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HIMSS Analytics:
The Value of Healthcare Technology and Use of its Data to Improve Outcomes
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Background

For the last 15 years, the healthcare industry has been engaged in a continuing debate on the value of technology in the healthcare environment. Current payer, legislative, and regulatory pressures have now reduced the debate to a discussion of "when," not "if," technology will be implemented across healthcare providers in the United States. Recent literature is sparse related to this topic, however in a 2004 article published in the Journal of Healthcare Finance (December 2004) Terhilda looked at over 30 benefits of technology that contributed to improved cash flow over an eight year period. Important is the finding that technology alone does not equal success, rather the study group concluded that leadership commitment, timeliness of implementation, partnerships developed, compliance with coding and workflow redesign were contributing factors. This study adds to the argument that while benefits can be achieved, direct cause and effect relationships linking technology alone to benefits is often not possible in the complex healthcare environment.

Currently, providers who have automation have an abundance of data. According to HIMSS Analytics data, 48 percent of U.S. hospitals have reached a level of clinical sophistication in which they have, at minimum, clinical documentation that uses flow sheets, a clinical decision support system that supports error checking, and the capability to view radiology PACS images outside of the radiology department. This can be compared to 36 percent one year ago[1].

There is a continuing struggle related to how organizations can best manage and liberate the data that are/will be contained in these electronic systems for clinical, operational, and financial improvement and decision making. To help resolve data access and reporting issues, half of U.S. healthcare organizations that have installed clinical systems have also installed a business intelligence vendor solution for executive reports/dashboards. Less widespread is the utilization/implementation of data storage solutions, such as enterprise-wide data warehouses. Approximately 21 percent of healthcare organizations have installed a clinical data warehouse solution that facilitate needed aggregation of clinical data from multiple source systems into a single repository to resolve issues with data access. Only 40 percent of healthcare delivery organizations in the United States reported that addressing data integration issues was part of the strategic plan at their organization. Therefore, pulling data from multiple systems and organizing it into a usable data set is an on-going challenge.

The challenges of data access and use are critical to overcome if the benefits of technology implementation are to be achieved. The recent enactment of the American Recovery and Reinvestment Act of 2009 (ARRA) includes incentives that will be paid to hospitals and physicians who adopt technology and document meaningful use related to patient safety, coordination, and quality of care. Required data reporting will be an essential component of compliance. In addition, ARRA also requires that healthcare organizations develop the capacity to share data with other healthcare organizations through Health Information Exchanges (HIEs). At present, only about 15 percent of U.S. hospitals participate in HIEs and another nine percent have reported that they have plans to either begin participating in this type of exchange or to expand their participation. The adoption of technology that enables data collection, storage, exchange, and reporting is a crucial first step in meeting the intent of these new mandates and achieving the associated value from compliance.

However, technology in itself will not solve the persistent patient safety and quality of care issues faced by the healthcare industry. Intelligent and intentional human interactions based on the information contained in these systems will be a critical component in the advancement of meaningful healthcare transformation on the near term horizon.

Couple these factors with existing data silos and limited synergy across disciplines and healthcare settings and we find the very solutions that are intended to improve healthcare quality and safety actually erode the technology's ability to have a positive impact. Some progress to solving these pervasive issues in healthcare has been made over the past few years. Quality improvement methodologies that use data as a foundation for measurement (such as Six Sigma and Lean) have taken hold in the healthcare industry, and automation has improved the capability for more robust analytics. In addition, the industry has been moving towards a more data-driven foundation through recent changes in accreditation standards and payer/government reporting requirements for data reporting at the national level.

Some of the reasons for lack of data use from technology is due to:

- Lack of knowledge and skills in analytics and data management,
- Insufficient and ineffective transparency and communications,
- Fragmented and expensive data sources,
- Challenges in getting data out of existing vendor systems and lack of integration across operational data stores,
- Lack of time to perform the required analyses, and
- Resistance and lack of cultural acceptance and adoption of measurement science as an integral part of daily operations.

Existing dashboard programs and benchmark vendors offer business intelligence data viewing and drill down capability, but they do not offer the analytical support needed to understand the meaning behind the data reported. This analytical task is now done through department managers who have little time to perform these functions and limited, if any, experience in analytics or data management. In addition, organizations and the technology implemented today lack the infrastructure to perform both structured and unstructured data investigations/inquiry with ease of use by clinicians and operational managers.

Purpose

Given the national focus on healthcare technology and the existing data management challenges (as described in the background section of this publication), HIMSS Analytics, and Dell launched this study. Jointly, a qualitative study was designed. This report will outline the project and will discuss the primary findings from this study. Secondary findings will be disseminated in subsequent publications.

The primary purpose of this operational study was to answer the study question, "Are there clinical, operational, and financial benefits (both realized and perceived) that organizations attribute

[1] HIMSS Analytics Q2 data, FY09.

to their clinical technology environments?" Secondary study questions were:

- How do these same organizations use technology to support benchmarking, data mining, and advanced analytics to improve performance, quality of care and decision making?
- Can a model be used to help organizations objectively identify their level of informatics maturity?
- Is there a relationship between the level of technology that organizations have implemented and their informatics maturity level?

Data Mining
Data mining is defined as the process of extracting hidden patterns from data. Data mining allows an organization to explore large amounts of data and discover relationships and patterns that shed light onto business problems. These findings can be incorporated by the organization to improve profitability, efficiency, proactive decision making, and competitive advantage.

Advanced Analytics
This term covers a broad spectrum of activating, including data collection and integration, statistical methods, and complex processes for enterprise-wide decision making.

	Informatics Maturity Level			
	Manual	**Basic**	**Intermediate**	**Advanced**
Characteristics	Lacks ability to obtain data from legacy systems Fractured and unorganized data systems Limited automated reporting if any at all Manual generation of all regulatory and accreditation reporting Has an awareness of the need for data management, but no/limited means to accomplish it Decisions are not prioritized or based on data/evidence rather they are based on expert opinion	The need for data based decisions is acknowledged but culturally, data provided is challenged by key stakeholders Volume and some clinical/operational statistics are reported, but have limited value due to data integrity issues such as consistency in collection across the organization or lack of comparability due to unexplainable variances Inability to collect data across legacy systems or from automated documentation systems	The organization has defined data management standards and definitions for all key performance indicators Metrics used are defined & consistently applied to all data and reporting Measurement methods are graphical display and are utilized for data reporting and comparisons where appropriate Automated systems are implemented and used for data collection and management of key data elements such as those used for CMS or P4P reporting	Informatics integrated into strategic goals An effective Data Governance Board is established and utilized All data extraction for mandatory reporting is automated Quality improvement initiatives are based on evidence from the organization Statistical process control is the primary means of data reporting via balanced dashboards/scorecards Data management planning and standards are utilized effectively

Illustration 1: Dell Healthcare Informatics Maturity Model™

Finally, the study also investigated the future priorities and intent to advance the use of technology and its information attributes in the participants' healthcare environments.

Definitions

In order to ensure that the individuals participating in the focus groups were responding to the questions using the same framework, standardized definitions of the terms were used throughout the conversation. These definitions are identified here for context.

Realized Benefits
Identifying benefits as a result of the implementation of information technology in providing healthcare and in the administrative functions associated with health care delivery. This can include improving medical errors, communication and documentation of clinical care and test results, staffing and storage, and information processing.

Advanced analytics can be a specifically designed set of techniques that allow organizations to produce actionable predictive information and build integrated business intelligence applications. Advanced analytics help to determine how techniques are applied to a variety of critical tasks facing decision-makers. The goal is to provide an organization with a method to find certain patterns in their data that fosters profitability, efficiency, proactive decision making, and competitive advantage.

Survey Instrument Design

An online survey tool and a focus group questionnaire were developed collaboratively by HIMSS Analytics experts and experienced Dell Services Healthcare consultants. These two tools were then reviewed for face validity independently by healthcare consultants and experts who were not part of the study team. The tools were then revised based on input from the reviewers using multiple rounds of review and revision.

The survey questionnaire grouped questions by the underlying constructs of the study. Logic based probes were also developed to be used as needed to elicit open conversation and dialogue. In addition, the questionnaire used an open-ended question framework to further enhance honest, unguarded conversation by the participants.

The online survey was entered into a common web-based survey tool using forced response options and limited open-ended response fields. This tool included questions related to the organization's current information systems environment, including the vendor solutions they were currently using. In addition, they were asked to rank their informatics maturity level using questions formulated from the Dell Healthcare Informatics Maturity Model™ (DSHIMM) (see Illustration 1).

The Survey Population

In order to get a representative understanding of the benefits that organizations realize from IT, a broadcast message was sent to individuals in the HIMSS Analytics Database. Participants who expressed an interest were identified and classified by vendor, by title within the organization, by type of facility and by their HIMSS Electronic Medical Record Adoption Model (EMRAM) level. In order to achieve participation from a variety of hospitals using a variety of vendors, the final list of participants was determined by evaluating the characteristics of the individuals who expressed an interest in the focus group study, including title, primary

	CFO	CIO	CNO/CMO	COO
Cerner	1	2	-	-
Eclipsys	-	1	1	-
Epic	1	-	2	1
McKesson	-	1	-	-
MEDITECH	-	1	2	-
Siemens	-	1	-	-

Illustration 2: Table of Participant Roles by Primary CIS Vendor

vendor, size of organization and EMRAM score. The final list of participants was a convenience sample based on the sample criteria to ensure a diverse group.

A total of 14 senior-level technology, medical, nursing and finance executives participated representing their organizations. Their organizations also represented diversity in terms of size and services including a 120-bed community hospital, a pediatric acute care hospital, hospitals specializing in the treatment of cancer patients, and large academic medical centers.

Once identified, the participants were then organized into cohorts using their level of technical maturity, as defined by the HIMSS Analytics EMRAM. The first group contained participants who had reached stages four through six, the second group was categorized at stage one to less than four and the final group was a mixed cohort. All combined, the cohorts included at least one hospital in each stage of EMR adoption as represented by the EMRAM model with the exception of Stage Seven where less than one half of one percent of all HIMSS Analytics participating organizational entities fall in the model.

The use of the EMRAM to group study participants provided an unbiased context for the level of maturity that organizations have related to their information systems capabilities. The study design hypothesized that those with a higher EMRAM score (i.e. a higher

EMR Adoption Model℠ Trends Q1 - Q2 2009		2009 Q1	2009 Q2
Stage 7	Medical record fully electronic; HCO able to contribute CCD as byproduct of EMR; Data warehousing in use	0.3%	0.3%
Stage 6	Physician documentation (structured templates), full CDSS (variance & compliance), full R-PACS	0.8%	1.0%
Stage 5	Closed loop medication administration	3.6%	4.5%
Stage 4	CPOE, CDSS (clinical protocols)	2.8%	3.6%
Stage 3	Clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology	37.0%	38.4%
Stage 2	Clinical Data Repository, Controlled Medical Vocabulary, Clinical Decision Support System, may have Document Imaging	32.1%	31.6%
Stage 1	Ancillaries – Lab, Rad, Pharmacy - All Installed	9.0%	7.2%
Stage 0	All Three Ancillaries Not Installed	14.5%	13.4%

Data from HIMSS Analytics™ Database N = 5170/5167 ©2009 HIMSS Analytics

Illustration 3: EMR Adoption Model Trends

level of technology sophistication) would have a higher level of informatics maturity and capability.

Study Approach

Using qualitative study design, the three focus groups were hosted via conference call as the primary method of data collection for this study. Prior to the focus group sessions, the respondents were asked to complete an on-line survey that addressed the clinical environment and clinical information systems used at their organization. This survey also asked the participants to assess and rank their organizations current level of informatics maturity using the PSHIMM model™.

After analyzing the pre-focus group online survey results, the study investigators scheduled the focus group's in one-week intervals, spanning a three-week period. This timeline allowed for transcription of the prior group's responses. The transcripts were used to help add clarity in the questions, but no changes were made in the interview questions based on the prior focus group responses. Therefore, all groups were asked the same questions longitudinally across the study. However, interactive discussion was encouraged and the conversations were managed to prevent constraints on the responses received.

Each focus group was facilitated by a team member from HIMSS Analytics. At the beginning of each session, a scripted message was read to the group. This message reviewed the definitions, process for the focus group, and general rules associated with time management and group facilitation. The members of the call were advised of all call participants, including members from the Dell Services and HIMSS Analytics study teams. Permission was requested to record the calls and use the respondents comments in any written publications generated from the study.

To stimulate participation, a small stipend was paid to each participant following completion of both the online survey and conference call session.

Analysis of Data

Prior to the focus groups, the online survey results were collated and tallied using SPSS. The results were reviewed to help inform the facilitator prior to the focus group sessions.

Following each focus group, the discussion was transcribed verbatim. Attributes were then assigned to the responses and the narrative comments were grouped by these attributes to identify magnitude and commonality across all three focus groups.

Findings

Informatics Maturity Level Assessment and DSHIMM Validation

The pre-focus group survey results give some background into the analytics capabilities of the organizations in this sample. All but one of the focus group participants completed this survey. In the survey, respondents were asked to describe their organization's overall level of maturity using the DSHIMM, taking into consideration that some departments/services might be more mature than other areas. Many characterized their organization's overall stage of informatics maturity as "intermediate," meaning that their organization has or does the following:

- Defined data management standards and definitions for all key performance indicators
- Metrics used are defined and consistently applied to all data and reporting
- Measurement methods and graphical displays are utilized for data reporting and comparisons, where applicable
- Automated systems are implemented and used for data collection and management of key data elements.

The use of the DSHIMM demonstrated that informatics and analytics capabilities can be assessed using the model, and that organizational informatics maturity varied widely among focus group participants. Some organizations are just beginning to explore and embrace this concept, while others use only rudimentary forms of data analysis that allow for the creation of reports, but don't allow for more sophisticated analysis. Others use informatics and analytics much more extensively for purposes such as identifying patients with certain illnesses that need additional care; determining why patients with similar illnesses cost different amounts to treat; and/or tracking patients in clinical trials.

In this sample, we also asked respondents to identify their use of data mining tools. Organizations that are more clinically advanced on the EMRAM model are more likely to use a data mining tool.

With regard to the tools that organizations are presently using to support their current analytics needs, most respondents indicated that they are using Microsoft based products such as Microsoft Excel (85 percent) or Microsoft Access (77 percent) to facilitate their data needs. Approximately two-thirds (69 percent) of respondents use Microsoft SQL Server. Only half of these respondents use Oracle and utilization rates for more specialized tools such as Business Objects (23 percent) or SPSS (15 percent) are much lower.

Stage	Clinical Data Warehouse		Financial Data Warehouse	
	Yes	No	Yes	No
0	0	1	0	1
1	0	1	0	1
2	0	1	0	1
3	2	3	3	2
4	1	2	1	2
5	0	0	0	0
6	1	1	0	2

Illustration 5: Table of Status of Clinical and Financial Data Warehouse Implementation by EMRAM Stage

Four of the organizations in this sample reported using a financial data warehouse; four reported using a clinical data warehouse. In all instances but one, this data warehouse was provided by an organization's enterprise software vendor. This particular organization created its own data warehouse. It was possible to do a brief base line assessment of a hospital's EMRAM score and the use of a data warehouse. Among the hospitals completing the survey, it is apparent that those hospitals that have achieved a higher level of clinical sophistication (and thus a higher EMRAM score) are more likely to use a data warehouse for either financial or clinical information.

Stage	Yes	No	Implementing
0	0	1	0
1	0	1	0
2	0	0	0
3	4	1	0
4	2	1	1
5	0	0	0
6	1	0	0
7	0	0	0

Illustration 4: Table of Status of Data Mining Tool Implementation by EMRAM Stage

Current Use for Analytics

To some extent, most organizations are measuring some metrics using the current informatics and analytics tools they have in place. Participants were asked to identify what benefits they have achieved from the information systems deployed in their organization in each of the following categories: quality and patient safety, operational efficiency, clinical adoption, evidence-based decision making and return on investment.

Benchmarking and Compliance

All hospitals are required to comply with numerous regulations for regulatory bodies, CMS (Centers for Medicare and Medicaid Services) or The Joint Commission. A number of respondents are using their organization's information systems to enhance the level of reporting that they are able to provide. For instance, the CFO of a major academic medical center reported the ability to use the data from their information system to meet the data reporting requirements for their state Blue Cross program.

Several respondents that do not have a comprehensive analytics tool in place indicated that they are looking forward to the time in which they can utilize data warehouses and informatics to simplify and streamline their reporting processes.

A number of respondents noted that they are creating and using benchmarking data to compare their current performance to past performance at their own organization. For instance, one organization reported measuring 70 to 80 quality indicators in a dashboard format with multiple levels of drill down reporting.

In addition, organizations are able to yield benchmark information in clinical trials or create benchmarks with third party organizations, such as the University Health Consortium (UHC) or Thomson/Solucient by virtue of having installed clinical information systems.

Improvements in the Care Process

Improvements in the care process are a key area in which respondents reported benefit as a result of information technology capabilities. For instance, several of the respondents' users indicated that their organization had made improvements in throughput (both within the hospital and with patients transferring into the hospital) or being able to optimize the utilization of services at their organization. One respondent noted that at their organization, the optimization of their emergency department system led to improved patient satisfaction scores, because their registration and triage process improved. This same respondent also noted that an electronic tracking board speeds up their throughput process.

Others noted that they were more streamlined in their care process because they had been able to reduce the number of duplicate orders placed. One organization achieves this by using an order communications module, enabling physicians to see which orders have already been placed.

The participants also cited specific benefits related to tracking and reducing medical errors through strategies such as standardized order sets. In one example cited, data about antibiotic use was examined to determine the costs and outcomes of using various antibiotics. After the analysis, the organization agreed to a standardized approach. Another respondent noted that the reports generated from their electronic medication administration record (eMAR) system allowed them to monitor quality of care issues such as managing antibiotic stop dates.

Return on Investment

Responses to actual recognition of return on investment (ROI) were mixed, with organizations generally falling into four categories. First, there are those respondents that reported that their organization has begun to see a return on their investments. One organization has been able to document a reduction in their expenses per admission and length of stay since they have implemented their CPOE system. Another respondent noted that they've seen tangible savings because they've been able to reduce inventory in their operating room.

Second, there are those who have invested and implemented the technology but haven't yet seen an ROI. One respondent noted that the ROI will be seen over time in direct payouts from complying with insurance programs. He noted that between 2008 and 2014 his organization will be eligible for up to $42 million in payments if they meet the criteria established in the program.

Third, there are respondents that have begun to implement advanced clinical systems, but are not yet able to document a return on this investment. The final category is comprised of those individuals who aren't far enough down this path, but do expect that purchases in this area will result in tangible cost savings.

Other organizations anticipate that their use of information systems will enhance their ability to meet pay for performance requirements. For example, one organization indicated they were using the technology to facilitate documentation reminders. This use of the system ensures that the level of care recorded in the patient medical record is accurately reflected.

Participants identified the need to design and implement a benefits realization program early in the technology deployment process to be able to capture meaningful baseline and post implementation metrics. This process enables true capture of return on investment benefits.

Study Limitations

The sample size for this study was limited to 14 participants therefore this should be considered when drawing inferences about the state of the industry as a whole.

Conclusion

This paper has highlighted a number of areas that address the ways in which healthcare organizations are deriving value from information technology. While not all benefits can be quantified, benefits have clearly been achieved. Even though the indicators measured varied, and even though the degree of value varied, there was real value realized in terms of quality of care and patient safety, operational efficiency, and return on investment driven by adoption of the technology and accompanying work flow redesign. This finding is supported in the literature through a study by K. Featherly (2007) which found that the implementation of electronic medical records achieved benefits that indirectly contributed to the "bottom line" through tangential impacts such as increased workflow efficiencies and reduced medical mishaps.

In addition to the findings published in this paper, the findings related to the secondary study question "How do these same organizations use technology to support benchmarking, data mining, and advanced analytics to improve performance, quality of care and decision making?" will be addressed in a subsequent publication. In that paper we will also review the future priorities and intent to advance the use of technology and its information attributes in the participants' healthcare environments.

The study group recommends ongoing investigation into this topic. Specifically, we need valid, reliable, and data-driven studies related to the specific benefits achieved. These studies should also include pre and post implementation measurement and a quantification of the variables driving the achieved benefit. This will only be accomplished when the industry agrees upon standardized measures for benefits realization so that comparative analysis can be conducted. Additional value would be derived by conducting studies that reflect the benefits and return on investment realized by vendor. This information would help organizations choose vendors and implement information technology that achieves their intended goals while optimizing the use of scare resources.

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