Discussion Paper

Return on Information: A Standard Model for Assessing Institutional Return on Electronic Health Records

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**Participants from the Digital Learning Collaborative of the IOM Roundtable on Value & Science-Driven Health Care*

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The Institute of Medicine (IOM) defines a learning health system as a system that has the capacity to both apply and generate reliable scientific evidence in the delivery of care (IOM, 2007). Although it may seem obvious that both the demands for higher reliability and higher-value health care require robust electronic health records (EHRs), information exchange, and deep analytic capabilities, it remains difficult to measure the return on investment (ROI) in information systems. The lack of a standard model for ascribing the costs of implementing or the benefits of using EHRs and related technology makes comparisons across different institutional experiences, different implementation approaches, and different technologies difficult. Moreover, the absence of a format for a standard business case for information investment may add to the hesitation for investment in information systems and thwart progress in creating the reliable digital foundation needed for a continuously learning health system.

A standard model for ascribing costs and benefits would need to specify what constitutes the entity investing (i.e., what are defined as the organization's boundaries), what constitutes the information system, what constitutes infrastructure that should or should not be included in a model, and what differentiates the information system from related technologies. Similarly, a standard model would specify not only how costs or benefits might be attributed to use of the information system, but also how these costs and benefits should be handled in a financial model. While a number of thoughtful analyses of costs and benefits of electronic health records have been published, each one has used different and, consequently, incomparable methods (Adler-Milstein et al., 2013; DesRoches et al., 2013; Fleming et al., 2011; Hillestad et al., 2005; Kaushal et al., 2006; Walker et al., 2005; Wang et al., 2003). Thus, the goal of this paper and the associated model is to provide a clear framework and propose a standard model for evaluating institutional investment in EHRs and related technologies to enable inter-organizational comparisons, help identify best-in-class implementation approaches, and prioritize process redesign endeavors. Given the institutional focus of this model, it is likely to be primarily useful to hospitals and health systems, rather than unaffiliated ambulatory care offices.

The authors are individual participants from the Digital Learning Collaborative of the IOM Roundtable on Value & Science-Driven Health Care. The collaborative seeks to accelerate progress toward the digital infrastructure necessary to achieve the roundtable's goal of continuous learning, improvement, and innovation in health and health care. We have also collaborated with health system leaders and colleagues from health care finance, economics, and information to identify proposed elements for a model to quantify and analyze the ROI from

[1] Participants from the Digital Learning Collaborative of the IOM Roundtable on Value & Science-Driven Health Care.

implementing electronic health technology. The collaborative is inclusive—without walls—and its participants include clinicians, patients, researchers, software developers, and health care financial experts.

WHY A COMMON VALUE REALIZATION FRAMEWORK IS ESSENTIAL

Robust health information technology (IT) infrastructure and health information exchange (HIE) are essential to achieve the vision of a learning health system. Achieving such a vision is a multifaceted challenge that calls for comprehensive implementation and effective use of interoperable health IT by a continually engaged research and data analytics infrastructure that generates actionable evidence to inform future care. Such a system, coupled with the business and care delivery process re-engineering that it enables, is expected to return value to all stakeholders, but the cost of implementing the necessary changes, such as interoperable EHRs and transforming practices, is carried primarily by health care providers.

Providers (individual and organizational) must weigh whether and when to invest their limited resources in health IT rather than other infrastructure and process improvements that would also return value to their patient-care missions. Currently, it is difficult to demonstrate the provider's business case for health IT investment because a commonly accepted framework is lacking for identifying and quantifying costs and benefits that is suitable for use across provider types and reimbursement models. A generally accepted, standardized but flexible analytic framework for calculating the provider's ROI from interoperable health IT and HIE can support strategic investment decisions, such as timing and product selection. With widespread use, a generally accepted business case framework will enable benchmarking across similarly situated providers to identify best practices in health IT selection, implementation, and use, and thus dispel concerns raised by negative anecdotes.

Although there have been promising reports on positive return on provider organizations' investments at scale, the methodologies used have not been generalizable across provider organizations, given differences in organizational structure and payer reimbursement policies (Wang et al., 2003). Assessments from individual provider perspectives have also not been conclusive. Without a generally applicable standard for quantifying providers' value realization from their investments in health IT, variation in results of applying different models and methods contribute to uncertainty and inertia in providers' consideration of the transition to interoperable health IT. In order to have rational discussions about value, and compare effectiveness of EHR integration, general standards are needed.

A RAPIDLY CHANGING BUSINESS AND POLICY ENVIRONMENT

The fact remains that health care is a reluctant late adopter when it comes to IT. Although health care is information- and technology-intensive, it has lagged behind other industries in the widespread deployment and use of information technology in ways analogous to the information technology–fueled increases seen recently in similarly complex industries. In fact, health care leads only mining and construction in realization of productivity growth largely attributable to the widespread implementation of information technology (Cutler, 2009).

However, the health IT environment is changing rapidly. Among the most significant policies shaping the current context of the health care information systems market is the Health Information Technology for Economic and Clinical Health (HITECH) Act passed as part of the

American Recovery and Reinvestment Act of 2009. HITECH authorized almost $30 billion in federal financial incentives for eligible hospitals[2] and professionals adopting and demonstrating "meaningful use" of certified EHR technology. This effort has driven a significant increase in health IT adoption, with hospital adoption of at least a basic EHR system increasing from around 10 percent in 2008 to 44 percent in 2012 (DesRoches et al., 2013). In addition, the regulatory EHR certification criteria and the Centers for Medicare & Medicaid Services' EHR Incentive Programs' meaningful use requirements for incentive payments have driven rapid increases in the availability and use of interoperable health IT across the country.

Enactment of the 2010 Affordable Care Act (ACA) has accelerated innovation in health care delivery and payment systems that will make standards-based, interoperable information systems increasingly necessary for providers to thrive in coming years. Alternative payment regimes such as bundled payments, and shared risk models, such as Accountable Care Organizations (ACOs), require more intensive collection, use, and sharing of clinical information and reporting of high-quality data to payers and purchasers. In addition, accompanying pressures to increase efficiency and provide higher-value care by controlling costs while maintaining quality, require a sophisticated understanding of clinical and administrative operations. These current and growing requirements are shaping the investment in and deployment of information systems by large and small delivery organizations vying to remain competitive in the changing health care marketplace.

CONSIDERING THE BUSINESS CASE

Despite the context of increasingly compelling business and policy environments, organizations attempting to calculate a business case and make investment decisions about health information systems continue to face many challenges, both logistical and conceptual. Logistically, calculation of ROI requires a thorough understanding of the baseline against which costs and benefits can be measured, an understanding that can vary based on the existing infrastructure of an organization. Conceptually, all organizations face challenges determining the scope and attribution of returns to the health information systems.

For example, benefits of robust information system implementation might include savings to an organization from the reduction or more effective deployment of full-time equivalents (FTEs) associated with more efficient business practices, decreased morbidity and mortality due to more consistently delivered, high-quality care, avoided complications from improved preventive care, and enhanced patient experience and outcomes through the opportunities afforded by EHRs and patient portals for engagement. In the first instance, the benefit is clearly realized within the same organization, while in the second the benefit might be considered to accrue primarily to society. For this reason, business case calculations can vary greatly depending on the scope to which the model calculation is constrained. It is not uncommon for costs and benefits to accrue differently to different stakeholders across the broad scope of the health care system.

Health care information systems are large and complex, impacting many parts of a health care delivery organization. Their performance affects and is affected by factors beyond the

[2] Acute-care inpatient (§1886[d]) hospitals are eligible for incentives under §1886 of the Social Security Act, and Critical Access Hospitals are eligible for financial incentives authorized at §1814 of the Social Security Act, as modified by the American Recovery and Reinvestment Act of 2009 (P.L. 111-5). Titles XII of Division A and IV of Division B together are referenced as the Health Information Technology for Economic and Clinical Health (HITECH) Act.

information system itself. Realizing full value of the system typically depends not only on successful deployment of the system but also on adaptation of other organizational processes and workflows. These factors pose challenges to the development of a business case by complicating both the attribution of costs and benefits, and the ability to draw causal relationships between them. Furthermore, these complex relationships can make anticipation of costs and benefits difficult and unintended consequences challenging to predict.

Another variable to be considered is the extent of function an EHR provides. To some degree, this is specific to the particular EHR and the robustness of its features. However, functionality is also enhanced or constrained by the quality of implementation, including user training and acceptance, as well as the universe of technology with which it is used. For example, an EHR might be able to receive input from medical devices (e.g., that record blood pressure), thus reducing labor used for transcription and latency in acting on changes in patient status. However, if the provider setting does not have interoperable devices, the potential benefit cannot be realized. Importantly, the deployment of EHR elements is typically done in a modular, stepwise manner across an institution in order to best manage the concomitant cultural and educational issues. Because realization of certain benefits will be dependent on the stage of implementation and interconnection across these modules, the ROI assessment must address and accommodate the circumstances at the individual stages, as well as those anticipated when fully operational.

The dependence of the return on interoperability can also extend beyond the walls of a single institution. Network effects that enable benefits achievable only if other members of the network have comparable technology, ability, and processes also pose a major challenge to understanding the boundaries to return calculations. A standard business case would specify the parameters for what is included, allowing comparability in calculations of cost and benefit across EHRs and provider institutions.

EXAMPLES OF APPROACHES TO DETERMINE RETURN ON INFORMATION

There have been several notable efforts to produce analytical models that predict potential return on investment from electronic health records (Hillestad et al., 2005; Walker et al., 2005; Wang et al., 2003); and some health care organizations have shared their health IT costs and documented benefits (Adler-Milstein et al., 2013; Fleming et al., 2011; Kaushal et al., 2006). Several of these examples were reviewed in the development of the model and are summarized below. In addition, more detail is provided in Table 1, demonstrating the variety of assumptions that are unique to each report and limit comparability, reinforcing the need for a standard model.

Among the examples reviewed were efforts from private industry, including Kaiser Permanente, which published a strategic business case analysis (Garrido et al., 2004) for its hospital information systems in 2004, and Sentara Healthcare, which measured the ROI for its information system and disseminated the results in 2011 (Konschak, 2011). These analyses differed in the costs and benefits evaluated, and in the case of the Kaiser study also assessed implementation and benefit realization lags, while the Sentara study included the redesign of 18 major processes. Also reviewed was a study from the U.S. Department of Veterans Affairs (VA) system, which conducted an assessment of its health IT system in 2010 (Byrne et al., 2010). This study benchmarked VA adoption, cost, and impact against private sectors; modeled the financial value of VA's health IT investment; and included only benefits for which there was strong evidence of their relation to EHR implementation. Also included was a recent study conducted

across diverse practice settings, which showed how practice type differences and EHR uses can have implications for ROI (Adler-Milstein et al., 2013). The authors found that primary care and larger practices have higher ROIs, the reduction of paper medical record costs is the most common financial change, and practices that actively use EHRs to increase revenues have more positive ROIs. Finally, a literature review conducted in 2010 (Buntin et al., 2011) that assessed published outcomes from deployment of various forms of health IT was also reviewed. The literature review found that 92 percent of studies were either positive or mixed-positive, with 62 percent fully positive. Most negative findings were associated with workflow implications of health IT implementation, while strong leadership and staff "buy-in" were found to be critical to successfully manage and benefit from health IT.

Although the analyses summarized above are helpful, the variability in their methods and the costs and benefits they consider make it difficult to compare across cases or to draw overarching conclusions about the value of EHR systems.

BUILDING THE MODEL

To better understand and calculate the costs and benefits of investing in EHR systems, stemming from common interests as participants of the IOM's Digital Learning Collaborative and members of the Healthcare Financial Management Association, we are proposing herein a standard model of evaluation. This tool is meant to be used as a guide by health system management teams—including CEOs, CFOs, COOs, CIOs, and clinicians, among others—to help determine the financial impact of implementing and optimizing EHRs and related technologies. The key elements of the tool are presented as a catalog of categorized benefits, expenses, and potential revenue impacts and the accounts where these may be captured.

The fact that many stakeholders are impacted by organizational decisions to invest in EHR technology was considered in building this model. However, for the purposes of this initial phase, the focus of the model is the individual organization considering investment. To acknowledge the reality of broad impact, we identify other stakeholders affected by EHR investment throughout the model, and a full description of stakeholder definitions and the potential impacts can be found in Appendix 2. Future efforts may build on the model, to consider a broader range or different subset of impacted stakeholders.

After defining the scope, the model was built over the course of several months. We held discussions by teleconference and one in-person meeting to identify potential expenses, benefits, and revenue impacts—and suggest hospital general ledger accounts where those costs (both increases and decreases) and revenue impacts might be captured. The list is not exhaustive, but seeks to provide a macro-level tool. A full list of all expenses, benefits, and potential revenue impacts included in the model can be found in Tables 3, 4, and 5.

Expenses

Expenses are identified by category, including productivity loss, staffing and consulting costs, technology costs, maintenance, and training. These expense categories are then organized into two types, initial implementation and ongoing, to differentiate between the one-time costs that are incurred upon initial investment, and those that will be ongoing expenses.

Benefits

Benefits are categorized by overall core strategic goals, including improved clinical performance, reduced overhead, improved operational performance, reduced inappropriate utilization, and support of clinical trials. These are then categorized by the type of benefit, such as reduction in administrative cost or improved use of disease management strategies. As discussed in previous sections, these include some benefits that can be easily attributed as directly to the EHR system, such as avoiding redundant lab tests, and others for which the EHR works importantly, but less directly, in achieving the improved outcome, such as reduced readmissions. Given that many of these benefits align closely with the goals of the Office of the National Coordinator for Health IT's meaningful use standards, we identify those goals that closely corresponded with the benefit. We also recognize that the ability to capitalize on these benefits may differ based upon reimbursement type. Therefore, we offer a "yes" or "no" assessment of whether the benefits accrue to the provider based on reimbursement type, such as per diem or shared savings.

Revenue Impacts

Revenue impacts are categorized by overall core strategic goals, including improved operational performance and improved care coordination. We then identify specific revenue impacts, such as penalties or volume incentives, and designate them as having either a "positive" or "negative" effect.

Financial Prioritization

For both the benefits and the revenue impacts, we offered methods of financial prioritization as well as measurement methods. Financial prioritization techniques include the ability to quantify financial impact and the relative scale of financial impact. For the ability to quantify, we use the Institute for Healthcare Improvement's nomenclature to differentiate between "light green" (low ability to quantify) and "dark green" (high ability to quantify) dollars. For the relative scale of financial impact, we rank the revenue impacts from low to high.

There are several components of this model that differentiate it as an instrument to assess ROI on EHR implementation (reference numbers refer to row number in respective Tables 3, 4, and 5). From the expense side, we consider staff workflow optimization (14), which includes ongoing staff time, both clinical and administrative, spent optimizing the EHR and incorporating it into clinical work flows and administrative processes, such as billing and decision support. We also include costs related to the management of knowledge necessary for the development and maintenance of clinical decision support tools (20), and the increased costs associated with electricity for powering EHRs and cooling the server room (25). On the benefits side, our model accounts for potential benefits from the use of EHR data beyond clinical care, including to increase long-run accuracy of risk adjustment (11), to improve quality (5), to identify the highest-value setting (24/25), to identify underperforming service lines (26), and to enable auto restocking and ordering (32). Potential benefits also include strategies to increase staff efficiency and effectiveness, including embedding clinical protocols and pathways in the EHR (5/6) and enabling de-skilling strategies that allow clinicians to perform at the "top of their license" (28).

The complete version of the model can be downloaded and examined at http://www.iom.edu/returnoninformation.

The primary purpose of the model is to offer providers a standardized framework for evaluating investments in health IT and related process re-engineering versus other investments that may, or may not, be value-accretive. The creation of a standardized framework offers the possibility of a secondary—and potentially more significant—benefit to providers. Given that most organizations have already invested in health IT to satisfy the requirements of meaningful use, the ability to compare the financial returns, or lack thereof, from these projects across organizations has the potential to illuminate opportunities to reduce the ongoing cost of maintaining these systems. Furthermore, the potential benefits (both cost reduction and incremental revenue increases) that can accrue from investments in health IT are predicated on significant internal care and administrative process redesign. A standardized framework will help organizations identify those redesign projects that may have the greatest financial impact. This information, along with the potential implications for patients and other stakeholders, can be considered as organizations prioritize clinical and administrative process redesign projects.

TABLE 1 Summary of Past Business Case Analyses

	Benefits	Costs	Overall Value
Kaiser Permanente	- *Reduction in operating costs*: Increased staff efficiency, decreased average length of stay, reduced use or elimination of legacy systems, reduced litigation and malpractice premiums, improved materials management, optimized medical records management, reduced adverse drug events, and increased prescription adherence - *Increased revenue*: Improved billing, reduced Medicare risk, improved new product collections, and improved pricing accuracy - *Reduction in capital expenditures*: Decreased average length of stay and optimized medical records management	- *One-time costs*: Electrical wiring, desktop products, networking devices, labor costs for implementation, testing, training, backfill, and project management - *Ongoing costs*: Clinical content maintenance, system administration, desktop support	Anticipated $2 billion cash flow from the $1 billion investment over the 10-year investment horizon (using medium implementation scenario). Long-term hospital cost structure reduction of up to 2.3 percent and increased revenue by 0.6 percent
Sentara	Reduced length of stay, reduced adverse drug events, increased outpatient procedures, increased unit efficiency, improved retention of nurses, reduced transcription, reduced medical record supply costs, reduced medical records positions, reduced health plan costs, improved charge capture, and reduced administration positions	$237 million over 10 years, including hardware maintenance, software maintenance, disaster recovery, work redesign, training, implementation, ongoing support, and other non-salary reports	Higher benefit-to-cost ratios during each implementation year, resulting in cumulative benefits of $48.5 million for 2010
U.S. Department of Veterans Affairs	Reduced workload due to improved or eliminated tasks, freed office and storage space, eliminated redundancies, avoided utilization attributable to improved quality of care, decreased expenses	- *Acquisition costs*: Development or purchase costs, initial hardware, and training - *Annual costs:* Operations and maintenance costs	The total net value exceeded $3.09 billion, with annual net value exceeding $687 million. The gross value of the benefits was projected to be $7.16 billion, with 65 percent resulting from prevention of unnecessary care and 27 percent from eliminated redundancies. Reduced work, decreased operating expenses, and freed space accounted for the rest

TABLE 2 Stakeholders Affected by EHR Investment

Stakeholder Definitions	Potential Impacts
Provider Investing Institution (Institution Investing In and Deploying EHR Technology)	Benefits include • Improvements in operational efficiency and quality that reduce direct and indirect costs of patient care delivery and other administrative operations • Organizational receipt of bonus payments related to the direct implementation of the EHR • Facilitation of quality measurement, reporting, and improvement so as to receive bonus payments (e.g., value-based purchasing) or avoid penalties (e.g., readmissions) • More accurately capture charges and facilitate risk adjustment • Improvement of patient satisfaction, with expected outcome of positive volume impact on high-performing organizations
Patients	Benefits include • Decreased cost sharing • Improved health outcomes • Improved patient safety • Improved patient satisfaction (e.g., through increased opportunity for involvement and understanding of their conditions and care) • Improved productivity at work (e.g., fewer sick days or time away from the office) as a result of improved outcomes or increased efficiency of the delivery system (e.g., patient flow improvements that reduce wait times in the emergency department) This group could be negatively impacted if her-enabled charge capture leads to increased cost sharing
Patient's Employer	Value accrues to this group if EHR deployment results in improvements in care delivery that improve quality or efficiencies, thus reducing the time employees are not working
Patient's Families	Value accrues to this group if EHR deployment results in improvements in care delivery that improve quality or efficiencies, thus reducing the time family members spend caring for or coordinating care for patient
Purchasers	Value accrues to this group if EHR deployment results in improved aggregate efficiencies (better throughput) or direct reduction in the cost of patient care, through improved quality This group could be negatively impacted if EHR-enabled charge capture leads to increased cost sharing
Physicians/Care Providers	EHR deployment will increase revenue for physicians and other care providers within the organization if it • Allows them to be more efficient (e.g., reduces documentation time) • Expedites results reporting • Eliminates redundant testing • Helps identify and eliminate non-value-added care processes EHR deployment will result in value for providers not affiliated with the investing institution if it facilitates care coordination

	Some physicians/care providers could experience a decrease in revenue stemming from improved efficiencies
Society	Value is created for broader society if EHR deployment • Creates efficiencies that reduce the organization's consumption of resources or creation of waste (e.g., less silver from eliminated duplicate X-rays) • Reduces patient need for trips to a care provider (e.g., e-mail visits), which reduces traffic and energy consumption • Facilitates process improvements or research, which should ultimately accrue to society in the form of reduced insurance premiums and taxes,
Post-Acute Care Providers	Value accrues to this group if EHR deployment improves care coordination with post-acute care providers
Pharmaceutical Products Manufacturers	This group could experience either an increase or decrease in value, depending on the product
Supply Manufacturers	This group could experience either an increase or decrease in value, depending on the product
Support Staff (Maintenance, Lab, Radiology, and HIM Staff)	This group could experience a decrease in value stemming from decreased demand for services as a result of improved efficiencies
Policy Makers	Value accrues to this group if EHR deployment generates better data from which to make coverage and reimbursement decisions
Researchers	Value accrues to this group if EHR deployment generates better data that can be used in clinical trials and comparative-effectiveness work

TABLE 3 Complete List of Expense Components of Model

	Expense Type	Category	Description
1	Initial Implementation	Reduced Productivity	Implementation of the EHR decreases clinician productivity (both in inpatient and outpatient settings) until clinicians are able to "master" the new system, resulting in lost revenue due to lost throughput or increased staffing costs necessary to maintain historical volume during the learning period
2	Initial Implementation	Staffing Costs Related to Setting Up System Configuration	Upfront staff time (both clinical and administrative) spent optimizing the EHR and incorporating it into clinical workflows and administrative processes (i.e. billing, decision support). Includes staffing costs for data migration and mappings/ remappings
3	Initial Implementation	Consulting Cost	Expense related to consultant assistance during implementation (if not included in hardware/software costs) or if they are an incremental expense related to integrating EHR into clinical workflows and administrative processes
4	Initial Implementation	Hardware Cost	Additional servers, routers, cabling, desktops, local area networks, and other items required to implement EHRs
5	Initial Implementation	Software Cost	Licenses for EHR software and associated analytical tools for data extraction, report writing/distribution and integrating with other systems (i.e. registration, billing, scheduling, lab)
6	Initial Implementation	IT Staff Cost	Staffing costs associated with EHR implementation, including project management, content development/customization, system interfaces (both internal and external), workflow mapping, building/quality assurance of interfaces, IT help desk and technical deployment
7	Initial Implementation	Networking Cost	Initial costs associated with connecting/integrating EHR with sites of care within a system and other providers within the community
8	Initial Implementation	System Design/ Product Evaluation Cost	Upfront costs for articulating the EHR's business goals and incorporating them into the system design. This includes both staff and consultant costs, associated research and evaluation of available alternatives, and staff travel and lost productivity related to specifying requirement development/gathering and product selection/design phase of implementing an EHR
9	Initial Implementation	Training Cost	Cost of initial staff training during system implementation. Includes salaries of trainers (newly hired or repurposed), opportunity cost for trainee staff time, and costs related to development of training materials
10	Initial Implementation	Transition Cost	Cost of uploading existing medical records into the EHR. Includes non-labor costs for data migration and mappings/ remappings
11	Ongoing	Physical Plant Cost	Space in the server room and other IT-related square footage required host/support the EHR
12	Ongoing	IT Cost	Costs associated with disaster recovery plan and "downtime" support

13	Ongoing	Software Cost	Annual license renewal and/or upgrades for EHR software and associated analytical tools for data extraction and report writing/distribution and integrating with other systems (i.e. registration, billing, scheduling, lab)
14	Ongoing	Staff Costs Related to Changing Workflow	Ongoing staff time (both clinical and administrative) spent optimizing the EHR and incorporating it into clinical workflows and administrative processes (i.e. billing, decision support)
15	Ongoing	IT Staff Cost	Post-implementation IT staff required to support/maintain operations of the EHR and associated technology investments (BI tools, data warehouse, patient portal)
16	Ongoing	Hardware Maintenance Costs	Cost for replacement or upgrades of servers, switches, etc.
17	Ongoing	Networking Cost	Ongoing costs associated with integrating the EHR with other providers within the community
18	Ongoing	Training Cost	Ongoing training for new capabilities or new clinical staff. Includes salaries of trainers (newly hired or repurposed), opportunity cost for trainee staff time, and costs related to development of training materials
19	Ongoing	Staff for Newly Created EHR-Related Functions	Application coordinators, clinical content maintenance, reporting/data extraction
20	Ongoing	Knowledge Management	Includes costs related to knowledge management for development and maintenance of clinical decision support tools
21	Ongoing	Staff for Newly Created EHR-Related Functions	Costs associated with "medical scribes" (may even be nurses) replacing transcription
22	Ongoing	Performance Improvement	Costs associated with newly hired business process improvement teams
23	Initial Implementation	Hardware Cost	Hardware costs associated with specific technologies that complement an EHR (i.e., data warehouse environment, patient portal environment, etc.)
24	Initial Implementation	Software Cost	Software costs associated with specific technologies that compliment an EHR (i.e., data warehouse environment, patient portal environment, business intelligence tools)
25	Ongoing	Utilities	Increased costs associated with electricity for powering EHRs and cooling the server room
26	Initial Implementation	Reduced Productivity	Implementation of the EHR reduces revenue cycle productivity until new data and work flows are established. The results in lost revenue due to lost throughput or increased staffing costs necessary to maintain historical productivity during the learning period
27	Ongoing	Software Cost	Upgrade/replacement/licensing costs associated with specific technologies that compliment an EHR (i.e., data warehouse environment, patient portal environment, business intelligence tools)

28	Ongoing	Hardware Cost	Replacement/upgrade hardware cost associated with specific technologies that compliment an EHR (i.e., data warehouse environment, patient portal environment, etc.)

TABLE 4 Complete List of Benefits Components of Model

	Core Strategic Goals	Benefit Type	Description	Aligned with Meaningful Use Goals
1	Improved Clinical Performance	Supply-Chain Management	EHR facilitates identification of less-expensive pharmaceutical alternatives	•Improving quality, safety, and efficiency and reducing health disparities
2	Overhead Reduction	Offsetting	If EHR replaces existing systems that performed similar functions, the EHR ongoing maintenance costs should be offset by the legacy system maintenance costs	•Improving quality, safety, and efficiency and reducing health disparities
3	Improved Operational Performance	Supply-Chain Management	EHR enables decision-support tools to identify less-expensive/more-effective supply alternatives, reducing supply costs	•Improving quality, safety, and efficiency and reducing health disparities
4	Reduce Inappropriate Utilization	Appropriate Site of Care or Therapeutic Pathway	EHR facilitates ability to suggest therapeutic alternatives (i.e., watchful waiting for lower-back pain vs. immediate surgery).	• Improving quality, safety, and efficiency and reducing health disparities •Engaging patients and families in their health
5	Improved Quality Performance	Patient Safety Initiatives	EHRs can facilitate process improvements that reduce "never events" (i.e., medication errors, patient falls, pressure ulcers, wrong site of surgery) that typically aren't reimbursed and substantially increase episode costs and reduce cost to remediate harm	• Improving quality, safety, and efficiency and reducing health disparities
6	Improved Operational Performance	Reduced Cap-Ex	EHR could reduce demand for imaging and lab services to a point that it reduces the need for new/replacement capital assets (computed tomography machines, X-ray machine, lab equipment)	• Improving quality, safety, and efficiency and reducing health disparities
7	Improved Operational Performance	Improved Workflow—Reduced Cap-Ex	Clinical protocols/pathways embedded in the EHR can enable reduced variability in care delivery in all settings, allowing the facility to make greater use of fixed capacity (i.e., available beds through decreased average length of stay (ALOS), magnetic resonance imaging (MRI) machines, and surgery suites).	• Improving quality, safety, and efficiency and reducing health disparities

8	Improved Operational Performance	Improved Workflow—Staffing	Clinical protocols/pathways embedded in the EHR can enable reduced variability in care delivery in all settings allowing the facility to make greater use of step-fixed staffing resources (i.e., free-up floor staff through decreased ALOS, MRIs, surgery suites)	• Improving quality, safety, and efficiency and reducing health disparities
9	Reduce Inappropriate Utilization	Reduce Duplicative Services	EHR info available on previous tests reduces laboratory and radiology costs for redundant and unnecessary tests	• Improving quality, safety, and efficiency and reducing health disparities
10	Improved Operational Performance	Supply-Chain Management	EHR can enable auto restocking/ordering to support pre-defined par levels	• Improving quality, safety, and efficiency and reducing health disparities
11	Reduce Inappropriate Utilization	Disease Management Strategies	EHR facilitates automated reminders and alerts identifying those with chronic disease(s) and enables optimal care of these patients based on predefined protocols reducing ambulatory sensitive emergency department visits and admissions	• Improving quality, safety, and efficiency and reducing health disparities •Engaging patients and families in their health •Improving care coordination •Improving population and public health
12	Improved Care Coordination	Reduce Repeat Hospitalizations	EHR can facilitate improved discharge process and improve care coordination across providers, reducing unnecessary readmissions	• Improving quality, safety, and efficiency and reducing health disparities •Engaging patients and families in their health •Improving care coordination
13	Improved Quality Performance	Improved Clinical Outcomes	Improved effectiveness of quality improvement projects (not otherwise mentioned in this file) that result from improved data gleaned from EHRs	• Improving quality, safety, and efficiency and reducing health disparities
14	Network Management	Increased Labor Efficiency	Enables de-skilling strategies allowing organizations to take advantage of clinicians performing at the "top of their license"	• Improving quality, safety, and efficiency and reducing health disparities
15	Improved Clinical Performance	Improved Workflow—Staffing	EHR can decrease clinician time spent on documentation, allowing more patients to be seen in a day	• Improving quality, safety, and efficiency and reducing health disparities

16	Reduce Inappropriate Utilization	Disease Management Strategies	Allows for development and management of clinical registries to improve care delivery and coordination	• Improving quality, safety, and efficiency and reducing health disparities •Improving care coordination •Improving population and public health
17	Overhead Reduction	Reduced Cap-Ex	EHR reduces need for floor space related to radiology film library and medical records/chart rooms	• Improving quality, safety, and efficiency and reducing health disparities
18	Overhead Reduction	Reduced Operating Costs	EHR reduces need for film-processor and related maintenance costs due to reduced radiology tests	• Improving quality, safety, and efficiency and reducing health disparities
19	Improved Operational Performance	Reduced Operating Costs	EHR reduces need for printing X-rays and related radiological film supply costs	• Improving quality, safety, and efficiency and reducing health disparities
20	Overhead Reduction	Improved Workflow—Staffing	EHR can reduce time spent on order processing by lab techs	• Improving quality, safety, and efficiency and reducing health disparities
21	Overhead Reduction	Improved Workflow—Staffing	EHR can reduce time spent pulling charts	• Improving quality, safety, and efficiency and reducing health disparities
22	Overhead Reduction	Improved Workflow—Staffing	EHR can reduce transcription costs	• Improving quality, safety, and efficiency and reducing health disparities
23	Overhead Reduction	Improved Workflow—Staffing	EHR can reduce time spent on film processing by radiology department clerks	• Improving quality, safety, and efficiency and reducing health disparities
24	Improved Quality Metric Reporting	Metric Development/ Management	EHR allows for automation of quality reporting, reducing the need for manual chart abstraction	• Improving quality, safety, and efficiency and reducing health disparities •Improving population and public health

25	Reduce Inappropriate Utilization	Appropriate Site of Care or Therapeutic Pathway	EHR enables the use of phone and e-mail visits to address relatively minor issues that otherwise would have required an office visit	• Improving quality, safety, and efficiency and reducing health disparities •Engaging patients and families in their health •Ensuring adequate privacy and security protection for personal health information
26	Overhead Reduction	Administrative Costs	EHR-enabled quality-improvement efforts decrease medication errors and other "never events," leading to a reduction in malpractice premiums	• Improving quality, safety, and efficiency and reducing health disparities
27	Reduce Inappropriate Utilization	Appropriate Site of Care or Therapeutic Pathway	Data from a health system's EHR can identify the highest-value (lowest cost for a given level of quality) setting to provide care for patients with certain conditions. Patients can then be routed to the most appropriate care setting	• Improving quality, safety, and efficiency and reducing health disparities
28	Opportunity Costs	Service Line Management	Data from a health system's EHR can better identify underperforming service lines and determine whether the quality/cost point can be improved or the organization should discontinue the service and pursue other opportunities with its resources	• Improving quality, safety, and efficiency and reducing health disparities
29	Network Management	Improved Clinical Outcomes	EHR allows for provider profiling	• Improving quality, safety, and efficiency and reducing health disparities
30	Support Clinical Trials	Revenue Opportunity/ Halo Effect	More easily provides data to support clinical trials conducted at the organization or increases the opportunities for organizations to participate in clinical trials	•Improving population and public health
31	Improved Operational Performance	Payer Management	Allows for decreased administrative costs related to payer prior authorization and utilization management/review activities	• Improving quality, safety, and efficiency and reducing health disparities

32	Reduce Inappropriate Utilization	Disease Management Strategies	Reminders in EHRs can alert providers to administer necessary vaccines and preventative screenings	• Improving quality, safety, and efficiency and reducing health disparities •Improving care coordination •Improving population and public health

TABLE 5 Complete List of Included Potential Revenue Impacts

	Core Strategic Goals	Revenue Impact Type	Description	Explanation
1	Improved Operational Performance	Financial Incentives	Payer offers bonus payments for meeting predefined EHR functionality (i.e., Medicare Meaningful Use program)	
2	Improved Quality Performance	Pay-for-Performance Schemes	Payers offer bonus payments for performance on a range of process, outcome, cost, and efficiency metrics	Embedding protocols related to the process measures in an EHR has been identified as key to improving performance
3	Improved Operational Performance	Financial Incentives	Payer reduces reimbursement for failing to meet predefined EHR functionality (i.e., Medicare Meaningful Use program)	
4	Improved Quality Performance	Penalty	Hospitals receive reduced reimbursement if they have higher-than-average rates of hospital-acquired conditions (HACs)	EHR functionality can support process improvements to reduce HACs
5	Improved Care Coordination	Penalty	Hospitals receive reduced reimbursement if they have higher-than-expected readmissions for certain conditions.	EHRs can facilitate care coordination, discharge planning, and post-discharge follow-up
6	Improved Quality Performance	Pay-for-Performance Schemes	Payers decrease payments for failing to meet performance targets on a range of process, outcome, cost, and efficiency metrics.	Embedding protocols related to the process measures in an EHR has been identified as key to improving performance
7	Improved Quality Performance	Non-Payment	Payer will not pay for specified "never events"	Embedding protocols related to "never event" mitigation in an EHR can reduce "never events."
8	Steerage	Volume Incentives	Payer steers volume to (away from) providers for meeting (failing to meet) EHR functionality criteria	

9	Improved Operational Performance	Payer Management	EHRs can provide more accurate/granular data at the per unit/case level.	This will allow providers to better understand their true costs associated with providing a service and negotiate increased reimbursement where they are currently underpaid or, where overpaid, trade price for volume
10	Increased Patient Loyalty	Volume Incentives	EHR allows hospitals to offer patients access to a personal health record (PHR)	PHRs are viewed as a mechanism to build deeper relationships with patients and potentially increase perceived switching costs
11	Improved Operational Performance	Volume Incentives	Clinical protocols/pathways embedded in an EHR can enable reduced variability in care delivery in all settings, allowing the facility to make greater use of fixed capacity	Assuming backfill, any capacity created by decreasing ALOS or the efficiency of other areas within the organization will allow the provider to see more patients, increasing revenue-generating opportunities
12	Improved Overall Margin	Non-Patient Revenue	Sale of de-identified patient data for research purposes	
13	Improved Operational Performance	Revenue Cycle Management	Identifies services that previously would have not been included on the bill	
14	Improved Operational Performance	Increased Revenue	Inclusion of previously unidentified conditions/services increases the long-run accuracy of risk adjustment	

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