2012 HIMSS ANALYTICS REPORT:

Quality and Safety Linked to Advanced Information Technology Enabled Processes

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Background and Purpose

Many industry observers believe that widespread adoption of electronic medical records (EMRs) and electronic health records (EHRs) will lead to healthcare savings, a reduction in medical errors and an increase in healthcare quality in the United States. Healthcare organizations have been trying to figure out how to demonstrate the value and financial benefits of investing in information technology (IT) for quite some time and there is controversy surrounding the ability of these systems to produce measureable benefits.

An extensive body of literature around the benefits yielded from EMR implementation exists. This literature includes publications in trade journals, peer-reviewed journals and the lay literature, as well as case studies published by vendors, trade associations and other organizations. However, the body of literature has several limitations and may be contradictory.

Many articles are narrowly-focused and typically address a scope of benefits limited to a single benefit or to the use of technology at a single organization type. For instance, some hospitals, mostly academic medical centers, have published dramatic clinical and financial EMR benefits data[1][2][3][4]. Researchers have aggregated the benefits described in these individual accounts to argue that a complete EMR are capable of producing very substantial benefits for individual hospitals and the healthcare system as a whole[5][6].

Other studies have compared data from large numbers of hospitals with and without EMRs and have found no significant differences in clinical and financial outcomes[7][8].

The number of hospitals that have achieved Stage 6 and Stage 7 on the HIMSS Analytics EMRAM model is growing, making it is worthwhile to undertake more specific analysis to identify the benefits that hospitals are able to achieve. A recent study by HIMSS Analytics assessed the benefits realized by hospitals that have achieved Stage 6 and Stage 7 on the HIMSS Analytics EMRAM model and demonstrated that supporting the conclusion that hospitals with more advanced EMRs may be more able and likely to realize substantial benefits[9].

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[3] Bates DW, Teich J, Lee J, et al. The impact of computerized physician order entry on medication error prevention. Journal of American Medical Informatics Association. 1999;6:313-321.
[4] Mekhjian HS et al. Immediate benefits realized following implementation of physician order entry at an academic medical center. Journal of American Medical Informatics Association. 2002;9:529-539.
[5] Hillestad R, et al, "Can Electronic Medical Record Systems Transform Health Care? Potential Health Benefits, Savings, and Costs," Health Affairs, 24, no. 5 (2005): 1103-1117.
[6] Thompson DI, Classen DC, Haug PJ, EMRs in the Fourth Stage: The Future of Electronic Medical Records Based on the Experience at Intermountain Health Care, Journal of Healthcare Information Management. 2007 Summer;21(3):49-60.
[7] Electronic health records' limited successes suggest more targeted uses, Health Affairs (Millwood) 2010 Apr;29(4):639-46.
[8] Furokawa MF, Raghu TS, Shao BB, "Electronic Medical records, Nurse staffing, and Nurse-Sensitive Patient Outcomes: Evidence from California Hospitals, 1998-2007," Health Services Research, 45, no. 4 (Aug, 2010): 941-962.
[9] EMR Benefits and Benefit Realization Methods of Stage 6 and 7 Hospitals: Hospitals with Advanced EMRs Report Numerous Benefits. February 2012. http://www.himssanalytics.org/research/AssetDetail.aspx?pubid=79509&tid=122

This research also examines the relationship of hospitals based on their EMRAM model in comparison to top-performing hospitals in the US, as demonstrated by the Thomson Reuters 100 Top® Hospitals program.

Study Population and Approach

This study was designed to understand if there was a relationship between the hospitals that have been identified as a 100 Top Hospital award winner by Thomson Reuters and the scores that have been assigned to US hospitals using the HIMSS Analytics EMRAM model. At the time the analysis was done in November of 2011, HIMSS Analytics and Thomson Reuters agreed to review data using the hospitals that won the award in 2009 and 2010.

Before the relationship between these samples could be examined, it was necessary to match the 100 hospitals of the Thomson Reuters data set to the hospitals in the HIMSS Analytics Database. Hospitals in each year were matched to the year-end HIMSS Analytics data base from their respective year. This would allow us to determine the EMRAM scores for each of the hospitals in the 100 Top sample.

Hospitals were matched using a manual process that included the hospital name, city, state and health system name. HIMSS Analytics initiated the matching process and then submitted the matched list to Thomson Reuters for review and validation. Based on this methodology, 98 percent of the hospitals in the 2009 sample yielded a direct match. In the 2010 sample, 95 percent of the hospitals had a direct match.

In order to determine the most appropriate match for the hospitals that did not yield a direct match, Thomson Reuters and HIMSS Analytics determined that this was because Thomson Reuters uses the Medicare ID number to determine whether or not a hospital is considered a single entity for the purposes of this award. In the few instances where there was not a direct one-to-one match, the match was actually to the health system, which uses a single Medicare ID for the entire multi-hospital organization. In these instances, the EMRAM score used for analysis was an average of the hospitals in the system. In all instances where it was necessary to create an average EMRAM score, all hospitals in the health system had installed the same technology across their facilities – and thus had earned the same score. As such, the average score reflected hospitals that were all in the same stage.

HIMSS Analytics Electronic Medical Record Adoption Model (EMRAM)SM

Understanding the level of electronic medical record (EMR) capabilities in hospitals has been a challenge in the US healthcare IT market. In 2006, HIMSS Analytics created the EMRAM model, which identifies the levels of EMR capabilities ranging from the initial clinical data repository (CDR) environment through an EMR environment where paper charts are no longer used to delivery patient care – all care processes are supported with electronic documentation. HIMSS Analytics has developed a methodology and algorithms to automatically score more than 5,300 US hospitals relative to their progress in implementing the components of an EMR.

Description of EMRAM Stages

Stage 0: Some clinical automation may be present, but all three of the major ancillary department systems for laboratory, pharmacy, and radiology are not implemented. Systems that are in place are departmentally focused, not patient centered focused via a common patient record.

Stage 1: All three of the major ancillary clinical systems (pharmacy, laboratory, radiology) are live and operational. Again, these are departmentally focused, not patient centered focused via a common patient record.

Stage 2: Major ancillary clinical systems feed orders and results to a CDR that provides physician access for retrieving and reviewing results in a patient centric record. The CDR contains a controlled medical vocabulary, and the clinical decision support/rules engine for rudimentary conflict checking. Information from document imaging systems may be linked to the CDR at this stage, and initial linkages to health information exchanges (HIEs) may be accomplished at this stage for sharing diagnostic patient information. The first level of clinical decision support is implemented to conduct error checking with order entry from ancillary systems (i.e., drug/drug, drug/food, drug/lab conflict checking normally found in the pharmacy, or duplicate laboratory order checking found in lab) by this stage.

Stage 3: Clinical documentation (e.g. vital signs, flow sheets) is required; nursing notes, care plan charting, and the electronic medication administration record (eMAR) system are scored with extra points, and are implemented and integrated with the CDR for at least one service or one unit in the hospital. Some level of medical image access from radiology picture archive and communication systems (RPACS) is available for access by physicians via the organization's intranet or other secure networks outside of the radiology department confines.

Stage 4: Computerized Practitioner/Physician Order Entry (CPOE) for use by any physician is added to the nursing and CDR environment along with the second level of clinical decision support capabilities related to evidence based medicine protocols. If one inpatient service area has implemented CPOE and completed the previous stages, then this stage has been achieved.

Stage 5: The closed loop medication administration environment is fully implemented in at least one patient care service area. The data flows of the CPOE, pharmacy, and the electronic medication administration record (eMAR) applications are tightly coupled and integrated with bar coding technology (or RFID technology) for the nurse (nurses may be identified via their logins to bar code scanning equipment), patient and medication to support the five rights of medication administration, thereby maximizing medication administration point of care patient safety processes.

Stage 6: Full physician documentation/charting (using structured templates) is implemented for use by any physician that generates discrete data for at least one patient care service area. Level three of clinical decision support provides guidance for clinician activities related to protocols and outcomes in the form of variance and compliance alerts. A full complement of radiology PACS systems provides medical images to physicians via an intranet and displaces all film-based images for radiology services.

Stage 7: The hospital no longer uses paper charts to deliver and manage patient care and has a mixture of discrete data, document images, and medical images within its EMR environment. Clinical data warehouses are being used to analyze patterns of clinical data to improve quality of care and patient safety. Clinical information can be readily shared via standardized electronic transactions (i.e. Continuity of Care Record -CCR and Continuity of Care Document - CCD) with all entities within a integrated delivery system, or a health information exchange (i.e., other non-associated hospitals, ambulatory clinics, sub-acute environments, employers, payers and patients in a data sharing environment). There is a continuity of data flows for patients between the inpatient, emergency department, and outpatient service modalities.

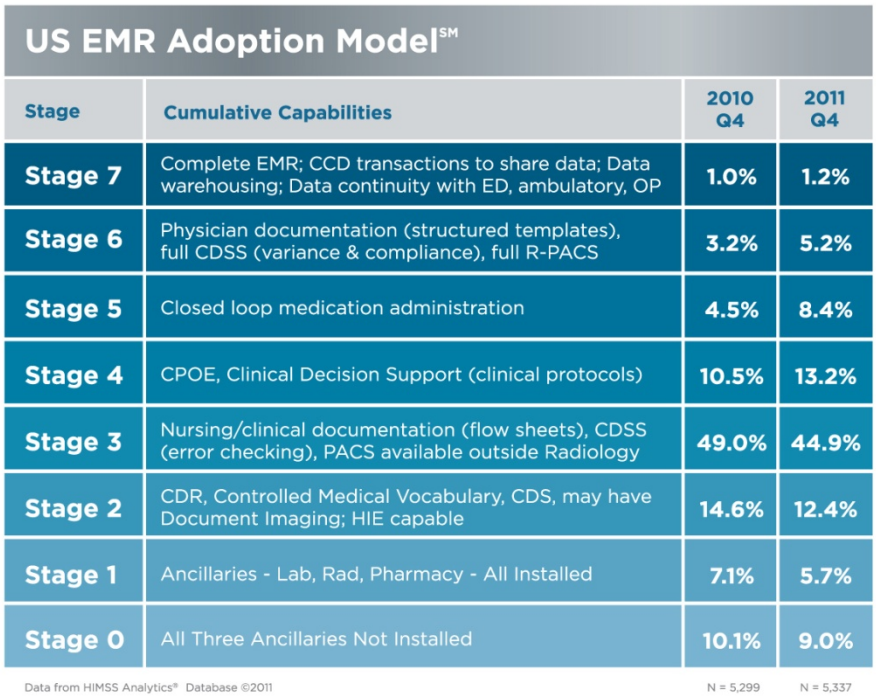
This version of the EMRAM model is also applied to Canadian hospitals. This model has been adapted to score hospitals in Europe, the Middle East, Asia and Australia. The model has also been adapted to score ambulatory facilities (A-EMRAM)

Scoring Format

An EMRAM score is represented by the following format – S.nnnn, where "S" equals the current stage achieved for the model, and the ".nnnn" represents the weighted score representing the implementation of higher stage clinical applications that have been implemented before the higher stage has been achieved. In this model all applications in previous stages and the current stage must be achieved before the current stage is achieved. For example, if CPOE is implemented before clinical documentation in Stage 3, and the organization has a CDR, their EMR Adoption Model score would be 2.nnnn, where the nnnn would represent the weighted score for CPOE and any other upper level stage applications that have been implemented. Once the clinical documentation applications have been implemented in a service, the hospital would automatically become a Stage 4 since they have accomplished what is required for that stage as well as Stage 3. In 2009, we added cardiology PACS (CPACS) modalities as extra credit items for the EMRAM scores.

Current Scores Summary

By the end of 2011, six percent of US hospitals had achieved Stage 6 or Stage 7 on the EMRAM model. In 2011, 14 hospitals achieved Stage 7 and 120 hospitals achieved Stage 6 on the EMRAM model. In addition, there was a 90 percent growth in hospitals achieving Stage 5, which requires closed loop medication administration, a difficult achievement requiring process changes affecting pharmacy, nursing and medical staff. Lastly, the number of hospitals at Stage 0 has fallen below 10 percent.



US EMR Adoption Model℠

Stage	Cumulative Capabilities	2010 Q4	2011 Q4
Stage 7	Complete EMR; CCD transactions to share data; Data warehousing; Data continuity with ED, ambulatory, OP	1.0%	1.2%
Stage 6	Physician documentation (structured templates), full CDSS (variance & compliance), full R-PACS	3.2%	5.2%
Stage 5	Closed loop medication administration	4.5%	8.4%
Stage 4	CPOE, Clinical Decision Support (clinical protocols)	10.5%	13.2%
Stage 3	Nursing/clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology	49.0%	44.9%
Stage 2	CDR, Controlled Medical Vocabulary, CDS, may have Document Imaging; HIE capable	14.6%	12.4%
Stage 1	Ancillaries - Lab, Rad, Pharmacy - All Installed	7.1%	5.7%
Stage 0	All Three Ancillaries Not Installed	10.1%	9.0%
Data from HIMSS Analytics® Database ©2011		N = 5,299	N = 5,337

More information about the HIMSS Analytics EMRAM model can be found at http://www.himssanalytics.org/emram/index.aspx

Thomson Reuters 100 Top Hospitals

Thomson Reuters 100 Top Hospitals program, which began in 1993, uses independent and objective research to select top-performing hospitals and health systems. Organizations do not apply or pay for this honor, or pay to promote their award. Only publicly available data and peer-reviewed methodologies are used in the study to assure inclusion of all hospitals. The program features three annual research studies:

- 100 Top Hospitals
- 15 Top Health Systems
- 50 Top Cardiovascular Hospitals

The 100 Top Hospitals National Balanced Scorecard,[10] is a core set of measures used to evaluate balanced performance across key organizational functions: clinical care, patient safety, patient perception of care, operational efficiency, and financial stability. To yield actionable comparisons, hospitals are measured against peers of similar size and teaching status. Each year, additional research is performed, frequently in conjunction with academics and organizations such as HIMSS Analytics, to explore a range of research questions including drivers of excellence, best practices, validity of specific

[10] Kaplan RS, Norton DP. The Balanced Scorecard: Measures that Drive Performance. *Harvard Bus Rev*, Jan–Feb 1992.

methodologies and metrics and characteristics of organizations with highest balanced excellence, as evidenced in a number of published studies[11-27]. Achievement of 100 Top status is extremely difficult. Selection is based solely on objective statistical analysis and requires performance in the top three percent of the nation. Since the program started in 1993, no hospital has won each year and only 13 hospitals have won the award 10 times or more.

100 Top Hospitals Selection Methodology

Because this research focuses specifically on hospital-level data, the details of the 100 Top Hospitals study are included in this white paper. Thomson Reuters takes four main steps in selecting the 100 winners:

1. Building the database of hospitals, including special selection and exclusion criteria. The study focuses on short-term, acute-care, non-federal U.S. hospitals that treat a broad spectrum of patients. The data come from public sources including the Medicare Provider Analysis and Review (MedPAR) dataset, the Centers for Medicare and Medicaid Services (CMS) Hospital Compare dataset, and the Medicare Cost Report. The study routinely includes nearly 3,000 hospitals.

2. Classifying hospitals into five comparison groups according to bed size and teaching status: major teaching hospitals; teaching hospitals; and large, medium, and small community hospitals.

3. Scoring hospitals on a balanced scorecard of performance measures centered on:

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[26]Foster DA. *Trends in Patient Safety Adverse Outcomes and 100 Top Hospitals Performance*, 2000–2005. Ann Arbor, MI: Center for Healthcare Improvement, Thomson Reuters. March 2008.
[27]Shook J, Young J. *Inpatient and Outpatient Growth by Service Line: 2006 Thomson Reuters 100 Top Hospitals®: Performance Improvement Leaders versus Peer Hospitals*. Ann Arbor, MI: Center for Healthcare Improvement, Thomson Reuters. August 2007.

- Clinical outcomes – including patient survival and complications
- Clinical process – following accepted care protocols
- Extended patient outcomes
- Efficiency – including average length of stay and costs
- Hospital financial health
- Consumer assessment of care

4. Determining the 100 Top Hospitals® award winners by ranking hospitals relative to their comparison group. Within the five hospital comparison groups, Thomson Reuters ranks hospitals on the basis of their scores on each of the performance measures, relative to other hospitals in their group. Each hospital's performance-measure rankings are summed and re-ranked, overall, to arrive at a final rank for the hospital. The hospitals with the best final rank in each comparison group are selected as the winners.

More information about the Thomson Reuters 100 Top Hospitals can be found at http://www.100tophospitals.com/top-national-hospitals/.

Findings

As seen in table one, the mean EMRAM score for US hospitals in 2009 was 2.7552. In 2010, the mean EMRAM score for US hospitals for US hospitals was 2.9478. When the 100 Top Hospitals were isolated, the average scores were higher. This data is shown in Table Two and suggests that average scores were nearly one stage higher at 3.5939 and 3.8629 respectively.

	Mean	Median	Number	Low	High
2009	2.7522	3.1560	5,235	0.0000	7.0710
2010	2.9478	3.2000	5,281	0.0000	7.0710

Table One. EMRAM Scores for All US Hospitals

	Mean	Median	Number	Low	High
2009	3.5939	3.3570	100	0.0340	7.0490
2010	3.8629	3.4470	100	1.0950	7.0710

Table Two. EMRAM Scores for 100 Top Hospitals

An analysis of the percent of hospitals in each stage also demonstrates that there is a higher proportion of 100 Top hospitals in advanced stages of the EMRAM model when compared to the overall US population, as shown in Tables Three and Four.

In 2009, 100 Top hospitals are over-represented in Stages 3 through 7 compared to the overall US sample and under-represented in Stages 0 through 2. More specifically, 92 percent of 100 Top hospitals are in Stages 3 to 7, compared to 64 percent of all US hospitals.

A similar trend exists in 2010. In fact, in 2010, only one percent of the 100 Top hospitals were at Stage 0 or Stage 1, compared to 17 percent of all US hospitals. Additionally, 39 percent of 100 Top hospitals are at Stage 4 or higher, compared to 19 percent of all US hospitals.

	2009	
	All US	100 Top
Stage 0	11.50%	2.00%
Stage 1	7.20%	1.00%
Stage 2	16.90%	5.00%
Stage 3	50.90%	66.00%
Stage 4	7.40%	12.00%
Stage 5	3.80%	8.00%
Stage 6	1.60%	5.00%
Stage 7	0.70%	1.00%
Total	5235	100

Table Three. EMRAM Model 2009

	2010	
	All US	100 Top
Stage 0	10.10%	0.00%
Stage 1	7.10%	1.00%
Stage 2	14.60%	10.00%
Stage 3	49.00%	50.00%
Stage 4	10.50%	18.00%
Stage 5	4.50%	7.00%
Stage 6	3.20%	13.00%
Stage 7	1.00%	1.00%
Total	5281	100

Table Four. EMRAM Model 2010

In order to demonstrate that these samples were statistically different, a T-test of the samples was conducted and the samples were found to be statistically different.

Conclusion

Analysis of hospitals in all stages of implementation of EMR systems has shown that hospitals in advanced stages (Stages 5 and above) are significantly more likely to set national benchmarks for balanced performance than are peer hospitals. While specific analysis of the measures for balanced performance collected by Thomson Reuters has not been conducted, this data clearly suggests that hospitals at a high level on the EMRAM model are more likely to demonstrate top performance on both how patients are cared for through clinical measures and how the hospital performs as an efficient business.