of 2004. Early stakeholders at WHIE were funded by a grant through "Connecting Communities for Better Health."

The first 24 months were spent planning, establishing bylaws, and building support in the community. WHIE's initial project was to link the EDs of several metropolitan Milwaukee hospitals. The project was funded through a Medicaid transformation grant and start-up funding from each of the Milwaukee County health systems through the Wisconsin Hospital Association (WHA). The project was a collaboration with the Milwaukee Healthcare Partnership whose membership includes CEOs of five health systems, CEOs of Milwaukee federally qualified health centers (FQHCs), WHA, Medical Society Milwaukee County, and Wisconsin Department of Health Services. The project sought to identify challenges in the community that were impeding effective communication of care issues between EDs and also from ED to FQHC. The exchange was the enabling technology to tackle the business issues they were identifying.

WHIE selected Amalga UIS as the technical foundation for the exchange, signing an agreement with Microsoft in the spring of 2007. Thus, WHIE became the first HIE entity in the United States to select Amalga UIS as its technology platform.

The decision to select Amalga UIS at WHIE was the result of an RFI process. For WHIE's stakeholders who were breaking new ground with the ED linking project, it was important to have a partner that was willing to enter into a collaborative development agreement. Microsoft's willingness to be this partner led to the selection decision. Although WHIE was the first U.S. HIE to select Amalga UIS, Pemble noted that it is no longer alone, as other HIEs have followed in WHIE's footsteps in recent months with the selection of Amalga UIS technology.

ED physicians in every hospital face the challenge of working up patients with little or no knowledge of the patient's medical or social history. The approach ED physicians use in the absence of such information is both resource intensive and cost intensive because it requires working up patients in a manner that addresses all potential causes of a complaint, without knowing about conditions that may have been either ruled out or diagnosed and treated in past encounters.

Thus, the ED linking project sought to tackle these communication and information barriers by extending the value of established EMRs within the health systems beyond the individual facility, using IT to gather and disseminate information about an ED patient's past history, previous encounters, and chief complaints collected at each participating institution.

The Implementation

Using Amalga UIS technology, WHIE started collecting information from hospital systems in November 2007, including admitting transactions from three integrated delivery networks (IDNs). Admission data provided by participating IDN varied; however, all included ED encounters, while some also included inpatient and ambulatory services and hospital-based clinics. Admission transaction data that was collected included the patient's demographics, chief complaint, primary care provider, emergency contact information, and in some cases, allergy information. This data is received by WHIE in real time.

Amalga UIS' approach is to accept a copy of the data in whatever form it is available, parsing it into the format needed for the exchange. For an HIE like WHIE, this approach was perfect because it lowered the effort required of the IDNs participating in the exchange, moving a substantial portion of development cost to WHIE. Use of existing interfaces within the IDN eased workload; however, the time commitment in validating interfaces and data, as well as final acceptance testing, remains. Additionally, each site is responsible for education and user account management.

Once the data is received by the exchange, a patient identification process begins. Inbound data is assessed using a matching algorithm to determine if the patient is new or has been seen previously by the hospital initiating the message or by another provider whose data is captured in the community exchange. The matching process uses identifiers such as medical record numbers and demographic data. The matching algorithm is part of the Amalga UIS toolkit; no external patient matching tool is utilized, although Amalga UIS provides the capabilities to integrate external master patient index tools. The matching algorithm typically runs with a 99%+ rate in patient matching. WHIE works with the member hospitals to rectify matching problems and makes the hospitals aware of discrepancies they find.

The data collected by the exchange is centralized, but not commingled. Each IDN retains custodial ownership of the data, while WHIE hosts a copy. This creates a hybrid data model that is federated but still centralized, assigning each constituent the responsibility to ensure the accuracy and integrity of its data and improving Amalga UIS' performance and availability versus typical federated approaches while providing member hospitals the flexibility to "opt out" of the exchange at any time.

Accomplishments

By the end of December 2008, more than 1.5 million encounters, representing over 500,000 unique patients, had been stored in WHIE's database. The data types available have been limited by the timing of interface expansion from particular IDNs. Working with available data, WHIE has established a solid foundation on which to add more data types as they become available, aided by the flexibility of Amalga UIS' data integration process.

In February 2009 Medicaid pharmacy claims data was added to WHIE, providing additional critical data to clinicians using the system. Later this year, all Medicaid claims data will be part of WHIE.

As of March, 14 hospitals are contributing data to the exchange, with 10 hospital EDs using data from WHIE in regular patient care. There are more contributors than users in part because there are data feeds from IDNs for hospitals outside Milwaukee County. In 2009, WHIE will continue to work with its current IDN participants to add clinical data to the feeds, including lab results, transcribed documents, pharmacy orders, and ECGs. Additional plans exist to add patient-centric community-based documents to WHIE, as part of a patient's history. Examples include physician orders for life-sustaining treatment (POLST), referral documents between the EDs and FQHCs, patient consent forms, and care plans. All of these initiatives will enhance the utility that ED physicians are already deriving from the exchange.

In addition to the IDNs it serves, WHIE also plans to expand to serve federally qualified health centers in its community. A great advantage of the centralized data storage is secondary use of data. Specifically, WHIE has worked with its advisory board and public health officials to establish use of WHIE by those public health departments. This is accomplished through a deidentified, aggregated view of the data and a reporting tool. Established queries may be set to run automatically and email results to the public health offices. Additionally, data is available for export to other analytical tools in these public health offices. WHIE's long-term goals include extending statewide collaboration with other exchanges serving other regions of Wisconsin and adding more data from payers and ambulatory providers. A recently signed agreement with Humana is one of the first steps in this process.

According to Pemble, ED physicians using the exchange have said that simply knowing about clinical events and past ED encounters has created significant, positive changes in ED care delivery. In some cases, providers have been able to avoid repeating expensive and, in some cases, invasive diagnostic procedures such as cardiac catheterizations or CT scans if they are able to determine that recent results remain clinically viable. Although the exchange does not currently provide actual test results, it creates an "index" that tells providers where the patient has been seen so that clinicians can call

and learn additional details. With the future incorporation of clinical data, the need for the call will be eliminated because providers will be able to view test results electronically. Nevertheless, this is still a significant, incremental improvement — and an important foundation for growth — over a year ago, when physicians might likely have repeated the test because they weren't aware of patient history.

CHALLENGES OF ADOPTING UNIFIED INTELLIGENCE

For most organizations, the potential benefits of adopting unified intelligence will outweigh the challenges. In fact, many of the challenges associated with the adoption of unified intelligence are contained in the implementation phase, which early adopters appear to have managed quite effectively. At the two organizations we spoke with, challenges included:

- **Availability of information to the data store.** Amalga UIS' strength lies in its ability to accept and parse almost any data feed, standard or otherwise, whether via direct point-to-point interfaces with source systems or via HL7 message streams received through an interface engine. However, extracting information from proprietary systems that are designed to be self-contained can be a formidable challenge. Although more and more vendors are "opening" their architectures and acknowledging the need to provide customers with the ability to extract data and interface with other, third-party applications, many still see their products as end-to-end solutions.
- **Data integrity and metadata definitions.** Most healthcare organizations have multiple systems in operation. While, ideally, standardized definitions of data common to multiple applications should be established and harmonized when these systems are first implemented, this is frequently not the case. When data is brought into Amalga UIS, these problems are often identified for the first time and/or magnified, as duplicate and inconsistent data elements become obvious when consolidated in a single data store. Although this can be a challenge for organizations and hamper implementation efforts, it can also provide the opportunity to document and correct these inconsistencies and create common data definitions. For example, although SJHS cited few challenges in its experience with Amalga UIS to date, it did note that the built-in patient matching capabilities had made it consider altering some of its existing business processes. Amalga UIS uses built-in logic to identify potentially duplicate patient records, and SJHS chose not to have Amalga UIS resolve these duplicates and consolidate the records in order to remain consistent with the hospital information system. Using Amalga UIS has caused SJHS to rethink how it resolves duplicate records, and the health system is

considering creating a process for merging records in the hospital information system. SJHS calls this concept "turning Amalga UIS on itself" — using Amalga UIS to standardize data and assist the health system in identifying and prioritizing the reconciliation of critical data within its source systems.

- **Legal challenges related to data privacy and security.** Defining and implementing an organizational security model can be challenging, particularly when a wide variety of individuals with different roles and responsibilities and access privileges are involved. Organizations must take the time up front to define and build consensus around a security model that balances their organizational and business process requirements with the relevant legal and regulatory constraints. However, early adopters have found that the capability and flexibility associated with Amalga UIS' security features have simplified their ability to define, and modify, their model as their needs have evolved.

FUTURE OUTLOOK: 20/20 VISION FOR THE HOSPITAL OF TOMORROW

We are in a period where the confluence of political, regulatory, and social pressures is forcing dramatic changes on the industry. It is quite clear that the U.S. healthcare system is on the cusp of fundamental structural change, as an aging population, rising costs, and increased government regulation threaten the status quo. Hospitals not only must proactively improve service quality and reduce cost but also must be prepared to respond to both more, and more complex, regulatory reporting requirements — changes that will mandate the measurement and reporting of the quality and cost of the care they are delivering.

External regulatory and compliance reporting requirements are not a new phenomenon. The need to measure and report on cost and care quality, whether for The Joint Commission, the Centers for Medicare & Medicaid (CMS), commercial payers, or other organizations and agencies, has existed in some form or another for 45 years, since the advent of the Medicare and Medicaid programs. In the past, some hospitals have accommodated these requirements by cobbling together information from existing healthcare IT (HIT) systems and augmenting it with labor-intensive, manual processes. This approach has proven costly in terms of productivity and accuracy. Merely reacting to these reporting requirements as they are defined is a recipe for short-term rework and repeated future investment. As reporting needs grow, so will the requirements for analytic solutions, and without a scalable, flexible, enterprisewide business intelligence strategy, each new requirement will mean fire drills and new investments.

For example, in 2008, CMS mandated reporting requirements that cover 27 core measures. In 2009, this number will increase to 30. In a document published on April 30, 2008, titled *Medicare Program: Proposed Changes to the Hospital Inpatient Prospective Payment Systems and Fiscal Year 2009 Rates, 23528–23938 [08–1135]*, CMS proposed that the number of core measures be increased to 72 in 2010. CMS is proposing that that this number be increased to 131 in 2011 and beyond.

Business intelligence and clinical intelligence will be essential to navigate through the transformation of the healthcare industry that we expect to see over the next several years. Those provider organizations that are not proactive in adopting these technologies to guide them through the turbulent days ahead will not prosper under this new order; they may not even survive.

Just as most of the industry has found that no one vendor's product offerings can meet all of its clinical, financial, and administrative transaction system requirements, no one architectural approach to meeting business intelligence and clinical intelligence requirements will suffice either. Providers are well-advised to implement a multifaceted strategy to adopt, and propagate, the effective use of analytics across the enterprise — one that maximizes the value of the IT investments they have already made.

ESSENTIAL GUIDANCE

The hospital of tomorrow will require on-demand access to information from all of its operations in order to meet day-to-day needs for operational intelligence; regulatory reporting requirements; and other information demands from providers, consumers, and regulators. What can the experiences of early adopters teach provider organizations considering increased investment in business intelligence and clinical intelligence solutions?

Lessons Learned

In speaking with the early adopters of a unified intelligence strategy at SJHS and WHIE, we identified the following best practices:

- **Establish a long-term strategy, but define short-term goals and use cases that deliver near-term value.** Unified intelligence is a broad capability, and both early adopters chose specific use cases and implementation goals that met immediate needs and demonstrated "quick wins." Because both organizations selected a solution with the flexibility to meet many more needs in the future, they were able to attain their initial goals and the broad "footprint" of Amalga UIS provided them with an infrastructure that could be leveraged for future projects as additional use cases were defined and their requirements crystallized.

- **Use an all-inclusive approach to building a data repository.** An all-inclusive approach to gathering data and contextual information is one of the key cornerstones of the unified intelligence approach. Because the unified intelligence approach does not require all data to be taken into a fixed data structure and actively managed, the infrastructure and maintenance requirements for storing data that will not be used immediately are lowered. This makes storing all available data in anticipation of unknown, future information needs a best practice for unified intelligence.
- **Establish the security model up front.** Using an up-front approach to actively managing the security model for unified intelligence minimizes the likelihood of breaches later and facilitates updating when needed. This is particularly important for disparate, decentralized systems that operate across multiple organizations, like WHIE's. Establishing legal and security policies and procedures before beginning implementation is essential for acceptance and successful adoption by stakeholders.
- **Leverage the side benefits of unified intelligence for enterprise data integrity.** Both case studies referred to the potential uses of unified intelligence to improve data integrity and establish data definitions throughout their organizations. Inconsistent data or duplicate patient identifiers can be found in unified intelligence systems that would not be easily identified in siloed source systems, but can result in medical and financial errors. Establishing a process to prioritize and then correct data inconsistencies in source systems can have significant additional benefits to the organization.
- **Seek open systems and best-of-breed tools.** HIT systems have historically closed systems, using proprietary data formats and architecture in monolithic applications. Unified intelligence is, by nature, an open system, and users can leverage the data repository in unified intelligence to feed other third-party analytic tools that allow them to pursue the best approach to analysis and information delivery for individual situations.

Checklist for Success

Healthcare organizations seeking to acquire technologies that leverage their investment in clinical and administrative transaction systems and reviewing traditional business analytics products would be well-advised to also consider Amalga UIS' unique unified intelligence approach as a precursor and complementary component of their business intelligence strategy.

Health Industry Insights recommends that healthcare organizations consider the following:

- **Ensure that solutions provide the flexibility to adapt to changing requirements, regulatory or otherwise.** It is impossible to predict changes or to select a system with 100% certainty that it will meet future requirements. However, it is possible to select solutions that have more potential than others to adapt to new requirements when the underlying data and systems and the needs of end users change. Buyers should look for flexible applications, financially stable vendors, and a track record of meeting regulatory deadlines for critical changes when considering a vendor's ability to adapt their applications to regulatory changes.
- **Select vendors based not just on their product's capabilities but also on their industry and functional area expertise.** Hospitals are a microcosm of multiple industries — hospitality, billing, supply, operations, staffing, etc. — and clinical and business leaders never know when one particular part of their operations will demand insightful scrutiny. Whether hospitals are considering business intelligence, data warehousing, or unified intelligence products to meet their information management needs, they should align with vendors that offer professional services expertise that spans the diverse clinical and administrative processes that characterize hospitals.
- **Consider the financial stability of the vendor organization.** All the flexibility that a solution may provide will not matter if the vendor does not continue to sell and support the product. With consolidation rampant among HIT, business intelligence, and data warehousing vendors and products, buyers should consider the long-term financial stability of the vendor as well as the vendor's commitment to the healthcare vertical and its healthcare solution offerings.
- **Address security and privacy concerns.** While access to information is important, protecting the privacy of patients and providers from unauthorized access is even more critical. Healthcare organizations should consider the ability of potential solutions to control access, as well as the flexibility and usability of the security features not only during initial implementation but also for ongoing maintenance.
- **Consider the total cost of ownership (TCO).** The cost of information solutions is not limited to the license fee for the application. Healthcare organizations need to consider the total cost of ownership, including both internal and external implementation, support, maintenance, and server and storage costs. The server resources allocated should be sufficient to provide acceptable performance of the application. The ability of the product to execute in a virtualized environment not only will lower hardware requirements and ongoing operating expenses but also will allow

additional server resources to be dynamically allocated during periods of peak workload demands. Similar considerations apply to storage costs. The cost of storage for the data repository will grow as the volume of data grows over time. The archiving strategy of the application should be considered during selection because the ability to archive and maintain historical information in a concise and compact manner will affect the storage requirements, storage costs, and TCO. Here, too, storage virtualization technologies can play a key role in minimizing TCO.

- **Consider the product's suitability for the task.** When evaluating products and their capabilities, healthcare organizations should be cognizant of the unique requirements of the end users of the solution. Clinical users' requirements are different from those of financial or administrative users. One significant difference is the time sensitivity of clinical users. Analytic applications targeted at clinical users typically require access to real-time or near-real-time data. They may also require access to retrospective, time-series data at the transactional level. Many analytic products use underlying data sources that are not updated that frequently and may not be architected to deliver information in such a timely manner or on such a granular basis.
- **Think big, start small.** Early success is important to maintain momentum. Healthcare organizations shouldn't attempt to "boil the ocean." They should work toward an initial pilot deployment that establishes a "proof of concept" as rapidly as possible. The pilot should not be simply a "throwaway"; rather, it should be a limited-scale effort that sets the tone and serves as a model for subsequent, broader-scale efforts. Healthcare organizations should start with high-cost, high-profile areas that are highly visible, and meaningful, to their organization.
- **Take advantage of the synergies that can result from a strong user group.** The need for shared experiences can be critical to success, particularly when an organization commits to being an early adopter. One of the observations noted by SJHS was the strength and cooperation among the Amalga UIS user group and the opportunities the group provides to have peer-to-peer interaction, share approaches, and contribute use cases to the Amalga UIS toolbox.
- **Consider future external uses of the data.** Many provider organizations that have implemented EMR systems are currently considering various strategies for the long-term use of the content of these applications. One of these contemplated uses involves sharing this information with patients themselves or their authorized caregivers in the form of PHRs. The latest version of Amalga UIS (2009) will be offering connectivity to Microsoft's HealthVault PHR. For those provider organizations considering HealthVault as part of their PHR strategy, this ease of connectivity may offer additional economic and operational benefits.

CLOSING THOUGHTS

Providers should carefully consider solutions that facilitate the unification of their business intelligence and clinical intelligence data requirements in much the same way that HL7 integration platforms facilitated the integration of data from their transactional systems. The future is intelligent; plan intelligently.

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