Electronic Medical Records 2.0

Achieving Improved Health and Service Delivery Economics in the United States from a National Investment in Health IT

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Executive Snapshot

With the passage of the American Recovery and Reinvestment Act, $19B in federal money is being invested to scale-up the use of electronic medical record (EMR) software. Unfortunately, current products and implementation approaches are not well suited for the task. Even at the best health systems, implementations take years and hundreds of millions of dollars and seem to produce little improvement in health outcomes or administrative efficiencies. A new model, or EMR 2.0, is needed if we are to lower costs and improve the quality care from a national investment in electronic medical records.

This paper outlines a proposal for an EMR 2.0 based on important advances in computing, healthcare informatics, content management and cognitive science. The new model calls for the collaborative development of on-demand semantic web services to capture, use, share and protect the electronic information we need to manage all aspects of health. Taking a services computing approach to EMR software offers the best way to lower the cost and accelerate the secure delivery of health information into homes, doctor offices, hospitals, pharmacies and everywhere health is managed. Unlike current products, EMR 2.0 will be chiefly designed to provide access, alerts, briefings, training, advice and other knowledge services that support cognition and behavior change across the healthcare continuum.

The battle cry of "automate everything in the patient record" will be put aside in favor of the 80/20 rule that claims automating 20% of the data about health can be used to produce 80% of the value created by improved outcomes, safety and operational efficiency. This approach to value informatics will dramatically streamline current electronic patient records efforts and provide the insights needed to apply incentives for use in a sustainable and equitable way.

The dated assumption that only highly trained professionals know anything about health, will be put aside to enlist motivated citizens, students, amateur scientists and others to participate in the open source development or crowdsourcing of the "common sense" semantic content needed fuel automation for EMR 2.0. This Wikipedia-style effort will break the bottleneck that has kept current approaches from scaling up. It can be done with quality assurance and is essential to capturing and maintaining the enormous amount of computer-readable content needed to lower the cost and improve the quality of health.

EMR 2.0 will be installed once on a large and secure computing cloud or data center on the Internet. Compare this to the cost and effort of installing EMR software thousands of times in healthcare facilities around the US. Consumers, doctors, nurses and anyone involved in health management will access EMR 2.0 via a browser and use only those services they need (or that we all have agreed to use) rather than having to implement large complex software modules. No software capital costs, pay for what you use and get paid to use certain aspects of it. EMR 2.0 will work with any current web-enabled EMR product meaning investments that have been made in the old model will not have to be redone. Instead, the services of EMR 2.0 can be used to fill in the holes and extend the functionality of older versions.

Building EMR 2.0 can happen quickly, incrementally and collaboratively. Web services for using lab and med information to help avoid safety issues, effectively managing people with high-cost chronic conditions, doing medication reconciliation, getting help making hard behavior changes or even more effectively managing hospital beds to avoid overcrowding, can be developed and implemented quickly and used on-demand under the lowest possible cost structure.

While there are challenges to overcome in realizing this vision there are related initiatives underway to address them. Importantly, with timely investment and focused implementation, EMR 2.0 products can be developed in pace with the schedule of the Economic Stimulus Plan and qualify users for significant incentive payments.

The Challenge

Over the next several years we will likely see the investment of billions of dollars to establish an electronic medical record (EMR) for US citizens. As of this writing $19B in spending has been approved and President Obama has pledge a total of $50B. The funding will support more healthcare information technology than electronic medical records but they are the centerpiece. The hope is that wide-scale implementation of an EMR will dramatically lower the cost and improve the quality of care in the nation. As numerous studies have documented the need for cost reduction and improve quality in healthcare is indeed urgent, and a multi-billion dollar push on the EMR in principle will help get us there. Unfortunately, the current products and more fundamentally the informatics and economic model behind them, call it EMR 1.0, is not up to the task. Said more directly, a large scale investment in EMR 1.0 would in fact be a disappointment. We will not achieve improved health and operational efficiencies in proportion to the cost.

There are a growing number of thought leaders, advisors, CEOs and healthcare influentials starting to voice this concern. Arguments vary but the most technically penetrating can be found in the report, *Computational Technology for Effective Healthcare*, commissioned by the National Academy of Sciences. The study looked at the best of the best when it comes to working EMR implementations and found that they offered little in the way of "cognitive support" (e.g. decision assistance to caregivers and education for patients) and appeared to be more geared towards complying with regulations and protecting against lawsuits than improving the quality of care.

The problems with EMR 1.0 run deep. It is database-centric, monolithic, interface poor and requires a significant capital investment by multiple parties and can take many years to fully implement before there is any hope of return. For example, one 10-hospital health system recently confided a seven-year $325M EMR implementation plan.

In another example, it was reported in *Modern Healthcare* magazine that the Geisinger Health System has been building an EMR since 1995 and has seen benefits over that last several years as they invest even more millions of dollars in innovations such as the advanced medical home. This suggests scaling up EMR 1.0 will be exceptionally expensive and long. A recent headline in *Computerworld* claims Obama's EHR plan could take $100B and 10 years.

Alarmingly, EMR 1.0 does not focus on the workflow automation, decision support or functionality other functionality needed improve productivity and quality. The interface and screen-flow to support key activities such as capturing clinical documentation or viewing information on the state of the patient has been implemented with little regards for human factors and how clinicians think. Clinicians complain that they spend more time feeding the database than working with patients and that it is nearly impossible to figure out the "story of care" for a patient given the hybrid mess of electronic screens and paper charts they must wade through. Further, attempts to bolt on additional software modules to do computerized order entry or provide decision assistance often result in safety alerts that are ignored and are something the clinicians need to work around.

The bottom line is that even at the showcase sites, value realizations in terms of improved patient outcomes or provider economics is questionable. EMR 1.0 does not fit how clinicians think let alone provide support for it. It is a costly, intrusive and demanding addition to the clinical workflow. This is likely why $17B out of the $19B in the stimulus package is aimed at paying doctors and hospitals to use the systems.

Some argue that many of the problems cited here indicated that an EMR must be viewed as an infrastructure investment very much like the highway system. Something that is monolithic by nature and produces no immediate or direct return making it a good candidate for government investment. Even if this where true, and an alternative view is argued below, it is still a non-starter given the dated technology EMR 1.0 operates on.

The database technology, integration layer and code base for many of today's EMR products is at least a generation behind. Scaling this up would be a bit like building a highway system without laying the proper foundation to support the pavement.

This is a serious limitation, one that we cannot likely incrementally work our way out of. The importance of this limitation becomes apparent when we look at the model outside the confines of a single hospital. Regional health information networks and the so-called national health information network seek to make health information available anywhere, anytime and to all appropriate parties. The promise of improved care and administrative efficiency implied by this health information superhighway is truly immense. A 2005 RAND study put the savings at approximately $80B per year assuming a 90% adoption rate. But the study assumes improvements in workflows and practices that seem hard to achieve with EMR 1.0. Although important progress has been made in developing standards, funding successful demonstration architectures and even launching the first production application, much of the value this promises will not be realized given the limitations of EMR 1.0.

Few hospitals, physician offices and other healthcare providers have fully implement EMR products. The same holds true for the personal health record (PHR) or the "little sister" system to EMRs that houses the consumers' view and sometimes the insurance company's view of health information. Some argue that the PHR model offers a better approach to scale up than does EMR 1.0.

To that point, PHRs are often built on modern web-centric architectures and do a much better job at human factors. However, the distinction between EMR and PHR products may not be a productive one as they are focused on different aspects of the same underlying goal. EMR software is clinically focused mostly on acute care and is primarily a tool for the medical professional. PHR products are focused mostly on prevention, wellness and provider selection and are primarily tools for the consumer.

> *The common goal of EMR and PHR software is to electronically capture, use, share and protect the data, information and knowledge needed for high quality cost effective health management.*

Fragmenting a solution across multiple products is just another issue with EMR 1.0.

We need to re-engineer EMR 1.0 before investing billions in a scale up. The new model or EMR 2.0 cannot be an incremental advance. It must operate on a new set of principles that not only guarantee substantial and sustainable improvements in health outcomes and provider economics but can be brought online quickly and reliably.

The Principles of EMR 2.0

As we re-conceptualize our national approach to electronically managing health information we should consider solutions based on four principles.

1. Cognitive Design: Support and enhance how clinicians and patients think, decide, learn and make behavior changes. A cognitive focus is the best way to insure value realization given the complexity, emotional-intensity and behavioral roots of health management. It means not only taking a human-centric approach to design but also guaranteeing that online content is computer readable so applications involving machine intelligence are possible.

2. Value Informatics: Optimize the role of technology in creating value in healthcare by capturing electronically just the data needed to improve outcomes and provider economics rather than capturing all the data you can "just in case" it is needed. This discipline, call it value informatics, needs to be extended to all forms of content including evidence-based guidelines. As 20% of the data is creating 80% of the improvement, using value informatics will streamline, accelerate and create a more sustainable health information network.

3. On-Demand Content: Provide universal access like the web but controlled access like electronic banking. The online information and knowledge needed for prevention and care must be everywhere capturable, accessible and embeddable but appropriately private. This means that health information must work on a wide variety of medical, computer and consumer devices and integrate remote monitoring and telepresence to insure on-demand and real-time health information.

4. Affordable Agility: Offer an implementation and ongoing operational approach that eliminates economic barriers for all participants no matter what scale they operate on. This includes delivering functionality in small building blocks rather than monolithic chunks that take months rather than years to master and can be configured to support innovative practice patterns rather than dictating workflows.

Although these principles may seem to be common sense -make an EMR that is affordable, easy to use, captures valuable data and improves care and efficiency - EMR 1.0 has failed in general to meet them.

Given the timeframe of the national investment (next several years) we are necessarily constrained by current and near-term technologies, clinical practices and other interventional capability when it comes to implementing products based on these principles. There is no time for lengthy analysis or long-term R&D. Fortunately there are a number of trends and emerging capabilities that with the proper investment can do the job including service computing, crowdsourcing, the development of health information standards for the semantic web and new insights into understanding cognition and health. We will look at each of these building blocks of EMR 2.0 in the next section of the paper.

Building Blocks of EMR 2.0

Service Computing

There can be no doubt that the Internet will play a key role in how we capture, use, share and protect the electronic data, information and knowledge needed for cost effective quality healthcare. The Internet has evolved rapidly over its short history and is now giving rise to a new capability called service computing. In service computing, complex enterprise-scale software applications are run in very large scale data centers on the Internet and delivered as on-demand web services. Technically, service computing is the convergence of several important trends including – cloud computing or using the Internet as your data center, software as a service or subscribing to rather than purchasing expensive software packages and others. The term "cloud" is used to highlight the fact that demand is flexibly allocated across a vast network computers.

From a consumer standpoint service computing is a revolution. There are no capital costs for software or server hardware. Data storage and bandwidth requirements scale gracefully and you can pay only for what you use like a utility. The application is accessed via a browser from anywhere. This dramatically lowers the cost and shortens the time to value realization. You can cost effectively absorb large swings in usage or swells of data because the Internet as data center is most elastic. Although just emerging, service computing has proven a winner for customer relationships management and workplace productivity software and corporations are testing it as a way to lower computing costs.

Service computing, or delivering software as a service from an Internet cloud, offers the best opportunity for satisfying the principles of on-demand content and affordable agility for EMR 2.0. There are however, a number of important issues that must be explored. For example, the functionality that can be delivered as set of web services over a browser is limited. EMR applications, especially those that support acute care hospitals must run very fast and in a non-stop mode. Privacy and data security are a major concern. These issues raise an important feasibility question: Can service computing over the net deliver rich enough functionality securely and support extreme performance requirements?

To make use of this type of computing we must be able to conceptualize an EMR and the workflows and activities it must support as a set of services.

Moreover, the set of services we specify must be maintainable and mass customizable to support rather than inhibit experimentation with new service delivery models.

These points raise another question for feasibility analysis: Can we model the richness and complexity of clinical workflows as a set of cooperating services and components?

Fortunately, work on a service-oriented approach to computing in healthcare has started to get traction. There is some background in place to address such questions and do a feasibility analysis. Major PHR offerings from Google and Microsoft have already demonstrated the effectiveness of many aspects of cloud computing for healthcare. Furthermore, there are EMR products for clinics and doctors' offices (e.g. Practice Fusion) that run successfully on a software as a service model.

The need for a further feasibility analysis is required as it will set the agenda for the engineering work we must do in order to accelerate the development of an EMR 2.0.

We can be confident that technical issues will be resolved. The importance of cloud and service computing goes far beyond health and is seen as the next major step in computation. Technology companies including IBM, Google, Microsoft, Sun, Dell and others are rapidly moving into the space and want to work with customers. For example, IBM offers a more corporate version of cloud computing called the Blue Cloud that likely provides the security needed to support HIPAA compliance.

In addition, there are projects underway, such as the Health Services Specification Project, coordinated by two major standards organizations, Health Level Seven and the Object Management Group, designed to rethink the monolithic modules of EMR packages as a set cooperating, small and well-encapsulated services.

Value Informatics

Another challenge to EMR 2.0 is figuring out which data elements to capture electronically. EMR 1.0 assumes that ultimately the entire patient record in all settings should be captured, used, shared and protected in an electronic format. Although this sounds compelling on the surface, it is the root cause of exceptionally long, low value implementations we have seen so far with EMRs. Trying to "automate everything" is usually a mistake when using information technology and signals a lack of understanding of the problem to be solved.

As the previously mentioned study on *Computational Technology for Effective Healthcare* found, the data elements captured by today's EMRs are geared more towards managing compliance and legal risks than improving care and efficiency. EMR 2.0 must embrace just the opposite. The new model will be focused on incurring expense to capture, use, share and protect just those data elements that improve prevention, self-care, chronic care, acute care and provider productivity and efficiency.

Preliminary work already suggests which data elements are essential for a value-focused EMR. Being able to access digital radiological exams from any location will prevent unnecessary reordering of such expensive tests. Capturing lab results and medication electronically provides the basis for powerful monitoring and decision-support aids that save lives. Monitoring and basic care delivered remotely via technology insures compliance, lowers costs, maintains quality and keeps patients in the comfort of their homes. Expert systems designed to assistant physicians in diagnosing patients and providing cost-effective second opinions, can help avoid the enormous quality and cost problems associated with misdiagnosis. Labs, meds, diagnostic logic and remote monitoring constitute a small fraction of what is normally considered to be an electronic patient record but shows the most promise of improving access, saving lives and avoiding billions of dollars in the misuse, overuse and abuse of healthcare services.

Value informatics however must go beyond clinical care and include an analysis of the economic importance of operational information. For example, overcrowded EDs in major urban centers around the US are a strong signal of our healthcare crisis. Studies show that one cause of emergency department (ED) overcrowding is the inability of hospitals to efficiently manage their beds, staff and supplies. Operations management in hospitals is incredible complex and is made even harder due to the lack of real-time information. Our inability to manage hospital capacity (e.g. beds and labor) and the demand for services by patients contributes significantly to the cost and quality crisis we have. Overworked staff and overcrowded hospitals contribute to poor outcomes and patient deaths. Furthermore, our inability to manage the operations has helped to trigger the biggest building boom and capital investment in new hospitals and beds in US history.

If we are to get value from the new EMR it must include the operational data needed to administer care in all settings efficiently and safely. This is a major departure from the current model and calls for a mixing of clinical/health data with operational and performance data. Interestingly, the marketplace seems to be recognizing this need. For example, Eclipsys a major EMR vendor has recently acquired Premise a leader in patient flow management systems. The goal is to offer an integrated package of EMR plus patient flow management to improve both the quality and efficiency of care simultaneously. In the real work of healthcare you cannot separate operations from clinical service delivery. Efficiency and quality go hand in hand. This reality must be reflected in the design of EMR 2.0 if we expected to drive systemic improvements in outcomes and provider economics.

Similar value informatics arguments can be made for disease management, self-care and changing health-related behaviors.

Value informatics can also be used to solve one of the most vexing problems with EMR implementations, namely how do you motivate participation in capturing, sharing, using and protecting electronic health information by those who do not directly receive the benefit from it.

For example, we may ask a physician that gives verbal or handwritten orders in a few seconds to now spend considerable time in front of a computer typing in orders and dealing with a variety of alerts, warning and best practice recommendations. As time is money, do we want to ask physicians to make less money in order to improve patient care? Is that tradeoff necessary or a consequence of EMR 1.0? And it is not just physicians. Any time we decide to capture health information electronically there are many parties involved in the continuum of care that must now change how they work to contribute to capturing, sharing, using and protecting the data.

To avoid cost and activity shifting as we automate the patient record it is necessary to provide incentives to fairly compensate those that must do more work. Value informatics provides an objective foundation for paying a fee for information services that are high value and provided by anyone in the continuum of care even the patient/consumer.

Most of the stimulus funding for healthcare IT includes incentives for use and adoption. We must formulate these incentives using the best available value informatics.

Furthermore, the funding of information-based fee for service in healthcare should be self sustaining. The government being the biggest single payer in the system will be able to fund paying information fees based on the fact that it lowers to total social cost of care. The feasibility of meaningful fees is further supported by the ultra-low overhead and utility-like costs of EMR 2.0 service computing model.

Using value informatics to fund a fee for information service allows us to value optimize across the continuum of care without nationalizing medicine or otherwise interfering with the market. It should also stimulate entrepreneurial development of new businesses, products and services. The new fee-for-service is likely in the billions of dollars annually and is essential for establishing a sustainable health business model for regional and national health information networks.

Healthcare reformers have called for relative value analysis that looks at the different cost/benefits of various options for diagnosis or treating a given condition. Value informatics operates on the same principle but calls for understanding the relative cost/benefits of electronically capturing a set of data elements that relate to the clinical, financial and operational management of health. As value informatics is a new discipline, it is important to set aside funding for demonstration projects that seek to establish new connections between information and improved outcomes and provider economics. Otherwise we will stifle progress in automating care.

One lesson from EMR 1.0 is clear. Just capturing data is not enough. You need to do something with it if you want to create value. In healthcare this is can be very hard. For example, automating complex clinical workflows, changing patient's health-related behaviors, making medication decisions when patients are on 10 or more meds, enabling primary care physicians to effectively manage the health of thousands of patients and managing beds and labor with global efficiency across an entire health system all require far more than just capturing the right data elements.

Tackling such complex challenges means EMR 2.0 must go an extra step and include semantically-rich data models. Such models support the development of smarter applications that function with a much deeper understanding of what the data means.

Crowdsourcing the Semantic Web

Semantically-rich data is created when the raw data such as a patients' weight or blood pressure is embedded in a computer readable format that supports understanding the meaning of the data within the context of healthcare. We develop semantics by describing the data in more detail and linking it to other related data elements in a formally consistent way. Computer programs that use semantically-enriched data are far smarter and more powerful than traditional programs because they understand what blood pressure is, what can cause problems with it, how it is treated, what other conditions it relates to and so on. This is just what we need if the services of EMR 2.0 are going to provide support for decision making, education, behavior change and other cognitive activities of clinicians and consumers.

Constructing a semantics for healthcare IT has been underway for sometime as is evidence by the development of large medical vocabularies such as the Systematized Nomenclature of Medicine and Clinical Terms or SNOMED, large-scale semantic networks at the National Library of Medicine and more recently the data standard harmonization work to support the National Health Information Network as well as the pioneering efforts of the Semantic Web Health Care and Life Sciences Interest Group of the WC3. It is clear that there has been no lack of effort to formalize the semantics of healthcare data. What has been lacking is an approach to scale-up the application of the standards to develop a critical mass of models to support the improvement of healthcare. The effort to create and maintain such models, however, is massive and overwhelming when viewed from the traditional approaches employed in data management.

Fortunately, we have seen the emergence of a new approach for building and maintaining high-quality online semantic resources, most visibly through Wikipedia. With the new technology and mass collaboration approaches of Web 2.0, complex semantically rich models such as encyclopedia articles are crafted by self-motivated volunteers and reviewed by the general public or "the crowd" until a highly polished product is created. Crowdsourcing is being used to tackle many large-scale tasks including conducting scientific research. For example, so-called citizen scientists (motivated amateurs) follow protocols to collect climate data, record events in urban settings and even help analyze star charts to produce real scientific results.

Crowdsourcing is already being used successful in healthcare to capture patient data and experience and share it other with related concerns. What we are proposing is a crowdsourcing approach to accelerate the development of some of the semantically-rich data models needed for EMR 2.0.

Health professionals, university students and even consumers can all play an important role in developing a semantic web to support health management.

For example, consumers can provide more detailed health data, annotate text and images and perform controlled work in citizen health science.

Much of what is needed to make EMR 2.0 smart borders on common-sense about health related matters. When more technically precise semantics is needed students and professional can be enlisted. For example, university students studying anatomy and other life sciences can take on reading assignments and class projects that involve the tagging and description of health data needed to give EMR 2.0 a more robust semantics. Medical students could learn the very latest treatment protocols by coding evidence-based guidelines as a set of clinical rules for EMR 2.0. There are dozens of relevant courses that taught every semester at many different universities. This provides a large, reoccurring and otherwise motivated labor force for crafting some of the more technically sophisticated semantic models needed to power EMR 2.0.

There is some evidence that tagging content can improve learning outcomes. It may be possible to develop new educational techniques focused on learning by teaching a machine that not only produce computer-readable semantic web content but improve student learning outcomes at the same time. By merging crowdsourcing and educational methods we are developing a "studentsourcing" approach that co-educates people and machines that has applications and implications far beyond EMR 2.0.

The power of crowdsourcing rests on our ability to take activities that many are already motivated to do and wiring them together into an "architecture of participation" or mass collaboration effort all pointed at the creation and maintenance of a complex product. Why would busy talent people work on such projects for free? The motivational theory that makes crowdsourcing work has been much debated but by offering a big tent (many possible motivations) and permitting self-selection the idiosyncratic motivations of a large number of individuals is effectively harnessed in a powerful new production model.

As with the use of cloud computing, there are serious feasibility questions associated with using a crowdsourcing approach to the development of the semantic models needed to power EMR 2.0. For example, many will be concerned with the quality of content. Quality studies on Wikipedia have shown that knowledge structures as complex as an encyclopedia can be created and refined to a professional-grade by the crowd. It is likely that much of the background semantics for using health-related information can be too.

We believe that a careful use of structured citizen science efforts (guided by professionals that will otherwise benefit from the work), studentsourcing or having students in the relevant disciplines learn by constructing semantic models as well as open and prized-based crowdsourcing efforts will all be necessary.

These various crowdsourcing efforts require a common language if they are to work together. Creating a common language, taxonomy or even ontology will have to be done with great skill.

Anything too formal will be unwieldy for human use and if it is too flexible (e.g. a folksonomy) it may not interoperate or be computer-readable. A key challenge in the proposed approach to EMR 2.0 will be to create a human-friendly but machine readable language to tag, annotate and express rules about health information. Fortunately, $2B of the &19B for Health IT in the Stimulus Package is dedicated to developing standards and laying the foundation for interoperability and a national health information infrastructure. We believe this should include the development of the standards, methods and tools needed to crowdsourcing a semantic web of health information.

If we just capture the data but fail to make it meaningful much of the potential value of our national investment in electronic medical records will be left of the table. Historically, semantic content for computer use has been unobtainable due to the lack of standards and no cost effective way of implementing them on a large scale.

Today we can put such standards in place and turn the majority of the task over to a crowd eager to do the work, and do it well. Crowdsourcing a semantic web for health represents a fast, low cost way to get a 20% solution that creates 80% of the value.

Cognitive Design Patterns

The final building block for EMR 2.0 pulls on both cognitive science and technical architecture to be sure that the services created can work together to provide cognitive support to caregivers and consumers. The purpose of semantic-rich web services is to, among other things, make better decisions, change behaviors and run complex operations more efficiently. The service-oriented computing architecture we need for healthcare must be engineered not so much to support workflows or departmental functions as traditional health IT systems do but instead they must be engineered to support the thought flows of caregivers and patients. By supporting the "workflows between the ears" or the way people perceive, remember, think, feel and interact we naturally support how they want to work but in a way that optimizes the most important variables in healthcare – cognition and behavior.

For example, EMR 2.0 services can be used to create processes that alert, brief, train and advise. These processes are simple but focused on the cognitive activities (e.g. learning, and decision making). They are similar in structure but different in content for doctors, nurses, patients, social workers, family members, pharmacist and others involved in health. Depending on your role, condition and goals a different set of EMR 2.0 services are delivered to alert, brief, train and advise you on medications, therapies, treatment decisions, self-care techniques, preventative measures and other aspects of health.

These services must be engineered to support how people actually make decisions and behavior changes not how we think they should. Understanding of how minds work has advanced over the last 20 years changing our view of human rationality, emotions, decision-making and behavior change. These insights have been popularized in best-selling books including, for example, *Blink* and *How Doctors Think*.

The new view of mind has reshaped economic theory contributing to two Nobel prizes and has given rise to behavioral finance, neuromarketing and a host of other new disciplines. The view of rational agents weighing alternatives and seeking to maximize utility in an objective computer-like way has been replaced by a new view of cognition as a mass of mental short-cuts mainly shaped by metaphors, emotions and other visceral factors. The new view has major implications for systems that hope to provide decision-assistance, accelerate learning and support sustainable behavior change in healthcare.

As we model the activities required to turn information into improve health we must be careful to bring to bear the best available thinking on how minds actually work. This means designing services and processes that respect cognitive load, leverages or mitigates cognitive bias, makes use of deep-rooted metaphors and supports the emotional management and self-regulation that is so essential to behavior change. In short, the services of EMR 2.0 must be based on cognitive design patterns.

Summary

On-demand computing using semantically-rich and cognitively-focused web services engineered to electronically capture, share, use and protect high-impact health information is the heart of EMR 2.0. Indeed, when you re-conceptualize electronic medical records software this way it is part PHR, EMR, Bed Management System, Staff Scheduling System, Enterprise PACs system and many other systems. There is really no EMR per se in EMR 2.0 but instead a set of crowdsourced on-demand services designed to alert, brief, train, advise and treat everyone in the healthcare continuum according to their role, needs and goals.

The original concept of automating the entire patient record just in case a data element is needed in electronic form is replaced by a value-focused EMR that selectively picks data elements that are proven to drive improved outcomes, safety and efficiency when they are electronically captured, used, shared and protected.

Observations on the Economics of EMR 2.0

Implementing the EMR 2.0 can be done incrementally and quickly in a way that immediately lowers costs and improves outcomes. Realizing the full vision will take time but substantial value will be regularly realized along the way. The investment required to scale-up EMR 2.0 to a national level is likely at least one order of magnitude lower than the cost of scaling up EMR 1.0. The software will be installed once on an Internet cloud-computing platform rather than thousands of times in healthcare facilities around the US. This means that providers, payers and consumers that purchase EMR 2.0 products will avoid the upfront capital costs of EMR 1.0 products.

Ongoing costs can be handled in several different ways depending on the business models offered by vendors of EMR 2.0 products. These include a fixed annual subscriptions fee, usage-based or pay-as-you-go fees like an electric bill or even a fee indexed to improved outcomes and operational benefits. Like EMR 1.0 products, EMR 2.0 products will qualify for economic stimulus payments in 2011 and allow users to avoid the corresponding non-compliance penalties slated to begin in 2015. Importantly, EMR 2.0 provides a sustainable model based on value informatics for continued payment of fees for-information-service that are necessary to keep benefits flowing across the entire continuum or chain of care.

EMR 2.0 provides minimal constraints on clinical workflows and business processes. It does not presuppose a specific service delivery model. It is intended to provide a computing platform optimized for how our minds work and is supportive of experimentation and rapid changes in clinical, business, service and process approaches. Figuring out the best value chain for healthcare delivery in the US will take time. An EMR that constrains choice will seriously inhibit important healthcare reform.

Once the methods and tools for doing value informatics, web service programming and semantic content crowdsourcing have been developed for the EMR 2.0 they can be extend to other healthcare IT challenges and even service computing applications in other industries. In this way, EMR 2.0 represents an opportunity for the nations dated or under developed healthcare IT infrastructure to leapfrog to the next generation of computing using a cloud-based services platform.

About the Author

Mark K. Clare has over 25 years of experience in technology, strategic innovation and informatics with leading Fortune 200 companies and a Silicon Valley start-up that include 3M and Allstate. Mark Clare is author of many publications including the book *Knowledge Assets*. He is also an inventor with patents in artificial intelligence and knowledge management. Before founding New Value Streams Consulting LLC, he held several executive positions including vice president of knowledge and informatics management at Parkview Health, an eight-hospital health system in Indiana. In addition to consulting, Mark is an adjunct professor at Northwestern University where he teaches graduate students in the learning and organizational change program and the medical informatics program. Mark Clare earned Master degrees in both Physics and Analytic Philosophy and is trained as a Six Sigma Black Belt.