

# A Review of Methods to Estimate the Benefits of Electronic Medical Records in Hospitals and the Need for a National Benefits Database

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## ABSTRACT

*Proponents of electronic medical record systems cite numerous benefits of their use; however, prospective electronic medical record (EMR) purchasers can find relatively little hard evidence these systems will deliver promised or expected benefits. The lack of good information to help identify EMR benefits, estimate and prioritize these benefits, and understand how the benefits are realized is a serious problem for the healthcare industry.*

*This paper describes the most useful current approaches for hospitals to estimate the potential benefits of their EMR systems. Positive and negative aspects of each approach are discussed, as is the question of determining whether a hospital provider could use the approach. Based on this analysis, the article explains the necessity of developing a standardized database of actual provider experience with clinical information system (CIS) benefits, and it describes the initial efforts of the HIMSS CIS Benefits Task Force to create such a database.*

## KEYWORDS

■ Electronic medical record ■ EMR benefits ■ IT value ■ Business case development

Acute care hospitals in the United States compete primarily in local markets<sup>1</sup> and are subject to conditions within those markets. Hospitals must compete for patients, physicians, staff and funds.<sup>2</sup>

Within this competitive framework, the following key success factors determine a hospital's position in the local marketplace.<sup>3</sup>

To be successful, a facility must deliver high-quality care

that is both safe and effective; provide an attractive network of providers and services to meet the needs of patients, payors and employers; provide an attractive care environment for patients; provide an attractive work environment for physicians, other caregivers and staff; generate sufficient funds through operating profits and fund raising to cover ongoing operations and make necessary capital investments; and meet regulatory requirements.

Hospitals that achieve these key success factors more fully than other hospitals in their local markets will realize a competitive advantage over other facilities in their markets.

One of the tools available to help hospitals achieve success in these areas is information technology. Since the early 1980s, many other industries have reported significant gains in quality, safety and productivity using IT in combination with other modern quality improvement methods, and there has been a general expectation healthcare would do the same. With some exceptions, this promise has remained unrealized, but recent advances in commercially available clinical information systems have raised expectations the much-anticipated transformation in healthcare is imminent.

The new clinical systems have many different components and functions, but a common term for the entire “package” is the electronic medical record.<sup>4</sup> EMR proponents contend these systems support higher quality care and increase efficiency, enabling facilities that use them to enjoy fundamental competitive advantages over those who do not have them. This has led to an arms race in some local markets where hospital leaders have rushed to implement EMRs before their competitors. State and national legislators have promoted or required EMRs in government regulations, contracting requirements and Stark law changes. Payor and employer groups also have encouraged EMR use through pay-for-performance initiatives and other mechanisms.

As a result, the assertion—based on limited evidence—an EMR is a requirement for participation in the future healthcare marketplace, and local competitive arguments, have replaced the careful evaluation normally reserved for large investments. Ironically, those who insist on understanding how and when an EMR investment will bear fruit find it exceedingly difficult to quantify the promised and expected competitive advantages.<sup>5</sup>

The following examples illustrate why this lack of information is a serious problem today:

- A hospital’s executive leadership and board of directors have a fiduciary responsibility to the organization and its stakeholders to evaluate the costs, benefits and risks of an EMR purchase. But few hospital leadership teams actually do this in a rigorous manner,<sup>6</sup> so the costs may be greater and benefits smaller than anticipated, resulting in severe consequences to the organization.
- After a system has been purchased, it is important to

understand the technical, organizational, cultural and process changes needed to realize benefits. This enables benefits to be engineered throughout the design, build, test and implementation processes. Many decisions must be made that will support system benefits or prevent them from being realized, but there are few data available to support one choice over another.

- Building a system to meet technical specifications does not align and motivate organizational leadership, clinicians and staff in the way a clear vision of benefits—such as better and safer care—can. Yet few hospitals are able to clearly articulate and credibly estimate those benefits.
- Monitoring quantitative benefit metrics enables an organization to make course corrections if anticipated benefits are not received in a timely manner. Alternatively, most hospitals wait until after the system is in and then look for evidence of benefit, losing many improvement cycles during system implementation and early use.
- The lack of good EMR benefits information hinders policy makers and payors, who must decide what to require of providers without substantial evidence of overall EMR value, and without knowing what technologies and implementation strategies produce the greatest value.

There are several significant complicating factors that make it difficult to estimate EMR benefits.

To begin with, there are very few comprehensive studies of overall EMR value. A 2005 RAND review of 256 published studies attempted to quantify an EMR’s economic value.<sup>7</sup> While 82 of these studies involved the inpatient setting in hospitals, researchers could not find any rigorous study that quantified the economic benefits of a full-functioned, vendor-supplied system.

Similarly, it is difficult to compare focused studies of individual EMR benefits. There are a growing number of published studies that quantify the value of individual EMR components, such as computerized provider order entry, decision support or automated documentation, or specific benefits, such as adverse drug event prevention, documentation efficiency and drug utilization control. But few of these studies consider exactly the same benefit areas, and those that do often use different research methods, definitions, terminology and metrics.

Indeed, many EMR benefit studies have used slipshod or impractical methods. Weak benefit analyses are done by EMR vendors that are trying to sell their products, and by consultants, whose objectivity may be limited by the fees allocated to these analyses or influenced by the biases of their clients. However, academic or professional researchers also have published many poorly substantiated analyses of EMR value or made assumptions that are not useful for hospital decision-making. For example, it is common to impute a dollar value to minutes of time saved, even when the expected time savings will not lead to actual staffing cost reductions. The best benefits analysis techniques

currently available are not understood or valued by many hospitals.

Also, the complex factors that contribute to EMR benefits appear to be poorly understood. Healthcare delivery organizations are complex systems of which IT is only one component. There are many processes, cultural, organizational and other changes that surround IT implementations, and the resulting benefits and difficulties are the result of a combination of these factors. The clinical IT component is especially complex, and it is difficult or impossible to separate system benefits from these other factors.

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Differences in the environment, such as culture, IT infrastructure and organizational structure, and system implementation methods in the hospitals where the available studies were done also make it difficult to generalize their results and compare them with the results of other focused studies.

There are unintended consequences in implementing an EMR.<sup>8</sup> Seemingly, obvious areas of benefit often do not turn out as expected, and what seems logical may not be real. For example, after the introduction of computerized practitioner order entry, the amount and quality of work performed by clinicians' increases significantly. Simply measuring and comparing the time required to document a simple patient encounter often results in a seemingly negative return on investment unless researchers are careful to measure the actual work that is accomplished along with any improvements in the quality of work.

#### **Estimating EMR Value**

In light of the importance of understanding and estimating EMR benefits and the difficulty of doing so, what are the best ways for hospital leaders to estimate the expected clinical and economic value of an EMR, and how can value estimates be tailored to the characteristics of individual hospitals?

Unfortunately, no widely accepted standardized method exists for estimating or measuring EMR benefits. Based on the experiences of more than 100 hospitals in conducting EMR benefit estimates, the following analysis summarizes

methods available to individual hospitals to estimate EMR benefits.

#### **Use vendor-supplied benefits data**

**Pros:** EMR vendors have ready access to their own system installations, know how to measure benefits, and have the resources and incentive to do so.<sup>9</sup> Vendors are usually happy to share what they have learned about their system's benefits and can help prospective clients apply those lessons to their hospitals. This information and assistance is sometimes provided without additional cost to the hospital.

**Cons:** The usefulness of vendor-supplied benefits data is limited by a lack of organized and structured data, poor credibility and transparency of vendor-supplied information, and an inability to compare the results of vendor benefits analyses. Few vendors maintain a structured database of benefits information; most rely on anecdotes. Vendors have a tendency to overstate the positive and understate or omit mention of the negative; they are usually unwilling to share their sources and raw data. Each vendor uses different metrics, terms and definitions, and describes the benefits of different features, making it difficult to compare different vendors' benefit estimates.

#### **Synthesize and apply studies of overall EMR value**

**Pros:** Perhaps the most obvious method of estimating the value of an EMR is to conduct a literature search for studies that summarize all major EMR benefits to a specific hospital or integrated delivery network (IDN), and then extrapolate that value to a target hospital based on bed size or other readily available characteristics. This can be accomplished with a few days of work and an Internet connection, with no additional expense involved.

**Cons:** There are a small number of publications that quantify the overall value of an EMR at academic medical centers with self-developed EMR systems.<sup>10, 11, 12</sup> The overall benefit estimates from these studies are not useful for most EMR purchasers because of the differences between academic and community hospitals, and between self-developed and commercial systems. These studies vary widely one from another in their areas of benefit, technology solutions and implementation approaches, and metrics and measurement methods; as a result, they are not comparable. It is not meaningful to use simple extrapolation, such as patient volumes or bed size, but there is little information in available published accounts about the hospital environment before the EMR was installed to support more meaningful extrapolation.

#### **Create logical engineering models of EMR value**

**Pros:** The construction of logical benefit models based on careful measurements of pre-EMR processes and outcomes, and the expected changes enabled by EMR functionality, seems to overcome the problems of extrapolating from published studies. Because the results achieved by EMR users depend heavily on the current state of their

Evaluation Method	Usefulness of Information		Ability to Obtain Information	
	Availability of Benefit Data	Ability to Extrapolate	Required Expertise	Required Level of Effort
1. Vendor-Supplied Data	-	--	++	++
2. Comprehensive Studies	-	-	+	+
3. Logical Modeling*	*	*	-	--
4. Focused Studies	++	+	--	-
5. Site Visits	+	+	-	--

\*Logical modeling uses no external data but requires large amounts of data on local processes and system functionality.

**Table 1. Evaluation of Common Methods for Estimating EMR Benefits**

clinical and operational processes, and the way the new technology will influence those processes, detailed measurement and analysis of processes and system interactions is necessary to understand potential system benefits. If the current state of processes and new system functionality are well understood, then this approach could produce accurate benefit analyses. This approach is common in vendor analyses.

**Cons:** Unfortunately, logic separated from evidence is not sufficient to predict the effects of an EMR. These effects are often illogical and unpredictable, as can be seen in the earlier discussion of unintended consequences. The results of logical analysis depend primarily on the assumptions of the analyst; these assumptions are influenced by the biases and incentives of the analyst, who can use logic to support many different assumptions. Used independently from actual results data, logical analysis is probably the least accurate of all approaches.

**Summarize focused studies of elements of EMR value**

**Pros:** There are numerous studies of individual technologies and individual EMR benefits. Because of their focused nature, these studies generally include more detailed information about how the benefits were achieved, so it is possible in some cases to conduct meta-analyses comparing the results of various studies that considered the same technologies, benefits or both.

**Cons:** It is very time consuming and sometimes technically difficult to do good meta-analyses. It requires detailed literature searches to identify the relevant articles and careful reading of the full text of all relevant articles. It requires identification and analysis of the relevant bases of comparison between studies. Extrapolating the results of a meta-analysis requires data on hospital operations that may not be currently collected. It also requires an understanding of current and proposed future system functionality and clinical operations. For this reason, it is not practical for

most hospitals to conduct good meta-analyses in all of the areas where an EMR may provide benefits.

**Conduct and apply information from site visits (case studies)**

**Pros:** Personal observation of a system in operation and the ability to have detailed discussions with its users about their environment, results and benefit mechanisms can provide more useful than is available in many published accounts. It is presumed many successful EMR

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implementations or individual benefits have not been the subject of published studies, so the only way to obtain any information about their results is by talking with the hospital staff directly.

**Cons:** It is time-consuming and expensive to conduct site visits. Time onsite often is limited, and vendor or IT staff may limit or script the conversations that are allowed. Many hospitals will not allow site visits, and most hospitals have not done a careful measurement and analysis of their results, so the benefits they describe are anecdotal. It is not practical to visit a broad range of hospitals that have implemented EMRs to gain a comprehensive view of their benefits.

Table 1 above shows whether the characteristics listed at the top of the columns are positive (+), negative (-), very positive (++) or very negative (--) for each of the five methods.

The table shows the more useful information a method

provides, the more effort and expertise is required to use that method. Of the methods listed above, the most useful are the last two because they provide a good amount of comparative data and a chance of meaningfully extrapolating the benefits.

The ideal hospital-specific EMR benefits analysis would combine external results data gathered from focused studies and site visits with information about hospital operating processes, costs, reimbursement mechanisms and EMR system functionality. However, these methods require a detailed understanding of system functionality, hospital operations, costs and clinical processes; familiarity with various methods of data analysis; and the time and money

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to travel, gather and analyze data from published studies, and gather detailed local data on hospital performance and outcomes. Very few hospitals are able and willing to effectively use these methods.

Some research and consulting organizations have the expertise and funding to use these methods, but very little work has been done that combines the information from analysis of focused benefit studies and site visits, with a practical understanding of how hospitals and clinical processes really work. As a result, studies done by researchers and economists often produce findings that do not adequately consider process and system differences and hospital finances; meanwhile, studies done by technologists and engineers are not adequately informed by actual system results. It is expensive for hospitals to hire experts to help them estimate system benefits.

### Conclusions

There are no low-cost, easy-to-use methods for a typical hospital to accurately estimate the benefits it should expect from an EMR purchase. The main reason for this is the lack of detailed information about actual benefits from a large number of hospitals that have implemented EMRs. The results from existing information on EMR implementations lack detail about user environments and how they achieved the benefits.

To fill this gap, the healthcare industry needs a national database of actual results of EMR implementations using common terms, definitions and metrics, along with supporting information about the environment that produced those results. This will take a year or two to develop and agree upon, and many years after that to build, if the effort begins immediately.

One of the most challenging aspects of creating a national EMR benefits database is normalization of the self-reported data to enable meaningful summaries and comparisons, for example, by benchmarking. It is not possible to account for all differences in current processes, performance, environment, culture and implementation approaches that may exist in reporting organizations; however, meaningful comparisons are best supported by including basic information about these factors in the database, carefully defining benefit categories and standardized benefit metrics, making allowances for the limited reporting of benefits in new categories rather than forcing all responses into existing categories, and supporting reporting and analysis within defined provider groups—for example, community or academic hospitals.

An initial framework that begins to address these issues has been proposed and developed by the HIMSS CIS Benefits Task Force. This framework consists of:

- Demographic information about the hospital organization, such as bed size, location and academic status.
- Measures to describe the technology infrastructure of the organization, such as the number of terminals available for clinician use and overall system reliability as measured by the percentage of system downtime.
- Measures to describe how technology is being used by clinicians throughout the organization, for example, the percentage of all orders entered by clinical providers responsible for making medical decisions.
- Defined system benefit categories, such as the reduction of adverse drug events or improvement in the quality of care for acute myocardial infarctions.
- Defined system components associated with each benefit, such as computerized practitioner order entry-driven decision-support alerts.
- Defined quantitative metrics for each of the benefit categories, such as adverse drug events (ADEs) per 100 admissions two days as measured by the Institute of Healthcare Improvement (IHI) Trigger Tool or the percentage of acute myocardial infarction (AMI) patients prescribed aspirin at discharge.
- Using this framework, hospitals can enter information into a Web-based data collection tool linked to a database, which is being pilot tested on the HIMSS Web site. As the database grows, hospitals will be able to view online reports showing the average amount and range of each potential benefit for hospitals matching their own characteristics and environment.

To make this framework useful, it must be adopted by the industry and especially by standard-setting bodies such as the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), Centers for Medicare and Medicaid Services (CMS), The Leapfrog Group, The National Quality Forum, Agency for Healthcare Research and Policy (AHRQ) and others. Their stamp of approval will increase the

willingness of hospital leaders to make the considerable investment required to pursue and measure benefits in standard ways.

EMR pioneers also must be persuaded to measure and report their EMR benefits using these standardized methods. The few hospitals and integrated delivery networks with rich EMR benefits data can teach the industry more if their results could be compared and contrasted. This type of comparative benefits analysis is rarely done today, but it is of great value in understanding how to realize the greatest possible benefit from an EMR.<sup>13</sup>

The effort to collect and report EMR benefits must be coordinated with other industry initiatives. A roadmap for realizing enhanced value nationally from clinical decision support—a key driver of EMR benefits—has been developed recently through a multi-stakeholder effort sponsored by the American Medical Informatics Association (AMIA).<sup>14</sup> This report echoes many of the challenges noted above regarding learning about, measuring and improving benefits. For example, one of the roadmap's six strategic objectives for national action on clinical decision support (pages 42-43 of the report) outlines the need to "assess and refine the national experience with CDS (clinical decision support) by systematically capturing, organizing and examining existing deployments; share lessons learned and use them to continually enhance implementation best practices."

The results of that objective feed into another of the roadmap's strategic objectives (pages 38-41 of the report), to "Improve clinical adoption and usage of CDS interventions by helping clinical knowledge and CIS producers and implementers design CDS systems that are easy to deploy and use, and by identifying and disseminating best practices for CDS deployment." Best practices are those that produce the best results, or benefits; the proposed benefits database

includes both the amount of benefit and information about the IT infrastructure and how technology is used. A future version could include additional details about implementation approaches, which would help hospitals choose the best methods.

In the meantime, more published accounts are needed of comprehensive benefits from leading sites and better analysis of focused studies, including careful blending of results data with an understanding of the practical operational considerations that exist in real healthcare environments (see sidebar.) This work cannot be left to individual hospitals at the point of purchasing an EMR—it must be adequately funded and done by experts in information systems, hospital work processes, clinical care, measurement methods and data analysis.

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#### Sidebar: Estimating Time Savings from Nursing Documentation Systems

A recent meta-analysis of 11 studies<sup>15</sup> comparing nursing documentation time on paper with electronic systems found nurses who used clinical documentation systems saved 24 percent of their documentation time, on average.

After reviewing these 11 articles individually, the authors found at least six also quantified the amount of time nurses spent on documentation before system implementation. Four of these studies dealt with intensive care units; the average number of minutes spent on documentation per eight-hour shift was 117. A 24 percent savings in time represents 28 minutes per eight-hour shift.

Only two studies considered non-intensive care unit (ICU) nursing units and one of these dealt with the post anesthesia care unit (PACU). The remaining study found nurses spent an average of 150 minutes per eight-hour shift on documentation. This higher value for non-ICU documentation is logical, because ICU nurses have fewer patients and spend more time on direct patient care. It is also consistent with the authors' own findings<sup>16</sup> in seven non-ICU nursing units in five hospitals; those findings showed nurses (n = 108) reported spending an average of 138 minutes per shift (eight-hour equivalent) on documentation. Using the higher figure, a 24 percent savings in time spent would be 36 minutes per eight-hour shift.

Nurses are typically assigned anywhere from five to 10 patients<sup>17</sup> on medical-surgical units, to one or two patients on intensive care units. On a large 32-bed medical-surgical unit with a 1:8 nurse to patient ratio, the staffing would therefore be four nurses per shift. If each nurse saves 36 minutes per shift, only two hours and 24 minutes in total are saved, which is not enough of a savings to enable sending one of the nurses home.

The argument for staff reductions is even less convincing on higher acuity units with lower nurse-patient ratios. And this purely

logical argument leaves aside the resistance from nursing staff and leadership to staff cuts, which has persisted since the reengineering era of the 1990s.

Hospitals with which the authors have worked have measured the actual time spent on a variety of nursing activities, including documentation, order clarification, MAR reconciliation, chart location, shift change, patient assignment and chart review, and have estimated the potential impact of an EMR on the time spent on those activities. These broader models estimated time savings ranging from 95 to 260 minutes per 12-hour shift for each nurse. These greater time savings might support staffing reductions; however, this requires very challenging changes in nursing operations and culture: success is by no means certain.

It is unlikely nursing documentation time savings alone will reduce nurse staffing at a typical 300-bed hospital. However, the ongoing nursing shortage has saddled hospitals with a substantial amount of overtime and costs for “premium” nursing, such as traveling nurses.

A reduction of 28 to 38 minutes in documentation time per shift could reduce or eliminate “incremental” overtime costs, which are incurred when nurses complete their documentation after the end of a shift. In previous work with eight hospitals, the authors found incremental nursing overtime costs ranged from 96 cents to \$3.23 per admission, excluding newborns. After detailed conversations with nursing leaders about the nature and amount of incremental overtime they experienced, potential cost savings were estimated at 80 percent of current overtime costs, excluding certified registered nurse anesthetists (CRNAs), supervisors and enterostomal registered nurses (RNs), or 77 cents to \$2.30 per non-newborn admission. For a typical 300-bed hospital, that would be \$11,000 to \$33,000 in cost savings annually. Hospitals can customize this model by identifying their incremental nursing overtime expense and assuming an 80 to 100 percent reduction.

In light of all the above, with the exception of overtime cost savings, the most meaningful way to estimate the benefits of expected nursing documentation time savings for the typical hospital is as a number of minutes saved per shift. Based on the published literature, this is 28 minutes in ICUs and 36 minutes in other nursing units. Each organization can evaluate its ability to translate these time savings into improved outcomes or reduced costs.

A national CIS benefits database could help to more accurately describe similar cost savings or quality improvement benefits for numerous other EMR features and the commonly occurring clinical tasks they support.

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