Healthcare providers, in an effort to provide better, cost-effective care, are increasingly turning to IT-enabled business strategies. This increased level of investment is being driven by the need to:

- Improve the quality, cost-effectiveness, and efficiency of their services
- Increase patient/customer satisfaction
- Reduce medical errors and promote patient safety

The implementation of digital health records is leading to increased availability of detailed, comprehensive, and patient-specific clinical information in digital format. This, in turn, will pave the way for the next wave of IT applications. But investment in electronic medical record (EMR) and related clinical applications, which are designed to automate workflows and organize patient clinical data, while essential to lay the foundation for these improvements, is, in and of itself, insufficient to achieve these goals. The next wave of IT investment will build on this foundation, and a key component of this next wave will be the business intelligence (BI) applications that combine data from clinical, financial, and other applications. This is essential to provide the insights hospitals need to ensure that tangible operational, financial, and clinical benefits from their EMR investments are realized.

IN THIS WHITE PAPER

This white paper presents the findings and analysis of in-depth interviews conducted with nine senior executives and system architects at three prestigious teaching hospitals acknowledged to be industry leaders in their use of health information technology, in general, and BI applications, in particular. The three institutions are Brigham and Women's Hospital, Boston, Massachusetts; Maine Medical Center, Portland, Maine; and Yale-New Haven Hospital, New Haven, Connecticut.
SITUATION OVERVIEW

Trends in Hospital IT

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 projects close to a double-digit CAGR for software expenditures during the 2008–2011 period, 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

Although there is much debate in the industry when analyzing various surveys with regard to differences in methodology and validity of their definitions of automation, the scope of software functionality, and the extent of its deployment, there is clear evidence that IT investment in clinical information and electronic medical record systems (CIS/EMR) is rising. But so 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 can exceed $15 million per site. Project costs in the range of $100–200 million for large multi-hospital 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 this data to define, guide, and measure enterprisewide process improvements.

Hospitals that have been leaders in the adoption of CIS/EMR products, as well as those that have developed them internally, 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. Among the key components of that next wave are the BI applications that combine data from multiple applications to provide the insights needed to ensure that tangible operational, financial, and clinical benefits from this investment are realized. Without such investment, much of the value that can be derived from EMR investment will not be realized.
The Value Proposition of BI Tools

Today's commercial BI 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 effective deployment of the latest generation of BI tools can offer hospitals' clinical and executive leadership visibility into the operation of their enterprise that can 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:

- 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, imaging systems)
- 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) and federal and state regulations (e.g., HIPAA)
- Length of stay (LOS), hospital costs, revenue, and operating margins

The Experiences of Early Adopters

Hospitals considering the implementation of BI applications face a number of technical and organizational challenges, including data availability, data quality, data definitions, and differing goals and perspectives among their various constituencies. How they approach this process can spell the difference between success and failure.

What has been the experience of early adopters? To help answer this question, Health Industry Insights interviewed nine key executives at three institutions that embraced the concept and made significant progress in the past several years.
The objectives of these interviews were to understand how each of these organizations planned and implemented BI solutions that addressed these challenges and to share their experiences with other institutions considering similar initiatives.

**Brigham and Women's Hospital**

**Background**

Recognized internationally for its excellence in patient care, its outstanding reputation in biomedical research, and its commitment to educating and training physicians, research scientists, and other healthcare professionals, Brigham and Women's Hospital (BWH) is a 777-bed teaching affiliate of Harvard Medical School. The facility has approximately 44,000 inpatient admissions and 950,000 ambulatory visits annually. Along with its modern inpatient facilities, BWH's programs include extensive outpatient services and clinics, neighborhood primary care health centers, and state-of-the-art diagnostic and treatment technologies and research laboratories.

Brigham and Women's Hospital has deep and rich roots in medicine that date back to 1832. BWH is a founding member of Partners HealthCare System, the largest integrated healthcare delivery network in New England and one of the largest in the United States.

BWH embraces a culture of quality. It has been ranked on *U.S. News & World Report*'s Honor Roll of America's best hospitals for 11 consecutive years. It has also been named for eight consecutive years to Solucient's list of Top 100 Hospitals. The Solucient methodology uses a balanced scorecard approach, centered on nine key organizationwide measures: risk-adjusted mortality, risk-adjusted complications, risk-adjusted patient safety, Core Measures Score, severity-adjusted average length of stay, expense per adjusted discharge, profitability, cash-to-debt ratio, and growth in patient volume.

BWH was also recognized in 2005, 2006, and 2007 by the University Healthsystem Consortium (UHC) for being one of five top-performing academic medical centers in the country in a special quality and safety benchmarking study.

In 2006, BWH won the 13th annual National Quality Healthcare (NQHC) Award. The NQHC award was created in 1993 by the National Committee for Quality Health Care and is the first award of its kind to recognize outstanding, quality-driven healthcare organizations.

**The IT Imperative**

One of the pioneers in hospital IT, BWH has an extensive portfolio of clinical, administrative, and financial applications. Much of its clinical system environment is internally-developed. Its efforts to develop a
A balanced scorecard began in early 2001 with strong support from the hospital's senior executives, clinical leadership, and the board of trustees. The Executive Co-Sponsors for this effort were the CIO and the VP for Clinical Excellence, who was a physician with an MBA from Harvard Business School, where he was exposed to the Kaplan and Norton Balanced Scorecard framework. A steering committee was formed: Its members included the COO, CFO, CIO, CNO, three clinical vice presidents, and chairs of the clinical departments.

Initial efforts included the definition of a strategy map, an integral component of the balanced scorecard methodology, and the construction of a pilot scorecard using a combination of semi-automated methods. These initial efforts were well-supported by management, and the decision was made to expand the scope and engage the services of a software provider to support the data analysis and reporting process. In early 2002 a contract was signed with SAS to provide the software tools and infrastructure to facilitate and expand the initial design.

**Accomplishments**

Today, BWH's balanced scorecards are created from more than 80 different data sources. The majority, about 75%, of the source data is extracted from about 20 different clinical, administrative, and financial transaction systems; an internally developed corporate quality reporting system; and a legacy financial decision-support application. The remaining 25% comes from more than 60 unique data feeds from local departmental systems and custom-designed desktop applications.

At the outset of the effort, the scorecards primarily consisted of inpatient-focused metrics related to clinical quality, workload, and financial measures. Today, the scorecards and related dashboards provide 24-hour, online access to information derived from more than 50,000 annual patient encounters to more than 1,000 authorized users at all levels of the organization, from front-line supervisors to attending physicians to senior executives and even trustees. Their metrics relate to key strategic goals in the areas of patient safety, patient satisfaction, service quality, service volumes, resource utilization, financial performance, operational efficiency, and staff satisfaction. Users also include more than 200 surgeons and obstetricians, who can view their own scorecards that compare their facility utilization, case costs, infection rates, patient satisfaction, and other outcomes against established benchmarks pertinent to their specialties.

BWH has incorporated BI as an integral component of its ongoing efforts to improve quality and reduce costs. Its efforts have paid off. In the past three years, for example, the median LOS at BWH has declined by 0.3 days in the face of increasing case mix severity, while its Press Ganey inpatient satisfaction scores have improved from the 50th to greater than the 90th percentile compared with the scores of other national teaching hospitals.
The system continues to evolve. Future enhancements currently being implemented will focus on outpatient services, expanding on the current core of about a half dozen ambulatory metrics to include measures of appointment availability, visit duration, exam room utilization, and patient satisfaction. Development of measures to track the effectiveness and financial performance of research and teaching programs is a future goal.

**Maine Medical Center**

**Background**

Maine Medical Center (MMC) is a nonprofit, private corporation governed by volunteer trustees from the surrounding communities. MMC is not only a community hospital for the people of greater Portland, Maine, but also the premier tertiary care center for northern New England. The hospital has 606 licensed beds and provides comprehensive inpatient services in all medical specialties. Centers of excellence are being developed in cancer care, heart care, children's services, and other areas, building on existing excellence in multidisciplinary services.

MMC has a large and growing outpatient component, providing day surgery, cardiac catheterization, laboratory services, rehabilitation services, and some three dozen outpatient clinics. There are also preventive and consultation services, including the MMC Diabetes Center, the AIDS Consultation Service, and the Center for Lipids and Cardiovascular Health. Maine Medical Center is a teaching hospital, with active programs in undergraduate medical education, graduate medical education, postgraduate medical education, nursing education, and allied health professional education. MMC also offers continuing education for health professionals, a variety of community health education programs, and extensive clinical research programs.

**The IT Imperative**

Following the publication of the Institute of Medicine's (IOM) landmark 1999 report, multiple quality improvement (QI) efforts at MMC were introduced at departmental levels. MMC's commitment to replacing them with a consolidated, formalized, and rigorous approach began about five years ago. A Process Improvement (PI) function was created, and a senior nursing executive was named to lead it. The intent was to consolidate and standardize the various departmental-level QI efforts and to elevate their visibility across the enterprise.

A PI Steering Committee was created to establish priorities and oversee QI efforts on an institutionwide basis. Key members of the committee included the chief operating officer (COO), the chief medical officer (CMO), the chief nursing officer, and the chief financial officer, who, along with the COO and the CMO, routinely
provides status updates to MMC's Board of Trustees. The balanced scorecard methodology pioneered at Harvard and the work done at Brigham and Women's Hospital also served to confirm and shape MMC's approach. MMC's planning process included multiple site visits to BWH during the formative stage of its efforts. MMC also benefited from strong board support from members familiar with the balanced scorecard methodology.

The key challenge was the dependence of the QI initiative on existing methods of data collection and reporting, which were time-consuming, irregular, and inconsistent. Most were built with a variety of manual data collection processes combined with personal productivity software, predominantly spreadsheets. It was clear that this was not a feasible approach for the full-scale, enterprisewide deployment visualized, and in 2003, MMC contracted with SAS to serve as the platform for the expanded deployment.

**Accomplishments**

The initial scorecard was built in the July–December 2003 time frame. Today, there are more than 50 scorecards, encompassing more than 1,000 metrics, in production at MMC, with 50–60% of source data drawn directly from production systems; the balance comes from "one-offs," which can range from Excel spreadsheets to data embedded in an email that is abstracted by the PI team and entered into SPM. These scorecards focus on four cornerstone areas:

- "Internal Process" measures, which include monitors of patient flow and measurements of delays versus expected milestone events, a variety of other operational efficiencies, patient safety events, and compliance with evidence-based practices
- "Financial Performance" measures, which include a variety of measures of the institution's financial health, such as cost per adjusted discharge day
- "Customer Views," which report measures of patient, staff, and physician satisfaction scores, using a combination of results from both Press Ganey and internal surveys
- "Innovation and Growth" measures, which report measures of performance and growth in the areas of education and research

MMC has seen significant improvements in quality and cost performance as a result of the SPM effort. One of the most notable areas in which the scorecard process has been instrumental in facilitating significant process improvement has been that of computerized physician order entry (CPOE) compliance.
MMC was a pioneer in the adoption of clinical IT for the creation and communication of physician orders, implementing its first order entry system almost 30 years ago. Yet, despite MMC's pioneering efforts, physician compliance with order entry and the use of "order sets" and the associated protocols to enforce the "best practice" guidelines established by MMC's clinical leadership initially met with mixed success. Attending physicians continued to handwrite orders for subsequent entry into the system by nurses or resident physicians, increasing the likelihood of transcription errors, a significant risk factor for medication and other errors at many hospitals, including MMC.

With strong endorsement from the Medical Executive Committee, a CPOE compliance improvement campaign was created by MMC management. About 8,000 physician orders a day are entered into MMC's clinical order entry system. Prior to this campaign, only about 40% of orders originated by attending physicians were entered directly into the order entry system by the author, while compliance among resident physicians was about 90%. Implementation began in early 2003, timed to coincide with a major expansion of its Picture Archiving Computer System (PACS) and an upgrade of the clinical system.

Orders entered directly by physicians versus those entered by surrogates were incorporated as a key measure on the MMC scorecard following the campaign. Shortly after the start of the campaign, which included financial incentives, attending physician compliance rose to 85%. Today, after conversion to the latest generation of CIS, attending compliance has risen further and is now at 95%, with resident compliance now at nearly 100%.

But more importantly, MMC achieved a significant drop in medication transcription errors, from 193 in 4Q02, when the awareness campaign began, to 83 by 4Q03 and zero in 1Q04. The increased physician compliance was an integral part of a medication safety PI program that included the implementation of a robotic pharmacy dispensing system and a computer-aided medication administration recording system (MARS) that employs handheld computers and barcode readers to verify the match of patients to doses at the bedside, prior to medication administration.

Another area of improvement has been seen in MMC's scores on the Core Measures (CM) quality monitoring program mandated by the federal government's Centers for Medicare & Medicaid Services (CMS) and administered by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO). The Core Measures program focuses on case outcomes and other measures of quality in such areas as treatment of acute myocardial infarction (AMI), heart failure (HF), and asthma and pneumonia, and it also tracks post-surgical complications, such as venous thromboembolisms. The MMC scorecard metrics mirror the CM metrics, and significant improvements have been noted since these metrics were implemented.
The use of SAS scorecards has become so integral to the management of the institution that MMC now creates an annual performance improvement (PI) plan, which is an integral part of the enterprise's annual operational planning process. And the results are apparent not only to MMC but also to external organizations. In 2006, the Leapfrog Group named MMC as one of its Top 50 Safest Hospitals in the United States, and Health Grades, a leading hospital ranking entity, placed MMC in the top 10% of hospitals in the United States for excellence in cardiac care.

MMC is currently exploring options for a comprehensive ambulatory care system. One of the objectives is to extend its current inpatient EMR into its ambulatory programs to create an enterprisewide EMR. Extension of its balanced scorecard environment is expected to follow. PI has become an integral part of MMC's quality-driven culture, and SPM has become the key enabler.

**Yale-New Haven Hospital**

*Background*

Yale-New Haven Hospital (YNHH) is a 944-bed tertiary referral center that includes the 201-bed Yale-New Haven Children's Hospital and the 76-bed Yale-New Haven Psychiatric Hospital. It is the primary teaching hospital for Yale University School of Medicine (YSM).

A consistent winner of the Solucient Top 100 award, Yale-New Haven ranks among the best hospitals in the United States. Relying on the skills of approximately 2,200 university-based and community physicians and almost 500 resident house physicians, practicing more than 100 medical specialties, Yale-New Haven, the Children's Hospital, and the Psychiatric Hospital provide services for more than 447,000 outpatient and emergency visits and 45,000 admissions annually. In addition, Yale-New Haven is the second largest employer in the area with about 6,000 employees.

Yale-New Haven receives national and international referrals and, in conjunction with YSM and the Yale Cancer Center, is nationally recognized for its commitment to teaching and clinical research. The National Institutes of Health has recognized these facilities for the excellence of the Cancer Prevention Research Unit, Cancer Information Service Center, Comprehensive Cancer Service, Digestive Disease Research Center, Child Health Research Center, Children's and Adults' Clinical Research Centers, and Claude D. Pepper Older Americans Independence Center.

YNHH is the flagship institution of the Yale-New Haven Health System (YNHHS). In addition to the three hospitals in New Haven, YNHHS includes two other hospitals and their related facilities: the 425-bed Bridgeport Hospital in Bridgeport, Connecticut, and the 174-bed Greenwich Hospital in Greenwich, Connecticut.

©2009 Health Industry Insights, an IDC Company #HI215672
The IT Imperative

YNHHS had a long history of using performance management reporting and business intelligence systems, as well as using IT to improve clinical workflows and operations. Cost- and productivity-related performance analysis was first implemented more than 20 years ago and financial decision support applications more than 10 years ago, but until recently, the organization lacked a coherent, consolidated approach to quality and performance reporting. Existing reporting processes utilized disparate sources, had differing definitions and irregular reporting cycles, and did not provide an enterprisewide view. There was no one individual who served as the overall, corporate performance management "champion."

The commitment to enterprisewide clinical and business-oriented performance reporting was initiated in early 2004 by YNHHS' now-retired CEO, who, following the publication of the landmark IOM reports, embraced the findings and asked, "How are we doing?"

A steering committee of senior executives was formed representing each of the health system's operating units to guide the early design and implementation of the project, as well as the vendor selection. The key focus was to drive an enterprise culture across the three hospitals and to prepare for an era in which there was going to be a much greater need to demonstrate value creation, efficiency, and outcomes. SAS was chosen in 2003. A senior physician executive was selected to assume the role of the Vice President for Performance Management in 2004 and appointed as the committee chairperson.

Accomplishments

Initially, the project faced some common challenges such as lack of adoption and "buy-in" by elements of the user community, many of whom had contributed to past efforts and were current users of one or more of the legacy performance reporting systems. The challenge then shifted to meeting the demand, in terms of creating the next feed of data from a primary system or the next type of operational report/scorecard. Prioritization became critical because there were more requests than the team could implement.

An additional challenge was to define commonly acceptable measures across all three sites. For instance, there were differences in how sites calculated vacancy rates (based on budgeted versus authorized positions). As YNHHS worked to standardize definitions, identify process improvements, and resolve data quality issues, the development team built scorecard prototypes that led to more productive interactions between developers and users. SAS Web portals were also built to facilitate report delivery and user-driven data views.
The net effect of these challenges, along with continued strong, proactive support by a new CEO and COO, helped to take the development effort to the next level. YNHHS' first scorecards included metrics across four dimensions — quality and safety, operations, financial performance, and patient satisfaction. The early scorecards allowed comparisons between the three hospitals on a set of 30 very high-level metrics: net income, average daily census, case mix index, and some other critical performance indicators. The focus has evolved to a line operation view that allows one to see what underlies all the high-level metrics. The scorecards now provide over 100 metrics and drilldown capability to a level of organizational granularity not previously achieved. Approximately 75% of the data is automatically pulled for source systems.

A big win over the past year was a balanced scorecard that provides trend and overall performance detail in a roll-up structure to all nursing units across the three hospitals. This scorecard's metrics relate to those in the executive scorecard but allow the Senior Vice President for Nursing right down to the nursing unit managers to see what's going on and be able to relate to staffing variances, census, throughput, and performance quality measures. This scorecard creates a different kind of dialogue in the organization around what's driving performance, where the opportunities are, and where it is doing well or not doing well.

Timely discharge is a chronic problem at most hospitals, including YNHHS, yet early discharge, in conjunction with timely bed turnaround, can have a profound effect on throughput and inpatient revenues. Following a focused initiative, the Children's Hospital was able to decrease its median discharge time by two hours.

YNHHS is currently following metrics as diverse as infection rates, patient satisfactions, staff turnover, length of stay, and preoperative timeout protocol established to reduce OR errors.

Early successes have accelerated YNHHS' ongoing efforts. Increased capabilities are being developed in a number of areas simultaneously, including Ambulatory Care nursing services, Environmental Services, Materials Management, the Emergency Department, and the Operating Room, as well as in physician benchmarking.

**CONCLUSION**

While many hospitals have developed some basic data warehouses and other decision support applications, enterprisewide BI applications by provider organizations are far less common. The lessons learned by BI pioneers profiled in this white paper can be of significant value to other hospitals planning such efforts.
There are many common themes to the success achieved by these early adopters. First and foremost, they passionately embraced the principles embodied in the IOM reports and fostered a "culture of quality." They benefited from strong, broad, and enduring support from the top down, including commitment from executive leadership, clinical leadership, and key members of the board of trustees who understood the importance of and the commitment required for success. They also subscribed to the oft-quoted management credo: "You can't manage what you can't measure."

But in addition to strong executive sponsorship, they had strong leadership on the project team. Each had a "shirt-sleeved" project "champion," either the CMO specifically or another respected opinion leader from the senior clinical staff. Each had a strong project manager with a deep knowledge of the hospital's operations, management processes, and organizational dynamics and an understanding of the internal IT and external regulatory environments.

**Lessons Learned**

When asked about lessons learned, and the advice they would offer other hospitals contemplating BI initiatives, the interviewees agreed on several common principles:

**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 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, 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 be 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, and their nuances and peccadillos, 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. Even the institutions profiled in this document, known for their extensive investment in IT, found it necessary to conduct targeted chart abstractions and create supplemental data feeds for 30–40% of their source data elements.

**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 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.

**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; someone who 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 and with physicians and executives. Training is not a one-time 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 not only can provide and install the software but also 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, in both absolute terms and relative terms, 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 is all about the patients 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 scores 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.

As with an EMR, the deployment of BI applications in a hospital is a journey, not a destination. The experience of these pioneers is a testament to the benefits that 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. And where will this journey lead? Some thoughts on the future outlook are outlined in the following section.

**FUTURE OUTLOOK**

Historically, hospitals have been data rich and information poor. And while the growing investment in CIS/EMR applications has increased the net worth of hospitals' digital data, this investment has done relatively little to enhance the strategic use of that data. Hospitals that have made 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 application portfolios with BI tools that pair their growing clinical data repositories with their existing financial data to create meaningful, actionable information.
But if the implementation of a CIS/EMR can be thought of as the first leg of the journey, and the early BI applications profiled in this document 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 the following emerging, interrelated disciplines:

- **Evidence-based medicine** (EBM) 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 a patient's genomic makeup, such as his or her 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 that individual and the circumstances of his or her 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 way into packaged CIS/EMR applications.

But it is the development of these protocols, not merely their delivery, that 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 will likely 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 (CA) or, more broadly, clinical intelligence (CI). High-level CI solutions are currently in development at 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 (BA) systems, these applications will build upon these foundations, encompassing clinical, operational, and financial data, to truly link operational management to clinical practice.

Unlike BI and CI applications, BA systems will incorporate analytics to effectively weed through the noise, provide timely identification of critical opportunities, and provide predictive modeling to forecast future outcomes and advise on any necessary corrective actions. For instance, a BI system might tell administrators monthly how well you are doing on specific metrics such as ventilator-associated infections (VAP), while CI systems would give the caregivers alerts and hints on the specifics (e.g., how many days a patient was on a vent). In contrast, BA systems would look at numbers and patterns obtained from both the BI and CI applications to automatically count vent days and infection rates and analyze patterns and trends related to, for example, how many days into the stay infections were occurring and if they are traceable to a specific MD, or nursing unit, etc.

Currently this information must be manually retrieved and analyzed days, weeks, or even months after the events have occurred, and only if analysts are available, while BA systems would facilitate this analysis on a concurrent basis, allowing the information to be given to those accountable within an actionable time frame. This transition, however, will depend upon the availability of far more sophisticated underlying clinical data collection and documentation.

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 become only 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.

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 less frequent processes; processes that require specialized clinical knowledge as
well as software skills. Over the near term, this will remain the domain of 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.

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 those suffering from a chronic illness, during their routine activities of daily living using biometric sensors. Although these applications are still in the early "proof of concept" stage, large-scale deployment 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.

The case studies profiled in this white paper clearly demonstrate the positive impact that BI deployments have provided these thought leaders in the areas of compliance, quality improvement, patient safety, cost analysis, and patient and staff satisfaction. The results achieved by these leading-edge organizations not only have become a routine part of their IT environments but also are setting the standard for those provider organizations that are just beginning to exploit the value in their own CIS/EMR implementations. The future is intelligent; plan intelligently.

Learn More

In April 2008, the Healthcare Information and Management Systems Society (HIMSS), the healthcare IT professional society, published the results of its 19th Annual Leadership Survey. This Internet-based survey, sponsored by ACS Healthcare Solutions, polled more than 300 hospital IT leaders attending the HIMSS Annual Meeting in February 2008. Some of the key findings indicate that:

- 68% of respondents have seen or expect to see an increase in their 2008 IT operating budget.
- The 2008 finding was only slightly lower than the 74% reported in 2007.
- 44% of respondents indicated that their hospitals have fully implemented an EMR, up from 32% in 2007 and 24% in 2006.
27% of respondents indicated that their hospitals have begun EMR implementation, down from 37% in 2007, consistent with the increased number reporting "fully implemented" EMRs.

The top 3 priorities cited by respondents were implementing CPOE (42% in 2008 versus 47% in 2007), an EMR (31% versus 47%), and CIS (45% versus 46%); this decline can be attributed to the increase in the number reporting "fully implemented" EMRs.

This heightened level of activity is corroborated by the second annual American Hospital Association (AHA) IT survey of more than 1,500 nonprofit community hospitals, published in February 2007. Surveyed hospitals included urban, suburban, and rural hospitals, ranging in size from under 50 beds to more than 1,000. Relevant findings from the survey include the following:

- 23% of hospitals over 300 beds reported a "fully implemented" EMR.
- 69% of hospitals over 500 beds and 64% of hospitals between 300 and 500 beds reported having at least a partially implemented EMR.
- Increased usage of electronic methods over the 2005 levels were reported for lab and radiology results review, diagnostic image display, real-time drug alerts, and other clinical protocols and guidelines.
- Hospitals reporting that they rated their use of IT "high" (scoring at least 12 on a scale based on the automation of 15 core business and clinical processes) rose from 10% in 2005 to 16% in 2006; those rating their use as "moderate" (8–11) rose from 27% in 2005 to 30% in 2006.

The 2007 AHA survey data was collected during 2006. The 2006–2008 period has been characterized by intense EMR implementation activity by hospitals of all sizes, and it is expected that the AHA's 2009 survey, based on data collected in 2008 and due to be published in early 2009, will show even higher adoption rates.

ABOUT HEALTH INDUSTRY INSIGHTS, AN IDC COMPANY

Health Industry Insights, an IDC company, provides health and life sciences industry executives, and the suppliers who serve them, with market research and advisory services. The company's integrated coverage spans the entire health industry value chain and closely follows the payer, provider, and life sciences markets with special emphasis on developing and employing strategies that leverage IT investments to maximize organizational performance. Staffed by
expert analysts and consultants with extensive industry experience, Health Industry Insights delivers a portfolio of offerings relevant to both IT and business needs. IDC is a subsidiary of IDG, the world's leading technology media, research and events company.

For more information, visit http://www.healthindustry-insights.com.

ABOUT IDC

IDC is the premier global provider of market intelligence, advisory services, and events for the information technology, telecommunications, and consumer technology markets. IDC helps IT professionals, business executives, and the investment community make fact-based decisions on technology purchases and business strategy. More than 1,000 IDC analysts provide global, regional, and local expertise on technology and industry opportunities and trends in over 110 countries worldwide. For more than 44 years, IDC has provided strategic insights to help our clients achieve their key business objectives. IDC is a subsidiary of IDG, the world's leading technology media, research, and events company.

You can learn more about IDC by visiting www.idc.com.

Copyright Notice

Copyright 2009 Health Industry Insights, an IDC company. Reproduction without written permission is completely forbidden. External Publication of Health Industry Insights Information and Data: Any Health Industry Insights information that is to be used in advertising, press releases, or promotional materials requires prior written approval from the appropriate Health Industry Insights Vice President. A draft of the proposed document should accompany any such request. Health Industry Insights reserves the right to deny approval of external usage for any reason.