The Future of Business and Clinical Intelligence in the U.S. Provider Market

Healthcare Provider IT Strategies

LOOKING AHEAD #HI216056

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HEALTH INDUSTRY INSIGHTS OPINION

Healthcare providers, in an effort to improve care quality and reduce costs, are increasingly turning to IT-enabled business strategies. This is evidenced by the dramatic increase in the implementation of electronic medical record (EMR) and related clinical applications. The next wave of IT investment by providers will build on this foundation and a key component will be business intelligence (BI) applications that combine data from clinical, financial, and other applications. These applications are essential if hospitals are to realize the operational, financial, and clinical benefits from their EMR investments. Almost 30% of CIOs surveyed by Health Industry Insights reported that their organizations are currently developing enterprisewide data warehouses — efforts that will subsume the data marts and data cubes that comprise the majority of current BI deployments. The growth curve for BI adoption has not yet reached its point of inflection and, despite the current economic climate, investment in this technology represents one of the fastest-growing software segments in the health IT market. Success will require:

- A solid foundation of core technologies and well-integrated products that support the three cornerstones of BI: data quality, data integration, and metadata management

- Disciplined, mature methodologies and work processes that ensure a clear understanding of both the source data, the underlying business (or clinical) processes, and the relationships between them (These methodologies are also critical for ensuring consistency and the business validity of the underlying data definitions, inputs, and outputs.)

- Strong support and involvement by senior clinical, financial, and administrative leadership, in combination with disciplined project management and governance
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IN THIS REPORT

This Health Industry Insights report focuses on the growing interest by U.S. healthcare providers, and the vendor community that serves them, on products and services that support business and clinical intelligence (BI and CI) applications. It provides an overview of the business and clinical processes where this technology is increasingly being applied, a brief history of the evolution of this technology, the factors driving the sharp recent increase in adoption, and an overview of a typical business intelligence architecture and the major vendors with product and services offerings in this market segment. This report also provides survey data from several recent surveys by Health Industry Insights and IDC related to the current state, future plans, and key implementation issues and challenges faced by both healthcare providers and organizations in other industries with respect to their BI deployments.

This is the first in a series of three reports on this topic. A more in-depth view of BI vendors and their products and profiles of successful early adopters will be provided in two subsequent reports to be published later in 2009.

Brief Description of the Solution

Today's commercial business intelligence product offerings provide a rich set of capabilities. Their ability to extract data stored in a wide variety of formats and resident on a wide variety of technology platforms is rivaled only by the sophistication of their data analysis, reporting, and visualization options.

The latest generation of BI tools offers hospital clinical and executive leadership visibility into the operation of their enterprise that allow them to achieve their strategic goals and maximize the value they accrue from their investments in both clinical and financial applications. These insights can help them realize improvements in:

- The quality of care
- Patient safety and risk mitigation
- Staff performance and operating efficiency
- Patient flow and the elimination of process delays
- Scheduling of and access to clinical resources (e.g., beds, operating rooms, and imaging systems)
- Length of stay (LOS), operating costs, revenue, and margins
- Patient satisfaction
● Evaluation and management of patient referral patterns

● Physician practice patterns, including compliance with clinical protocols that positively impact patient and cost outcomes

● Compliance with process and reporting standards mandated by accrediting entities (e.g., JCAHO, CMS' Core Measures reporting program, and other related federal and state regulations)

SITUATION OVERVIEW

Introduction

The dramatic increase in IT investment by U.S. healthcare providers in recent years stands in sharp contrast to many years of limited investment in information technology. The rate of growth of IT spending by healthcare providers is outpacing that of many of the vertical market segments traditionally thought of as IT leaders. Despite the current economic downturn, Health Industry Insights forecasts close to a double-digit CAGR for software expenditures by healthcare providers in 2008–2011, driven by sharp increases in spending for clinical documentation and electronic medical record applications and business intelligence application development software.

Investment in Transaction Systems Alone Does Not Maximize the Value of IT

Hospitals' investment in clinical information and electronic medical record (CIS/EMR) systems is clearly rising. So, too, are the expectations of end users, clinical leadership, executive management, and board members, who are demanding to see evidence of tangible value for these capital investments. And, those capital requirements can be substantial. The total price tag for hospitals contemplating the deployment of a comprehensive CIS/EMR often exceeds $10 million per site. Project costs in the range of $100–200 million for large multihospital networks are not uncommon.

In light of this, CEOs and hospital boards demand that there be a compelling business case to justify the price tag. For most hospitals, the full breadth of the return on their CIS/EMR investment does not begin until they can use these data to define, guide, and measure enterprisewide process improvements. Given the complexity of healthcare service delivery processes and the diversity of source applications that must be tapped to acquire the data for analysis, business intelligence is the only feasible approach to meeting these needs.

Hospitals that have been leaders in the adoption of CIS/EMR technology are now entering a period of maturation. Having embraced
the concept of IT-driven process control, these leaders are now deploying the next wave of applications that leverage their investment in, and experience with, these transactional systems. A key component of that next wave are the BI applications that combine data from multiple applications to provide the insights needed to assure that tangible operational, financial, and clinical benefits from this investment are realized. Without such investment, much of the value that can be derived from the EMR investment will not be realized.

A Brief History

Historically, BI in the healthcare provider market is roughly 25 years old and traces its roots back to the mid-1980s, when the advent of DRG-based reimbursement models spawned interest in tools designed to analyze cost and profitability by clinical "product line."

The Early Pioneers

The earliest examples of these tools were Trendstar, from Amherst Associates, and the TSI Cost Accounting system, from Transition Systems Inc. In the 1990s, both were acquired, Trendstar by HBO and Co., which was subsequently acquired by McKesson, and TSI Cost Accounting system by Eclipsys Corp. Over the years, their architectures have been updated and their functionality enhanced. The successor products are now branded as Pathways Decision Support and Sunrise Decision Support, respectively. Over the past 15 years, other vendors of ERP, revenue cycle, and clinical system products (e.g., Cerner Corp., GE Healthcare, Lawson, Oracle, SAP, and Siemens) have also introduced analytics modules into their offerings. Newcomers, such as Accuro Healthcare, have also prospered by offering analytics-based products designed to extend and enhance the core functionality of a hospital's basic transaction processing systems.

Another early pioneer in the provider sector was SAS. Long known for its sophisticated statistical analysis software from which its name is derived, SAS has been a traditional fixture in the software toolsets of large academic medical centers, where it is used extensively in support of clinical research. Many early data marts internally developed at academic medical centers used SAS. Today, SAS offers a comprehensive set of tools to healthcare providers in the areas of business intelligence, clinical intelligence, and performance management. Several of the most advanced data warehouses implemented in U.S. hospitals have been built on SAS platforms.

A common characteristic of the BI products historically marketed to U.S. providers is that they are essentially packaged data marts, tailored to the unique needs of hospitals, rather than enterprisewide data warehouses. They are primarily targeted at providing hospital business and clinical leadership with insights into financial performance or clinical quality and outcomes analysis. They come with predefined
schemas, libraries of predefined queries, and extraction routines compatible with the schema specifications of many of the leading packaged hospital-specific applications.

**The "Resurgence" of Interest in Business Intelligence**

Despite this relatively long history, the sharp rise in interest and investment in enterprisewide BI applications is a relatively recent phenomenon; one that has been spurred by growth in hospital application portfolios that have created a wealth of patient- and service-related data in digital format covering a much wider set of clinical and business processes than ever before.

Over the past year or two, traditional players have been joined in the market by a number of new companies, while others, new to the provider market, have introduced healthcare-specific products. There has also been a spate of mergers and acquisitions. IT services firms with a focus on the healthcare vertical are now introducing business intelligence into their service line offerings. For example:

- In February 2008, Eclipsys expanded its offering by acquiring Enterprise Performance Systems Inc. (EPSi), a St. Louis–based software company specializing in performance management analytics.

- Three new services companies have entered the market. These include: InforSense, based in Cambridge, Massachusetts, and Recombinant, based in Waltham, Massachusetts. Both of these firms specialize in clinical analytics (CA). Also new to the industry is Dimensional Insight, based in Burlington, Massachusetts, which offers prebuilt business analytics (BA) products and services targeted at hospitals that utilize MEDITECH, one of the most popular hospital clinical and financial product suites.

- In the fall of 2007, two of the largest independent business intelligence software vendors were acquired, Cognos by IBM and Business Objects by SAP. While both of the acquired companies' products were in relatively widespread use in provider organizations, their software was principally acquired for use in self-development efforts, and primarily in the development of data marts. Both of the acquiring companies are now promoting service offerings wrapped around the software products focused on the development of enterprisewide data warehouses.

- In December 2006, HP acquired Knightsbridge Solutions Holdings Corp. Based in Chicago and London, Knightsbridge claimed more than 700 professionals devoted to training, consulting, design, and development of comprehensive data warehousing and business analytics applications. These service offerings have been incorporated across a number of HP vertical market business units, including its Healthcare and Life Sciences (HCLS) business unit.
From an industrywide perspective, the maturity, sophistication, and comprehensiveness of current hospital BI applications varies widely, with financial analysis and budget, performance and productivity analysis, and forecasting applications being the most comprehensive and mature, while those used to develop and monitor clinical care protocols are generally far less robust and less widely deployed.

**Business Analytics Architecture: An Overview**

As shown in Figure 1, the typical business analytics architecture consists of three components.

At the base of this figure are the tools for creating and managing the data warehouse. These include, for example, extraction, transformation, and loading (ETL) tools, data quality tools, and the tools for creating, maintaining, and managing the data warehouse schema and the operation of the warehouse.

The second component consists of the analytic tools used to create queries, reports, dashboards, and online analytic processing (OLAP) cubes, as well as the tools to create extracts that can be formatted and downloaded for further analysis by end users, using simplified desktop tools such as Crystal reports or Microsoft Excel. This component of the architecture also consists of advanced analytic tools used for data mining, advanced statistical analyses, and geospatial analyses — the latter is quite common in hospitals, which have traditionally analyzed both referral and admissions data by physician, clinical program or DRG, and zip code. Hospitals also routinely analyze public health data by zip code or county when developing new or expanding existing outreach and satellite care programs or evaluating merger, acquisition, or affiliation initiatives.

The third component consists of the canned analytic applications, either custom built or vendor provided, covering major components of the enterprise's applications portfolio. Represented here are both generic analytic applications, applicable to many different enterprises, in business areas such as staffing and labor cost analysis, ERP, budgeting, resource forecasting, financial cost and profitability analyses, and sales and marketing (all of which have direct relevance or map to related processes in the healthcare industry), as well as those operational and financial analyses that are unique to the healthcare sector. Many of the prebuilt data marts commonly marketed by ERP, revenue cycle, or clinical system vendors in the provider sector would fall into this component of the architecture.
The Building Blocks of Enterprise Information Management

To be successful, any endeavor must be built on a strong and solid foundation. For enterprise-level BI projects, this foundation is composed of the information management software, methodologies, and governance processes that will assure a high level of data quality, a stable yet flexible schema design, and realistic (and realizable) implementation schedules and budgets.

There are three specific attributes of enterprise information management (EIM) that are of particular importance to the successful deployment of enterprisewide data warehouses. These cornerstones are:

- Data quality
- Data integration
- Metadata management

From our research findings, it is clear that successful EIM efforts are distinguished by how well an organization executes with respect to these three foundational elements. A well-executed EIM effort includes:

- A solid foundation of core technologies and well-integrated products that support the three cornerstones
Disciplined, mature methodologies and work processes that ensure a clear understanding of both the source data and the underlying business (or clinical) processes — that is, understanding the meaning of data, how it is used, and its interrelationships with other data (These methodologies are also critical for ensuring consistency and the business validity of the data definitions, inputs, and outputs.)

Together, these factors help ensure that the resulting BI architecture can bend and evolve over time without breaking and with minimal reengineering, as changes occur in the underlying source systems. And for enterprises such as healthcare providers that are in a period of significant and rapid change in their application portfolios and architectures, this is critically important.

**Current Environment**

Managing cost growth has always been of critical importance to providers. Today, particularly in light of flat or declining reimbursement for many of the major payers, as well as the increased percentage of self-pay revenue resulting from higher deductible and consumer-directed healthcare plans, cost control and insights into cost trends and cost drivers have never been more important.

With the increasing availability of massive amounts of clinical data in digital form, those providers with broad (and mature) clinical systems portfolios now have the ability to unlock the real value in the data they have captured and stored in their EMRs. These types of analyses are crucial to meet both internal goals to improve care quality and reduce variations in practice patterns, costs, and outcomes.

Similar analyses are required to comply with increasingly numerous and sophisticated external quality and cost reporting requirements, such as CMS and JCAHO Core Measures, the pay for performance (P4P) programs introduced by private health plans, and state- and federal-level transparency initiatives.

For example, in 2008, CMS regulations defined 27 core measures. In 2009, that number will increase to 30. In a document published in 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. For the years beginning in 2011 and beyond, CMS is proposing that that this number be increased to 131.

External benchmarking has been a tradition in healthcare for many years, but these programs relied on metrics that lacked granularity and provided little ability to analyze and explain variances. With more data in electronic form and the availability of more sophisticated software
tools and analysis techniques, future benchmarks will make those of the past seem remarkably primitive.

**What Is the Current State of Business Intelligence Adoption by Hospitals?**

Twice a year, Health Industry Insights conducts our "Leading Indicators" survey of healthcare provider CIOs and CMIOs. One part of the survey is designed to gauge the rate of adoption of emerging technologies and one of the technology areas we asked about this year was BI. Here is a summary of data from three BI-related questions in our September 2008 survey.

The first survey question reads: "What best describes your organization's current use of business and clinical intelligence? Please select all that apply." The results are shown in Figure 2.

The most commonly cited form of BI deployments, at roughly 40%, was "Limited deployment of data marts and data cubes," followed by "Limited use of BI/CI tools that are incorporated into our packaged software applications (e.g., ERP, EMR, financial applications)," at about 35%.

Two other points are worth noting:

- Less than 10% of the respondents indicated that their institutions had no business or clinical intelligence applications in place, while at the other end of the spectrum, more than 15% of the respondents indicated that they have widespread usage of an enterprisewide data warehouse operational.

- Almost 30% of the respondents indicated that their organization is currently developing an enterprisewide data warehouse — efforts that we believe will subsume the data marts and data cubes that comprise the majority of current deployments.

Next, we asked the survey panel to identify six application categories their BI efforts addressed. The six categories included:

- Financial performance
- Financial forecasting
- Operational performance
- Cost and productivity analysis
- Clinical outcomes analysis
- Clinical protocol development
F I G U R E  2

Current Use of Business and Clinical Intelligence Applications

Q. What best describes your organization’s current use of business and clinical intelligence?

Please select all that apply.

- Limited deployment of data marts or data cubes (30% of respondents)
- Widespread deployment of data marts or data cubes (25% of respondents)
- Enhancing an already widespread deployment of marts and cubes (20% of respondents)
- Limited use of BI/CI tools that are incorporated in our packaged software applications (e.g., ERP, EMR, financial applications) (15% of respondents)
- Widespread deployment of an enterprise data warehouse (10% of respondents)
- No business or clinical intelligence applications (5% of respondents)

n = 36
Note: Multiple responses were allowed.
Source: Health Industry Insights’ Leading Indicators Survey, 2008

Not surprisingly, the two most frequently cited applications were, as noted earlier, financial performance and clinical outcomes analysis — application areas where leading healthcare ISVs already offer packaged solutions (see Figure 3).
FIGURE 3

Types of Business and Clinical Intelligence Applications Currently Deployed, May 2008 and September 2008

Q. Which of the following applications of business and clinical intelligence does your organization currently measure? (Check all that apply.)

*No BI/CI applications*

*Clinical protocol development*

*Clinical outcomes analysis*

*Cost and productivity analysis*

*Operational performance*

*Financial forecasting*

*Financial performance*

*No BI/CI applications*

(% of respondents)

May 2008 (n = 29)

September 2008 (n = 35)

Note: Multiple responses were allowed.

Source: Health Industry Insights’ Leading Indicators Survey, 2008

But as EMR implementations become even more pervasive and mature across the industry, look for clinical protocol development, an essential prerequisite for creating evidence-based care guidelines and monitoring compliance, to begin to rival the popularity of outcome analysis.

Finally, we asked respondents to identify the top 3 barriers to the deployment of business and clinical intelligence applications at their organizations. As shown in Table 1, some of the results were as expected; some were surprising.
TABLE 1

Top 3 Barriers to the Use of Business or Clinical Intelligence Applications

Q. What are the top 3 barriers to the use of business or clinical intelligence applications at your organization?

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<th>Rank Number 2</th>
<th>Rank Number 3</th>
<th>Weighted Total</th>
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<tr>
<td>Lack of funding</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>43</td>
</tr>
<tr>
<td>Lack of staff resources</td>
<td>7</td>
<td>7</td>
<td>5</td>
<td>40</td>
</tr>
<tr>
<td>Data quality or inconsistent data standards</td>
<td>8</td>
<td>3</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>Lack of essential source data in digital form</td>
<td>3</td>
<td>9</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Lack of executive sponsorship</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>Lack of effective project governance</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Lack of technical expertise</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
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</table>

n = 33
Note: Rank 1 = weight of 3, rank 2 = 2, and rank 3 = 1.
Source: Health Industry Insights’ Leading Indicators Survey, 2008

Not surprising was that "Lack of funding" stood out as the single-largest barrier to progress. Despite the relatively large year-over-year increases in hospital IT budgets, the demand for IT services continues to increase at an even faster pace. Funding and its close cousin, lack of resources, have been, and will likely remain, ranked as the number 1 and number 2 barriers, respectively, to IT progress across many different investment areas, including BI.

In the surprising category was "Lack of technical expertise." We believe that the low score in this area is a high praise for the vendor community, which continues to enhance not only the functionality of their product offerings but the ease with which relatively inexperienced IT professionals and end users can configure and utilize these complex applications.

But perhaps the most important point is that if one discounts the "usual suspects" of budgetary and staffing constraints, data quality and inconsistent data definitions were cited as the number 1 barrier to success. This issue is not unique to healthcare either.

**Common, Cross-Industry Business Intelligence Experience: Data Quality and Integration Remain the Top Challenges**

A similar question was asked in a much larger survey, with a sample size of about 500 respondents, conducted by IDC and its sister publication, InfoWorld, in January 2008. Here, too, data quality was
cited as the primary challenge. It is also interesting to note that the next most frequently cited challenges were data integration and master data management that, together with data quality, are the three cornerstones of an effective EIM discussed earlier (see Table 2).

**TABLE 2**

**Top 3 IT/Technology Challenges to Implementing or Deploying Business Intelligence Applications (% of Respondents)**

<table>
<thead>
<tr>
<th>IT/Technology Challenge</th>
<th>% of Respondents</th>
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<tr>
<td>Data quality: accuracy, completeness, and nonduplication</td>
<td>45.0</td>
</tr>
<tr>
<td>Real-time data integration from source applications</td>
<td>29.0</td>
</tr>
<tr>
<td>Integrating BI software with existing IT portfolio</td>
<td>29.0</td>
</tr>
<tr>
<td>Master data management (i.e., a single view of business entities)</td>
<td>27.0</td>
</tr>
<tr>
<td>Security and user rights management</td>
<td>22.0</td>
</tr>
</tbody>
</table>

n = 516, n = 405 end users, n = 111 system integrators


When asked to characterize their level of satisfaction with the quality of the data feeding their enterprise data warehouses, 23% of the respondents said that they were either extremely dissatisfied or very dissatisfied (scores of 1–4) (see Figure 4).
Concerns related to data integration were not far behind. When asked how they would rate the success of their organization's ETL/data integration initiatives over the past 12 months, 20% indicated that they were either very dissatisfied or somewhat dissatisfied (see Figure 5).
FIGURE 5

Satisfaction with Success of Extraction, Transformation, and Loading/Data Integration in Current Business Intelligence Applications

Q. On a scale of 1–10, where 10 is extremely satisfied and 1 is not at all satisfied, how would you rate the success of your organization’s ETL/data integration initiatives over the last 12 months?

Very dissatisfied (1–2) (6.7%)
Somewhat dissatisfied (3–4) (13.3%)
Neutral (5–6) (24.8%)
Somewhat satisfied (7–8) (35.2%)
Very satisfied (9–10) (20.0%)

n = 105

Note: Multiple responses were allowed.


What Is Data Quality?

So, what is data quality? We define it as an attribute that can be measured across four dimensions: structure, accuracy, completeness, and definition:

- **Structure.** Means that the type, size, and format of data elements is consistent across all representations. Where the structure is inconsistent across some representations, the rules for transforming all instances into a conforming standard are well defined and unambiguous.

- **Accuracy.** Means that data elements are unambiguous, reliable, consistently defined across multiple source representations, and time period specific, that is, they can be clearly associated with the time period in which they were created or for which they are valid.

- **Completeness.** Means that data items are complete and exhaustive with respect to the populations they purport to represent.
● **Definition.** Means that data is consistent, unambiguous, and congruent with respect to the organization's standards for metrics, algorithms, attributes, and variables.

To ensure this, three key project management principles must be adhered to. These include ensuring that:

● The business analysts and data architects on the development team have an intimate and complete understanding of the underlying business processes and the business meaning and usage of the data.

● Any differences are reconciled through appropriate data governance and metadata management processes.

● Adequate controls are designed into the ETL processes to ensure that all inputs from all mandatory data sources are accounted for and that each of these data sets meets an appropriate test of completeness.

**FUTURE OUTLOOK**

BI will be a key contributor shaping the future of healthcare service delivery, and the power of the insights it will provide will not be limited to individual provider organizations.

In the short term, look for BI to:

● Facilitate pay-for-performance reporting compliance

● Provide more comprehensive dashboards and performance management report cards

● Benefit from the replacement of ad hoc source data collection with automated transaction system extracts as hospital application portfolios mature

● Look, too, for the government to encourage the development of standardized data definitions not just for transactional data but ultimately for analytic data, as well

The current stream of IT investment is creating a very rich, although still primordial, "data stew" particularly with respect to patient-focused clinical data. For the past 25 years, we have witnessed a symbiotic cycle that has been fairly consistent over time — the payers and regulators demand providers supply more information to get paid and/or comply with regulatory guidelines of some form or another. At first, the providers meet that demand with manual or semiautomated reporting methods. Eventually, recognizing that it's a highly inefficient solution, providers invest in technology to automate the compliance process and come to realize that as a by-product of that investment,
they now possess the information to make better internal management
decisions. This fact is not lost on the payers or the government.
Recognizing when providers have the capability to more easily
provide data that they would find useful, the regulators initiate a new
round of requirements and the cycle begins anew.

Of late, this cycle has been accelerating. Eventually, all this data feeds
huge regional, statewide, and national databases. Now that we have
begun to introduce into the mix an increasing emphasis on data
standards and standardized use cases, the value of the data collected
will increase. This, in turn, will further accelerate the cycle.

Think of this as a grand metadata management process; think of the
state and federal agencies' and the private payers' data stores as data
warehouses and hospitals and physician practices as the source data
systems. One can only imagine the insights into population health and
research that such a resource could provide. The fields of evidence-
based medicine and personalized medicine are just in their earliest
stages of development. The maturation of BI technology, combined
with the ability to share the relevant data across provider
organizations, will be crucial to the evolution of these disciplines. But
in mining this data for its full value, both the industry and the
regulators will need to effectively address the issues of privacy and
confidentiality that inevitably arise.

Future Adoption Patterns

Hospitals that have made or are making a significant commitment to
IT-enabled care delivery recognize that it is not a goal, but a journey in
which implementation of an EMR is simply a milestone along the
road. To truly exploit the value of this IT investment, leading hospitals
have recognized that they must complement their applications
portfolios with BI tools that pair their growing clinical data
repositories with their existing financial data to create meaningful,
actionable information.

If the implementation of a CIS/EMR can be thought of as the first leg of
the journey and the early BI applications profiled here as the second,
what will the next leg of this journey look like? The actions and
experiences of early adopters suggest that future BI efforts will be
targeted at supporting three emerging, interrelated disciplines: evidence-
based medicine, protocol-based medicine, and personalized medicine:

● Evidence-based medicine focuses on the conscientious, explicit,
and judicious use of the current best clinical evidence available to
develop medical practice guidelines that support the efficacy of
medical diagnostic and treatment decisions by integrating clinical
expertise with the latest available research findings.
• Protocol-based medicine translates the guidelines developed through evidence-based medicine into operational clinical practice in the form of protocols. For hospitals with comprehensive CIS/EMR applications in place, this often brings the results of evidence-based research to the point of care in the form of software-based protocols. These can take the form of alerts, prompts, online clinical reference documentation, and standardized order sets.

• Personalized medicine is the ability to use detailed information about patients' genomic makeup, such as their genotype, combined with relevant medical record data to guide a caregiver in the selection and administration of a medication, therapy, or other preventative measure that is particularly suited to those individuals and the circumstances of their medical condition at the time the therapy is administered.

Once the purview of only leading-edge hospitals with heavily customized clinical systems, commercialized implementations of EBM knowledge, as well as software frameworks for rapidly building and operationalizing protocol-based alerts and order sets, are now finding their ways into packaged CIS/EMR applications.

But it is the development of these protocols, not merely their delivery, which is essential to the continuous learning structures that will ultimately lead to improvements in care quality and reduced care costs. The leading academic and research institutions are, and are likely to remain, the source of the underlying research and analyses that serve as the source for developing EBM guidelines and protocols. Collectively, when embodied in the form of software, this research, and the resulting body of knowledge, is often referred to as clinical decision support (CDS), clinical analytics or, more broadly, clinical intelligence. High-level CI solutions are currently in development as leading innovators and BI tools are a critical component of the CI infrastructure needed to implement these applications.

In the future, we expect the information foundations created by business and clinical intelligence applications and performance management applications to coalesce into unified environments similar to those developed by leading-edge adopters in other industries. Known as business analytics systems, these applications will build upon these foundations, encompassing clinical, operational, and financial data to truly link operational management to clinical practice.

Other trends in the industry will also contribute to the long-term growth of BI usage among healthcare providers. Healthcare is one of the most highly regulated and publicly scrutinized industries in the United States. This attribute will only become more pronounced in the coming years, and with it, the expectation of more, not less, internal and external compliance and quality reporting. We are already seeing
one very public manifestation of this trend: The increased availability and detailed quality reports found on consumer-oriented, government-sponsored Web sites.

**Market Trends**

In the coming years, the diversity of data sources for BI and CI applications will increase, not decrease, because the underlying transaction systems are likely to become even more heterogeneous. Despite predictions of the emergence of single-source vendor relationships as the norm in healthcare IT purchases, this has proven to be an elusive, and not necessarily desirable, goal. As the more common, dominant hospital processes are automated, subsequent efforts focus on the more esoteric, complex, and lower-volume clinical processes; processes that require specialized clinical knowledge, as well as software skills. Over the near term, this will remain the domain of specialty vendors, entrepreneurs, and start-up ventures. Integration of the data stored in these applications with that of other clinical and financial data sources will continue to fuel the demand for flexible, sophisticated BI tools for data extraction, normalization, and analysis.

This same phenomenon will shape the market for BI services, particularly those related to evidence-based and personalized medicine. While the development of specialized BI applications will utilize off-the-shelf software components, their successful deployment will depend heavily on the clinical expertise of the developers. Look for new entrants and continued growth of specialty niche service vendors offering the requisite clinical expertise.

**Transaction-Level Systems with Embedded Business Intelligence Functionality**

BI has begun to permeate transaction-level applications. The latency inherent in the analysis and delivery cycle and lack of granularity in many BI applications diminish the actionable potential of many BI initiatives. In contrast, embedding real-time BI capabilities in transaction-processing applications has the potential to address both issues and deliver actionable alerts to the end users and first-line managers to take timely corrective actions at the point of awareness. Look for this trend to accelerate.

There are many opportunities in hospitals to utilize BI functionality not only for improved management and financial planning and decision making, where it has generally been most successfully applied to date, but also for process, quality, and workflow improvement, as well. In support of the latter, BI's success to date has been more elusive. With the exception of the growing number of real-time clinical alerts built into many clinical information systems, the majority of BI/CI capabilities deployed today provide only a retrospective view of the processes and outcomes they target.
Arguably, the most successful and pervasive example of real-time BI/CI are the evidence-based guidelines offered by San Bruno, California–based Zynx Health, a subsidiary of the Hearst Corp. Zynx guidelines are embedded within numerous implementations of a variety of inpatient EMR products, particularly those from Cerner, and are now being licensed by vendors of ambulatory EMR products, as well.

In August 2008, InterSystems Corp., Cambridge, Massachusetts, announced DeepSee, an embedded BI enhancement to its widely used Caché database environment. Caché-based clinical and financial applications are currently marketed by HIT vendors such as Epic, QuadraMed Corp., Siemens, Sunquest, and GE Healthcare. Collectively, their user base accounts for roughly half of the installed clinical systems in the United States.

There is a decided need for capabilities such as the ones DeepSee provides. To provide embedded, real-time business intelligence, BI technology must be delivered as an integral part of its host application and have unfettered access to a complete set of data required for critical operational decision making, the ability to create, update, as needed, and apply the business rules that facilitate appropriate decision making and deliver it to the appropriate decision maker in an actionable time frame.

The first ISV to announce product enhancements based on DeepSee was QuadraMed. The QuadraMed patient registration application will be enhanced with InterSystems DeepSee to provide a registration auditing and quality improvement capability. This enhancement provides, among other functions, information needed to process insurance claims that provides users with dashboards to monitor data quality, throughput, and backlog as well as to change data rules and work assignments in real time. Look for more applications of this technology both in QuadraMed products and others based on the Caché platform. We expect that similar capabilities will be introduced into QuadraMed's and other Caché-based products in the near future.

Other transaction-level software vendors with a presence in the provider market have begun to offer similar capabilities in their products. Lawson Software, a leading ERP vendor with a significant presence in the provider market, now embeds what it calls operational business intelligence (OBI) features into many modules of its latest ERP offering. Essentially, these OBI capabilities are role based and aimed at transaction specialists or first-line supervisory personnel. They expedite and facilitate workflow completion and process quality by proactively delivering information regarding exceptions or incomplete transactions, rather than relying on users to search for the necessary information. These capabilities not only tell personnel what happened, but why and how they need to address the exception conditions.
Remote Patient Monitoring

Another emerging trend is remote patient monitoring, which will require the development of sophisticated clinical intelligence applications. Remote patient monitoring involves the acquisition, storage, and analysis of physiological measures from patients, typically ones suffering from a chronic illness, during their routine activities of daily living using biometric sensors. Although still in the early "proof of concept" stage, large-scale deployment of these applications is expected in the next three to five years. This will require a software infrastructure to acquire and manage large volumes of data from a large population of patients, combined with real-time analysis, to determine if patients are experiencing clinically significant deviations from their individual normal values. Where such deviations are noted, these applications will trigger alerts to patients, caregivers, and others for possible interventions.

ESSENTIAL GUIDANCE

Actions to Consider

As with an EMR, the deployment of BI applications in a hospital is a journey, not a destination. While the experiences of early adopters we have spoken with will be profiled in detail in an upcoming report, some of their "lessons learned" are summarized in the following paragraphs. The benefits they achieved attest to what can be achieved from such a commitment and ongoing dedication to the goal of continuous performance improvement and the crucial supporting role of BI every step of the way.

For end users who are beginning or simply contemplating such a journey, we recommend that these organizations:

- **Ensure alignment between the scorecard metrics and the institution's strategic and tactical planning goals.** Ensure that the metrics selected support key institutional strategies and initiatives; provide ongoing linkages to the institution's strategic management process. Remember that not all metrics have a home in a balanced scorecard; metrics should be a reflection of, and consistent with, the institution's strategy plan and key performance metrics.

- **Follow a bottom-up approach to metric definition.** There is truth in the old adage that "to decide where to begin, start at the end." Define and agree on your metrics first, and ensure that the metrics are both relevant to measuring effectiveness and provide important insights that can foster meaningful changes to the operating environment.
● **Think big, but start small.** Early success is important to maintain the momentum. Don't attempt to "boil the ocean." Work toward an initial pilot deployment that establishes a "proof of concept" as rapidly as possible. But rather than simply a "throwaway," the pilot should be a limited scale effort that sets the tone and serves as a model for subsequent, broader-scale efforts. Start with high-cost, high-profile areas that are highly visible, and meaningful, to the organization.

● **Link data to organizational units and management structures.** Provide high-level summaries at the enterprise level, but ensure that there is adequate drilldown capability to facilitate a view into the origin and root cause of exceptions. For example, provide the ability to trace inpatient-related data to specific nursing units and patients. Aggregate unit-level data in a manner consistent with the organizational structure to facilitate corrective action by management.

● **Know your data sources.** Invest the time in understanding your source applications, their nuances, and peccadilloes, in detail. Have strict, tight, and consistent data definitions. Different source systems may purport to contain common data elements and metrics, but unless the underlying logical data definitions are the same, the data may not be equivalent and will likely not reconcile. This will undermine trust in the data and acceptance of the metrics. Identify interfaces and plan on sufficient IT resources to build and maintain them.

● **Don't expect all source data to come from operational, transaction-level systems.** Recognize that even in those organizations with extensive and sophisticated application portfolios, a significant portion of the required source data may not be available from the operational, transaction systems. Develop standardized, well-defined processes for obtaining and converting supplemental source data into digital form.

● **Process improvement begins "at home."** Make sure that the process of process improvement is, itself, optimized. Focus on the process improvements necessary to minimize lag times in the collection, preparation, and input of source data. Recognize that some of the data that cannot be readily collected from transaction systems may not always be readily available. Do not make dashboard or scorecard production contingent on the availability of all source data, otherwise delays will undermine the support of line managers who are relying on the timely availability of the information to take corrective action.

● **Ensure auditability of source data.** Ensure that source data is auditable and provides sufficient detail so that errors can be corrected and exceptions can be appropriately investigated. This is
particularly important with respect to ad hoc data that originates from nonautomated sources.

- **Provide adequate staffing.** Ensure that the project is adequately staffed. Assign a full-time project manager with the breadth of experience and an in-depth understanding of both hospital operations and IT; one that can gain the confidence of, and work effectively with, a wide range of clinical and administrative personnel at all levels of the organization. Ideally, this individual should be equally at ease working with staff nurses as they are with physicians and executives. Training is not a onetime event; recognize the ongoing importance of education, training, and support; and ensure that there are sufficient resources to meet these needs.

- **Partner with your vendor.** Engage with a vendor that can do more than simply provide and install the software, but rather one that can serve as a partner; one that has deep domain expertise and a successful track record with similar efforts at comparable institutions, not just excellent technical support.

- **Incent the participants.** Provide a system of rewards that recognize excellence, both in absolute terms, as well as relative ones, such as "most improved." Rewards that tie improvements in performance to compensation, both personal and departmental, have proven highly effective.

- **Patient satisfaction scores are an essential component of any scorecard.** While not all quality or performance improvements may be visible to the patient, ultimately the core of these efforts are all about the patient and their satisfaction with the quality of the services they receive. Tracking patient satisfaction scores using a standardized national scale, such as Press Ganey, and correlating those score with other metrics is an essential component of any successful scorecard process. Hospitals should also recognize that patient satisfaction scores have direct financial implications. Not only is there a direct correlation with gains and losses of market share, but research has shown that there is a direct (and inverse) relationship between patient satisfaction and patient complaints and malpractice suits and losses, as well.

## Strategies to Consider

Specifically with respect to the EIM aspects of your efforts, our list of best practices includes:

- Build your EIM foundation on a product set with a significant level of "out of the box" functionality, including:
  - Integration and data quality tools
○ Industry- and source data application–specific routines

● Establish appropriate governance processes, but vest ultimate decision-making authority in a formal EIM project leadership vehicle — a "data czar," if you will — someone who can serve as the ultimate arbiter

● To maximize data quality, implement a metadata management process that adheres to the 4Cs:
  ○ Centralization
  ○ Collaboration
  ○ Consistency
  ○ Controls

● Remember that the only constant is change: commit to an ongoing "tuning" of your metadata architecture

● "Think globally; act locally" — avoid hype and overpromising; get small wins early

And, if you are just getting started on the "long and winding road," consider engaging a guide — an outside resource with tool-specific and, even more important, industry-specific expertise.

The future is intelligent; plan intelligently.

LEARN MORE

Related Research

● Cerner's Product Diversification Strategy: Will It Position Cerner for Another Era of Dramatic Growth? (Health Industry Insights #HI214851, November 2008)

● Oracle Unveils Its New Exadata Database Server at Oracle OpenWorld 2008 (Health Industry Insights #HI214522, October 2008)

● High-Level View of InterSystems' Latest Innovation: DeepSee (Health Industry Insights #HI214503, October 2008)

● U.S. Health Industry Provider 2008 Top 10 Predictions: The Use of IT in the Provider Landscape (Health Industry Insights #HI210302, January 2008)
EMRs, Their Current State and Future Direction, Part 1: Hospitals (Health Industry Insights #HI208878, October 2007)

Healthcare IT Maturity Model: U.S. Hospitals (Health Industry Insights #HI208775, September 2007)

The Value of HIT Investment: An Econometric Perspective (Health Industry Insights #HI206330, April 2007)

Vision for Sustainable Intelligence in Integrated Clinical IT Systems (Health Industry Insights #HI206165, March 2007)

The Personalized Health Paradigm: Transforming the Pharmaceutical and Healthcare Industries for the 21st Century (Health Industry Insights #HI203469, October 2006)

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