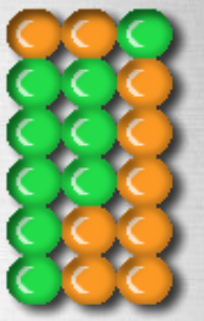


# SUCCOR CONSULTING GROUP

## Electronic Health Records

March 2011

# TABLE OF CONTENTS

# COMPUTER BASED PATIENT RECORD SYSTEMS

In the 17th Annual Health Information and Management Systems Society (HIMSS) Leadership Survey, an annual survey of healthcare information technology executives, patient satisfaction and safety appear at the top of the list of their business priorities. Patient satisfaction was stated as the business issue that will have the most impact on healthcare in the next two years. Survey participants believe one of the keys to making patients happy is implementing technology to reduce medical errors and promote patient safety.

Patient management systems offer an effective way to collect, store and distribute vital clinical information; when combined with computerized physician order entry systems (CPOEs), they also increase diagnostic accuracy, reduce medical errors and improve overall quality of patient care by providing immediate access to accurate patient information. As these new applications are implemented, the process of care delivery by clinicians becomes more dependent upon continuous availability of the underlying systems and technology. Once an organization has implemented clinical automation, patient care grinds to a halt if these automated systems become unavailable.

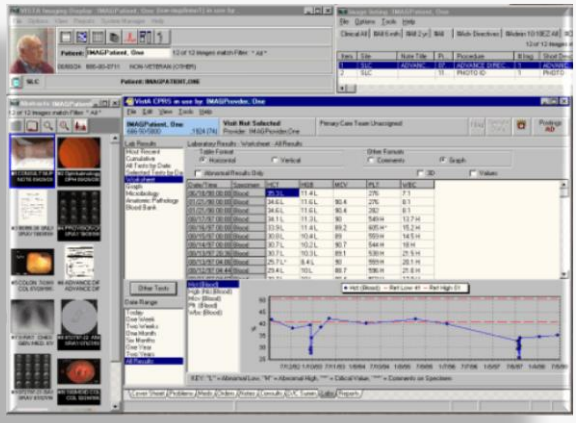
Users in many healthcare organizations currently view unplanned computer downtime as a nuisance that must be tolerated to some degree. For some leading healthcare providers, computer downtime is now being reported as a risk event with potential negative impact to patient care. The continuous availability of applications like CPOEs and automated pharmacy systems is increasingly required to ensure that patient care is not compromised. Information technology performance is becoming directly linked to the quality of patient care – if the system degrades or goes down altogether, patient care will likely suffer.

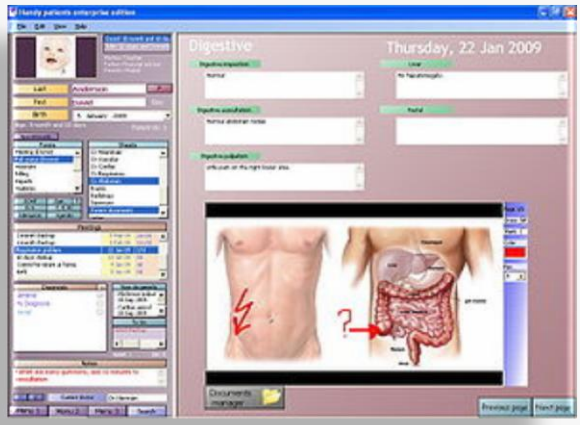
# ELECTRONIC HEALTH RECORDS

The Electronic Health Record (EHR) is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting.

Included in this information are:

- Patient demographics
- Progress notes
- Problems
- Medications
- Vital signs
- Past medical history
- Immunizations
- Laboratory data
- Radiology reports…and more.






The EHR automates and streamlines the clinician's workflow and has the ability to generate a complete record of a clinical patient encounter - as well as supporting other care-related activities directly or indirectly via interface - including evidence-based decision support, quality management and outcomes reporting.

The terms EHR, EPR and EMR (electronic medical record) are often used Inter-changeably, although a difference between them can be defined. The EMR can be defined as the legal patient record created in hospitals and ambulatory environments that is the data source for the EHR.

It is important to note that an EHR is generated and maintained within an institution, such as a hospital, integrated delivery network (IDN), clinic, or physician office, to give patients, physicians and other health care providers, employers, and payers or insurers access to a patient's medical records across facilities.

Today healthcare organizations face many challenges, including rising costs, a high number of preventable medical errors and productivity losses, due to inefficiencies and waste. Urgent industry initiatives to increase healthcare competitiveness and provide better patient care have driven healthcare organizations to integrate and rely upon technology for virtually all aspects of delivering patient healthcare.

# HEALTHCARE BACKGROUND

Every enterprise needs to continually focus on reducing errors; however, in the healthcare industry this is particularly critical because of the potential severity of an error's consequences. Illness, suffering and death may result if serious errors are made during the delivery of clinical care. As a result, healthcare has always placed a high priority on processes and procedures designed to ensure that activities involving patient care are safe.

A 1999 Institute of Medicine (IOM) report estimated that up to 98,000 people die each year in the in the United States as a result of medical errors. The report further stated that at least 70% of the errors were preventable. These findings sent shockwaves through the healthcare industry, prompting many organizations to begin applying information technology to address the crisis and ultimately transform healthcare.

Many healthcare organizations had previously deployed information technology to automate back office functions, such as accounting as well as patient management systems designed to manage patient admission, discharge and transfer. The mandate from the IOM report pointed to a new, emerging generation of computer-based patient record (CPR) systems designed to deliver accurate clinical information to the exact point of need — emergency room, examining room, operating room and so on — in a timely fashion. It is these systems, mission-critical in the most significant way, that healthcare organizations rely on to deliver high-quality digital healthcare today.

In an industry where swift access to information can literally mean the difference between life and death, end-to-end system reliability is critical. The information system must allow healthcare professionals to rapidly and accurately locate, retrieve, update and store relevant information to enable first-rate patient care decisions. It is not enough to invest in integrated clinical application suites to manage healthcare delivery; organizations must implement real-time application monitoring as well, to ensure both high availability of these systems and optimal performance.

24/7 system availability is becoming critical in the process of providing quality patient care. The complexity of integration also means that a failure of one application, for example- the laboratory system, means that physicians do not receive timely information, impacting their ability to make decisions regarding patient care. Even less-critical problems in application performance can adversely affect healthcare operations and directly affect patient care.

As the adoption of healthcare IT (HIT) solutions grows, the need to leverage new technology to better control and proactively manage the key IT systems and technology infrastructures increases. Real-time visibility into application performance, proactive alerts for potential system degradations and automated corrective actions will become required elements for effective delivery of digital healthcare.

## HEALTHCARE REFORM

Issues surrounding healthcare reform and quality of care have taken on new urgency. Expectations are high as patients, payers and policymakers demand more in terms of improving quality, lowering costs and ensuring that treatment decisions are based on the latest scientific evidence. EHRs are an integral part of virtually every ongoing quality improvement (QI) initiative, at both the health system and individual practitioner level. Indeed, the Federal Government has a goal of building the infrastructure to support a national electronic health information network based on secure, interoperable EHRs, by 2014.

Having pertinent medical information available "just in time" at key junctures in the delivery system certainly helps to appropriately monitor patient treatment protocols, coordinate care among multiple providers and avoid or eliminate medication errors.

Data from individual EHRs can be used to create electronic disease registries that make it possible to track specific patient information and characteristics over time for a defined population. These are useful in facilitating research to improve the quality of care for many chronic diseases, such as diabetes and heart failure. Although there is general agreement on their usefulness, EHRs have not been implemented on a broad basis. There are a variety of reasons for this:

- Systems can be costly to purchase and deploy.
- Until recently, there were no standards for interoperability, making communication among various proprietary systems difficult.
- Systems for managing clinical care and outcomes must be merged with the systems for handling business functions of the practice -- already in place in most small medical practices.
- Unsure of their own technology skills, many physicians are reluctant to make the necessary changes in practice patterns, although EHRs facilitate improvements in quality of care.

If physicians in small practices have good reasons for not investing in EHRs, getting them to do so is an important National goal, because a majority of patient encounters occur in small practices of four (4) physicians or fewer.

## THE MEANING OF "MEANINGFUL USE"

Totaling both private and government expenditures, the United States spends more per capita on healthcare than any other nation - in most cases by a wide margin. Yet, depending on which measures you consider, America achieves healthcare outcomes that are little, if any, better than those in other developed nations—and in some cases, they are worse.

EHR is seen as a way to reduce ongoing costs for both private and government providers of healthcare and health insurance, while simultaneously improving healthcare outcomes. Because the sometimes high costs of implementing EHRs are a major barrier to its adoption, the U.S. Government passed the Health Information Technology for Economic and Clinical Health Act (HITECH) provisions of the ARRA. HITECH authorizes incentive payments through Medicare and Medicaid to healthcare providers that adopt EHR to meet certain defined objectives.

These payments are expected to total up to $27 billion over 10 years. This translates into as much as $44,000 through Medicare and $63,750 through Medicaid, per clinician. This potential total payment of more than $100,000, per clinician will provide a strong incentive to adopt EHR. Payments are not turned over to compensate for just any investment in healthcare IT (HIT). Instead, the healthcare provider must demonstrate that "meaningful use" (MU) is being made as demonstrated by the fulfillment of the objectives mandated by HITECH.

HITECH is a staged program. The first stage includes 23 objectives for hospitals and 25 for healthcare professionals. Among these are 15 core objectives that must be achieved to qualify for the incentive payments. The core objectives are the essential building blocks of any meaningful EHR program.

Healthcare providers must also fulfill at least five of the remaining objectives within the first two years of the program in order to qualify for payments.

The HITECH objectives are not all-or-nothing requirements. For example, one objective states that the qualifying healthcare provider must record more than 50 percent of patients' data in an electronic database. Another objective requires that clinicians generate and transmit at least 40 percent of their prescriptions electronically using certified EHR technologies.

HITECH also requires that incentive recipients provide electronic reporting on the quality of care. In the first stage, clinicians will have to report data on three core quality measures— namely, blood-pressure levels, smoking status, adult weight screening and follow-up (or alternates if these measures don't apply). Further, clinicians must record electronically at least three other measures that they can choose from a list of acceptable measures.

In addition to fulfilling the mandated objectives, the implemented technologies must meet a set of standards designed to ensure that the implemented systems provide an adequate level of security, confidentiality and functionality. We will discuss those topics in the proceeding pages.

# INTRODUCTION OF EHRs

The movement in the healthcare sector to store and manage medical data electronically rather than on paper and film has been ongoing for some time. Known as EHRs, the storage of medical data on virtual, rather than physical media offers many benefits. Included among these benefits are lower costs, fewer errors and more flexibility to share medical information rapidly among authorized healthcare professionals. What's more, healthcare providers now have an even greater incentive to make aggressive use of information technologies. The American Recovery and Reinvestment Act of 2009 (ARRA) (HITECH is the addendum) offers billions of dollars in Medicare and Medicaid incentive payments to healthcare providers to partially offset the costs associated with implementing the "meaningful use" of certified healthcare-related IT products; as discussed in the previous topic.

Before adopting EHR and eliminating physical media, healthcare providers must address a serious issue associated with any electronic data—namely, data that begins its life and continues to be managed solely electronically is ethereal. If it is not backed up, it can easily be lost or destroyed, without any recourse to recover it. If business records of any type are destroyed or become unavailable for some reason, the consequences are serious enough, but the loss of health records could have serious medical repercussions, possibly including the death of a patient. Thanks to HIPAA in the United States and other legislation elsewhere, protecting data availability has been an even more stringent requirement for the IT departments of healthcare organizations than for IT departments in many other sectors. However, as healthcare providers increase their reliance on electronic-only data, in part due to the meaningful use incentives, they must be ever more vigilant in protecting data and application availability.

## THE BIRTH OF THE EHR

Healthcare providers have been providing assessments, procedures and therapies for patient care. There are several administrative processes that need to be coordinated, which result in delays in providing patient care. Healthcare providers have realized the importance of automating these administrative processes to provide appropriate care to patients in time. To automate these administrative processes, several systems have been procured from external vendors or built in-house. This automation has led to the process of capturing information related to patient care and storing them electronically. The electronic clinical record of patients helps clinicians to treat patients more effectively and accurately by providing the required information at the required time.

However, these systems catered to specialist departments and are usually best-in-class systems for the specific department, but not across an enterprise. This created a huge challenge in presenting the data in these disparate systems as a single unit. The introduction of the Integrated Healthcare Delivery Networks (IHDNs) and moving beyond the single episode of care in a single enterprise to the entire continuum of care in multiple enterprises, generated the need for availability of information as a single entity.

Economies world-wide have also started to realize the burgeoning costs of providing healthcare to its population. Several studies support the fact that the availability of correct data at the point of care reduces the patient's costs to a large extent. Real-time messaging between clinical systems did solve the problem of data being available at the right time to some extent, but it did not solve the problem of presenting data available in disparate systems as a single unit. The model of allowing clinical data to be presented as a single entity and sharing care records within an organization and between different organizations led to the birth of the EHR.

The ability to share clinical data helped decrease spiraling costs of providing healthcare. This was possible by preventing duplicate laboratory tests and by providing quick and effective treatment through easy access of the patient's clinical history. The models of sharing data to provide integrated healthcare have been envisioned by different national organizations in development and deployment of data repositories at provincial or national level, depending on the size of the country to which the organization caters.

## GOOD ISN'T GOOD ENOUGH

Traditional methods of protecting data and systems worked adequately when organizations used technology primarily to augment and accelerate paper-based, manual processes, rather than replace them. The organization backed up data to tape so that in the event of a disaster—which is a very rare occurrence—the data could be recovered from the tapes, possibly on another system at a third-party backup facility. Despite it being a far-from-ideal situation, in the event of a disaster, the manual processes sufficed until the data center could be restored from tape.

In the event of a lesser outage, such as scheduled maintenance or a recoverable hardware or software failure, because its systems did not eliminate the paper-based processes, the organization could continue to function to some degree if its systems or electronic data were unavailable briefly.

In the healthcare sector, tape-based backups might have been adequate for some back-office operations. They might have also been sufficient for some frontline treatment processes that retained paper and film records, assuming that the processes could, if necessary, revert to using those physical records. However, after eliminating the paper and film-based records and, thereby, foreclosing all options to revert to manual records processing, tape-based backups no longer suffice.

It can take hours or even days to restore a full datacenter from backup tapes. What's more, to be useful, tapes must be stored at another location so they will be unaffected by a disaster that destroys the datacenter. The time required to retrieve the tapes from their offsite location lengthens recovery times. Yet, for many patients, deferring treatment for hours or days while their records are restored would be detrimental—possibly fatally so— to their health.

# EHR BENEFITS

If the best things in life are free, either the creation and maintenance of EHR is not one of the best things in life or that saying does not apply here. Significant analysis and planning is required to ensure that the electronic medical data, and the systems supporting it, will fully meet the needs of medical practitioners and patients and that planning must also ensure that the resulting systems and processes will protect the security, privacy and availability of health data.

Beyond the cost of the planning phase, implementation typically demands the acquisition of considerable hardware and software. In addition, healthcare facilities will incur labor costs to install and configure the systems, convert existing data, and train users.

Considering all of these costs, the benefits to be derived from EHR must be substantial if there is to be an adequate return on investment (ROI). That return should not be measured solely financially, but also in the ability of the investment to improve health outcomes.

Nonetheless, despite the benefits being at least partly intangible, the investment should still be evaluated to ensure that, all costs considered, it is a wise one. The following are some of the major benefits that EHR can provide:

**• Accelerate Healthcare Delivery**

All other things being equal, providing medical care sooner, frequently yields better results. For example, reducing the time required to put a test result in the hands of the clinician who needs it, means that treatment can begin sooner, which might improve the outcome when treating a rapidly deteriorating medical condition.

Yet, paper and film—the traditional media for medical test results, images and other patient records—are slow media. They are typically transported physically. A medical chart can be faxed or scanned and emailed if necessary, but doing so requires that someone manually carry the chart to a fax machine or scanner, perform the fax or scan, and - in the case of a scan, attach the scanned file to an email and send it to the intended recipient. All of that takes time.

In contrast, test results, medical images and other health records that are created and managed electronically throughout their full lifecycle are available immediately upon creation. In addition, they can be accessed instantly whenever necessary, without the need for someone to hunt for them in filing cabinets and then manually deliver them to the medical professional who needs them. The alternative—manually filing physical documents—occasionally leads to the misfiling of documents, making them (at best) difficult to find or (at worst and more likely) irretrievable within an acceptable timeframe.

**• Simplify the Coordination of Care**

Patient care is often a team effort, with different specialists and front-line caregivers adding their contributions to the treatment program. Sharing medical records and exchanging professional opinions can be cumbersome and time-consuming if tests and diagnoses are stored in physical form. In that case, test results, images and other documents must be copied and distributed to the relevant medical professionals - or worse, the documents and images must be passed sequentially from person to person.

On the other hand, everyone who needs EHRs can access them as a matter of course, without the need to physically copy the document or image.

Furthermore, when a series of medical professionals needs to contribute sequentially to a patient's treatment, workflow software can, at the appropriate point in the prescribed sequence of events, automatically alert each professional in turn, to the need to provide his or her contribution to the patient's care. The software can also check to ensure that each task is done and, if not, remind the appropriate healthcare professional of the need for his or her services.

In addition, because it is as easy to access electronic records on the other side of the country as on the other side of a room, medical professionals can immediately access a patient's health records even when a treatment was performed in another State. For example, when a patient who lives, say, in Texas gets an emergency prescription while vacationing in North Carolina, the doctor and/or pharmacist in Texas can ensure that the prescription won't conflict with the patient's other medications—even if the patient forgets to mention those medications to the Texas doctor and pharmacist.

**• Automate the End-to-End Management of Care**
Depending on the disease or injury, a patient's treatment may stretch over a considerable period, requiring several visits to a variety of healthcare professionals and facilities. In addition, the patient may be prescribed a complex medication protocol.

When health records are maintained electronically, it becomes easy for the records to follow patients throughout the entire treatment, even when it involves different healthcare facilities and professionals and a series of pharmaceutical prescriptions.

**• Reduce Errors**
Humans make mistakes. It's inevitable. Handwriting is misread. Numbers are transposed. Documents get filed in the wrong file folder. EHR can eliminate all of these types of errors by receiving data directly from test equipment and then storing it electronically. By bar-coding sample containers, medications, and, for in-patient services, patient wristbands, EHR can also virtually eliminate many types of testing and treatment errors.

**• Reduce Costs**
Creating, filing, accessing and transporting paper- and film-based health records and images can consume considerable person-hours. Compare that to EHRs, which can be created, filed, accessed and transmitted with little or no human intervention. The labor cost savings are obvious and considerable.

Sizable savings can also be realized by eliminating the physical media itself. When records are created and stored solely electronically, it is no longer necessary to buy paper, film, or filing cabinets. Furthermore, the space that is now taken up by the filing cabinets that hold all of the paper and film records can be turned over to other purposes or vacated, thereby reducing real estate costs.

**• Eliminate the Constraints of Place**
Physical media can be in only one place at one time. To be viewed elsewhere, they must be either transported manually or digitized, faxed or scanned, and then transmitted, likely with a loss in the resolution of the image.

In contrast, EHRs are, in effect, everywhere all the time. Authorized personnel can access them wherever a secure connection is available. With today's securely encrypted Internet transmissions and new self-encrypted hard drives, that means anywhere on the planet.

## ELECTRONIC VS PAPER

**Legibility of Notes** – No more dealing with various handwriting styles since notes are typed.
**Accessibility of Charts** – Indexed and easily searchable by multiple identifiers. No more searching the entire clinic for a lost paper chart.
**Transcription Costs Savings** – Users have been able to save on transcription costs by implementing an EMR.
**Space Savings** – Users are able to save space where they'd normally be storing shelves and shelves of paper charts.
**Eliminate Staff** – This almost never happens immediately. Usually this happens through natural turnover of employees and usually occurs with your front desk or medical records staff.
**Eligibility for Pay-for-performance** – It could take some time for users to implement an EHR and implement a meaningful quality improvement mechanism that would lead to receiving payments from incentives programs.
**New Physician Recruitment** – Many new physicians are looking for practices that use an EHR and will only work for an organization that uses an EHR.
**Multiple Users Use a Chart Simultaneously** – Most EHR programs support multiple users accessing a chart at the same time. Many even allow multiple people to chart notes at the same time also.
**Lab Results Returned Automatically** – This depends on a lab interface, but is more reliable and integrated with the care given.
**X-Ray Results Returned Automatically** – This also depends on a X-ray interface, but has the same possible benefits of a lab interface.
**Save a Tree and the Environment** – You won't eliminate your use of paper, but you can significantly reduce the amount of paper/charts you use in your practice.
**Electronic Prescriptions** – Scripts sent electronically or printed out avoid problems of legibility by the pharmacy receiving the script.
**Spell check** – Many EHR software includes a spell check and often even include a medical dictionary.
**Disaster Recovery** – Depending on your EHR backup schedule, you can store a copy of your data in multiple locations for better disaster recovery. Plus, in an emergency you could carry a backup of your data with you. Think about how you would carry a room full of charts with you in an emergency.
**Drug to Drug Interaction Checking** – Most EHRs provide a database of drug to drug interactions when writing a prescription.

**Drug to Allergy Interaction Checking** – Most EHR provide a database of drug to allergy interaction checking when writing a prescription.
**Patient Safety** – Better information access, reduced gaps in communication between providers and reduction in duplicate testing.
AND….

**Quality of Care**
**Increased Efficiency**
**Better Patient Services**
**Improved Workflow**
**Improved Patient Communications**
**Improved Accuracy for Coding Evaluation and Management**
**Improved Drug Refill Capabilities**
**Improved Charge Capture**
**Improved Claim Submission Process**
**Reduced Medical Records Transportation Costs**

# SERVICE LEVEL MANAGEMENT

Today, forward-thinking organizations are taking steps to instrument and monitor entire data centers, including a diverse range of applications, servers, databases and networks to identify potential problems and avert them. Cost-effective service level management solutions are available to manage complex network systems with advanced performance and service-level management systems. Monitoring and instrumentation tools provide "service views" that provide insight into how critical business and clinical applications are performing. They also enable IT professionals to discern potential application service problems, in the making and to proactively apply corrective measures to avert application degradation or outage. The IT solutions industry terms these capabilities as core Service Level Management.

For healthcare organizations, effective infrastructure monitoring is even more critical because it can enable healthcare IT (HIT) organizations to identify potential system problems before they become actual problems and affect care delivery and patient safety. Implementing automated application service monitoring systems in a healthcare organization requires a financial commitment, but the costs of continuing to operate without them may actually end up being greater. In addition to unnecessary deaths, medical errors carry numerous secondary costs including malpractice lawsuits, financial losses and long-term damage to the organization's reputation.

Healthcare executives are tasking their IT organizations with justifying new technology by demonstrating how increased efficiency and improved communication results in bottom line payoffs. Typical investments in clinical information systems can reach into the millions of dollars for system-wide deployment of CPR systems and EHR applications – for large facilities, such as hospitals & IDNs. The return on investment (ROI) for these information systems must show how the applications address emerging business issues and provide value to the organization. To clearly demonstrate this return, IT organizations must define service levels and provide performance reports demonstrating that the systems are meeting the clinical needs of healthcare professionals.

# EHR DESIGN PRINCIPLES

This section discusses the key design principles or elements for successful development and deployment of a National Electronic Health Record.

In our view, the key capability of an HER system is its ability to generate a single patient-centric view of electronic health information showing a lifetime record. The records need to be retrieved from multiple organizations that are part of the patient's healthcare continuum. The information can vary from historical to current care data associated with the patient. The retrieved information should be presented in a consistent user interface to authorized users. The EHR should not only provide required information but also support decision making – that helps enhance the quality, safety of patient care and support delivery of healthcare effectively, without hindering the routine of the clinicians, whose main job is to provide care and not to record care information.

Figure 1, is a summary of the architectural principles that need to be followed while designing the EHR and the systems that feed the EHR.

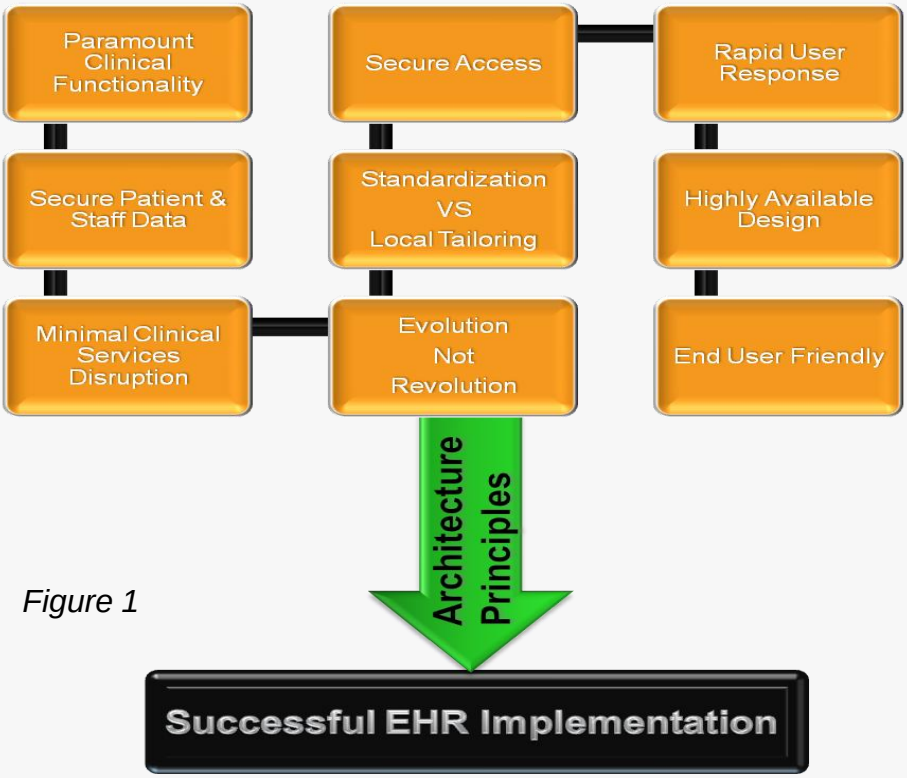



*Figure 1*

**Clinical Functionality** – The main principle that drives the success of EHR is the ability to identify the required clinical functionality within the EHR, which is required for the clinicians to enhance user acceptance of the system. User acceptance and extensive usage of the EHR depends on the importance of clinical functionality and the information maintained using that functionality. Besides this, the key requirement of EHR is to enable interoperability between EHR and the local systems used by the clinicians, which can be achieved either through interfacing (messaging) or integration.

**Information Governance** – A key requirement of EHR is to deliver robust controls and mechanisms to ensure that the shared information of patients and staff is properly protected. This requirement translates into providing application and infrastructure level security, ensuring data integrity and having a security policy design and enforcement team.

**Regulatory Compliance** – It is important that an external regulatory body functions as an accreditation agency and audits existing and future solutions that accommodate the short-term and long-term requirements of the EHR vision. This includes minimizing the duplication of services and information between different solutions which support EHR and which are a part of an EHR implementation. The regulatory body also needs to ensure that the products that feed the EHR also have a strategic long-term position in the EHR roadmap.

**Disruption** – Safeguarding and improving existing operational clinical care in a clinical setting with the introduction of EHR and not disrupting the existing services is a major driver. This can be achieved through seamless implementation of fully tested services and systems.

**User Access** – Providing user authentication and authorization systems would enable them to access the EHR and local systems securely through a common point of entry using a standard user interface such as a portal.

**High Availability and Fault Tolerance** – The EHR needs to support the retrieval and presentation of information in geographically dispersed clinical systems. This requires highly resilient infrastructure and strong business continuity processes. Besides this, it might require services hosted in a managed services environment, such as, Data Centers that can be managed by groups of consortia led by healthcare vendors, infrastructure vendors and system integrators.

**Fast Responses** – Users need to quickly access EHR to enable fast and efficient treatment of patients. Therefore, it is very important that the EHR system provides fast responses to the user.

**Flexibility to Adapt** – It is crucial to provide a modular system for different clinical domains within the EHR system as advances in a particular branch of medicine can be easily and rapidly adapted to meet the changing requirements.

**Revo-evolutionary Approach** - This approach will combine the innovation of revolutionary development with the controlled development of evolutionary design to develop the solution, without the need for major change, towards delivering the EHR requirements.

**Standardization vs. Local Tailoring** – In complex system environments, those solutions that form the building blocks of EHR should address the balance between rich standardized functionality and local tailor-ability for organizations and provinces in conjunction with local user focus groups.

**Conformance to National and International Standards** – The EHR should not only meet the standards defined by regulatory agencies but should also meet the requirements mandated by international organizations, such as the World Health Organization (WHO).

The above-mentioned design principles are important for the successful implementation of EHR. But, developers and deployers of EHR should be aware that the existing healthcare applications that form the basis for EHR by interfacing or integrating might not be built on the above principles. In such a scenario, the products which might be suitable to form the building blocks of EHR need to be embraced while those that are not suitable need to be replaced through the double R architectural policy of “Reuse and Replace”.

**Reuse** - Existing clinical systems that will endure - which are accepted by the health communities, but need minor modification in the clinical functionality and will be able to adopt new standards - should be allowed to become building block of EHR. These systems should be accredited in accordance with standards defined by the regulatory Agencies, which is responsible for the deployment of EHR.

**Replace** - Existing clinical systems that will not endure - which are not accepted by the health communities, cannot provide required healthcare functionality, and cannot be modified to adopt standards defined by regulatory agencies -should be phased out and replaced by newer solutions. *(see page 27 for Standards)*

In this section, we describe the architectural patterns of the two (2) most popular EHR models.

## CENTRAL REPOSITORY MODEL

The center of EHR model will be the repository, which will be fed by the existing applications in different care locations such as hospitals, clinics and family physician practices. The feed from these applications will be messaging based on the pre-agreed data set. The messaging needs to be based on HL7 (see Page 27).Reference Information Model (RIM) for which XML is used as the recommended Implementation Technology Specification (ITS). We observed that regulatory agencies of several countries are taking an active role in speeding up the balloting process of HL7 V3.0 so that an open system messaging standard is available.

Below  (Figure 2) is a graphical representation of the central repository model.

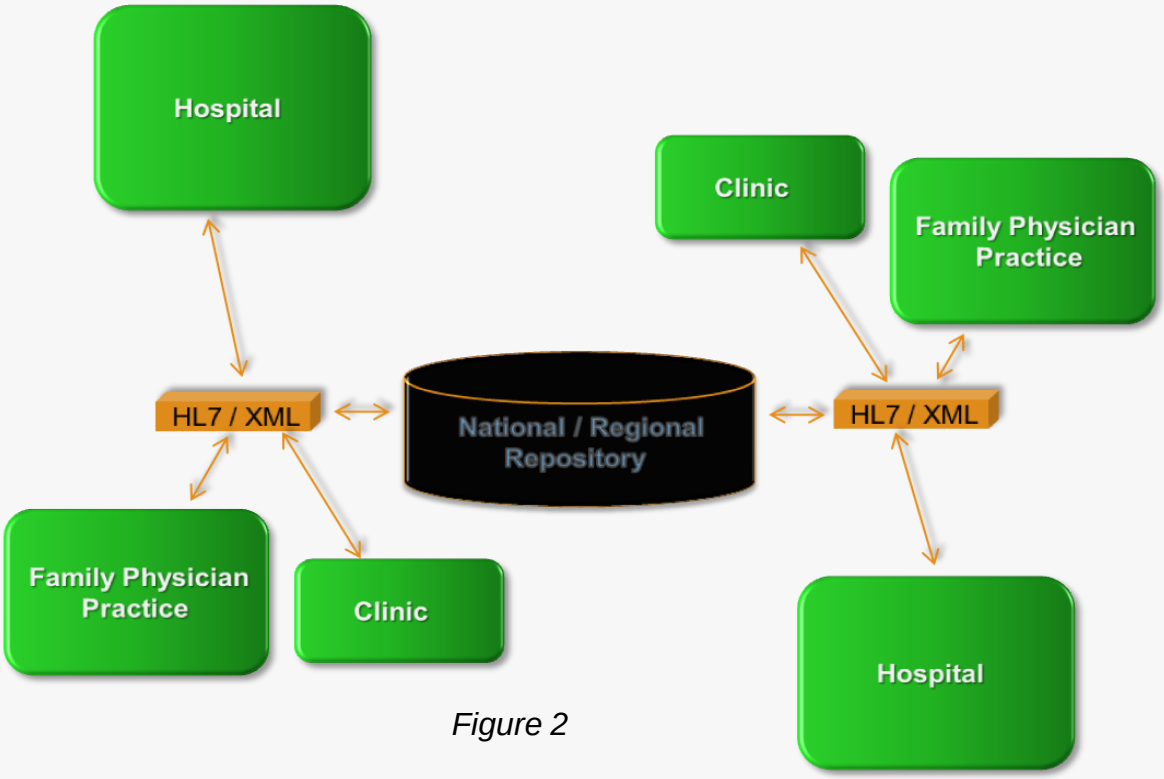



*Figure 2*

The technical feasibility of this solution depends on designing a repository, which can be populated based on the messages generated across the care continuum. Integration hubs need to be provided in different regions to receive the messages and route to the repository, where data will be stored for future retrieval and usage. The data will be retrieved using the XML queries. The Integration hubs need to perform validation and verification of messages sent by different applications and perform further rule-based processing. The messages need to be sent over secure channels of communication through a high speed dedicated network or alternatively through secure encryption and decryption mechanisms to the repository.

The event-driven messages that need to be sent and stored in the repository will essentially be event-based summaries as shown in Figure 3. The event-based summaries stored in the repository can be queried and retrieved by different clinicians who are treating the patients in different scenarios and by different clinical settings where the patient's previous clinical data and history does not exist. The retrieval and access of data from the repository is subject to establishing that the clinicians are legitimately accessing the data for treating only those patients who are in their care. The retrieval is done through messaging, which can be done either through synchronous or asynchronous messages depending on the urgency, complexity and importance of the data that is being retrieved. The technologies used for messaging can be SOAP Web services and XML, as dictated by HL7 transport specifications for V3.0.

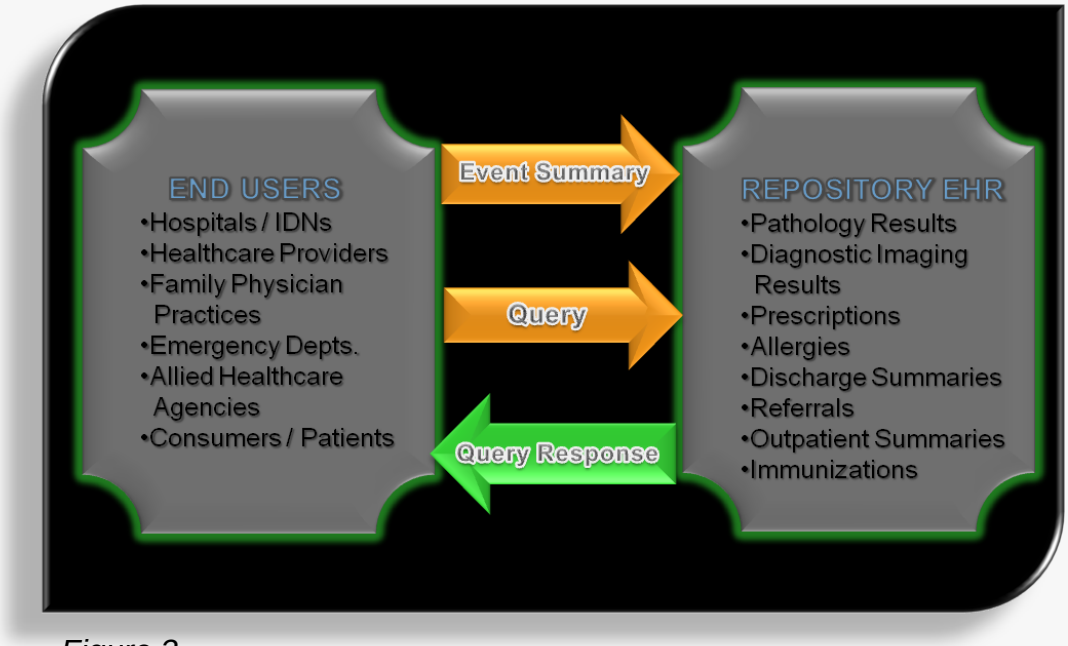



*Figure 3*

The query for the patient's data from the repository can be initiated from point of care applications used in the clinical settings. This is done after completing the authentication and authorization process, which is performed through security services provided as part of the repository. The security services can be provided through security middleware products for managing presentation of user credentials held in a central directory server, hosted as part of the repository. For quick access, the user credentials from this central directory can be cached in a local Lightweight Development Application Protocol (LDAP) services directory. A user management product can be deployed directly into applications to manage the provisioning of user accounts from the LDAP (where direct integration with LDAP is not supported) so that user account creation and removal is automated and auditable. Figure 4 shows the architecture to support this approach.

Applications can also be built around the repository so that sites without any IT infrastructure can access the data from the repository and enter data directly into the repository by using a user interface provided by these built applications.

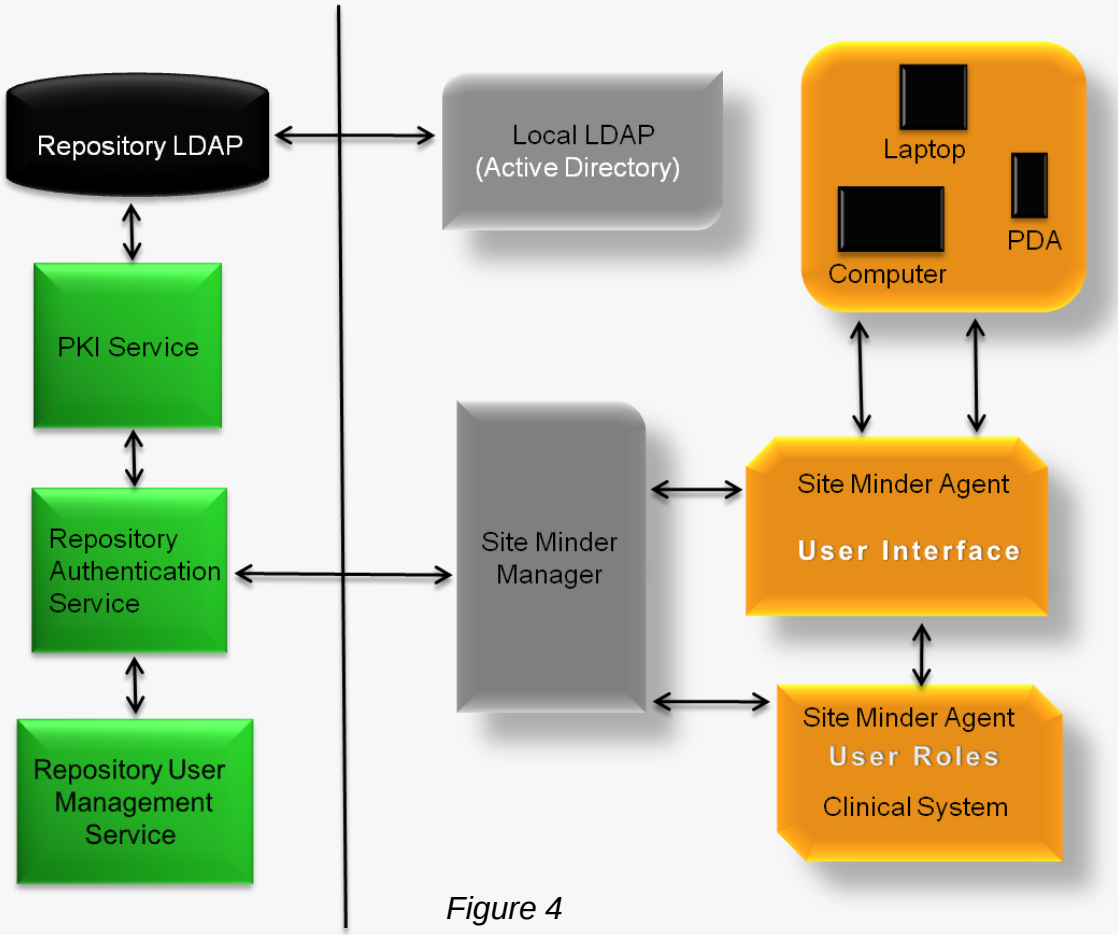



*Figure 4*

## MANAGED SERVICES MODEL

The managed / shared services model is based on hosting applications for different care providers and care settings in a data center by a consortium, which may consist of group of infrastructure providers, system integrators and application providers. The hosted applications can be used to provide an effective EHR by building a common repository using a shared database or by providing a common user interface to all hosted applications and extracting data from these systems using a portal whose authentication and authorization mechanism can also be controlled at the data center level as shown in Figure 5.

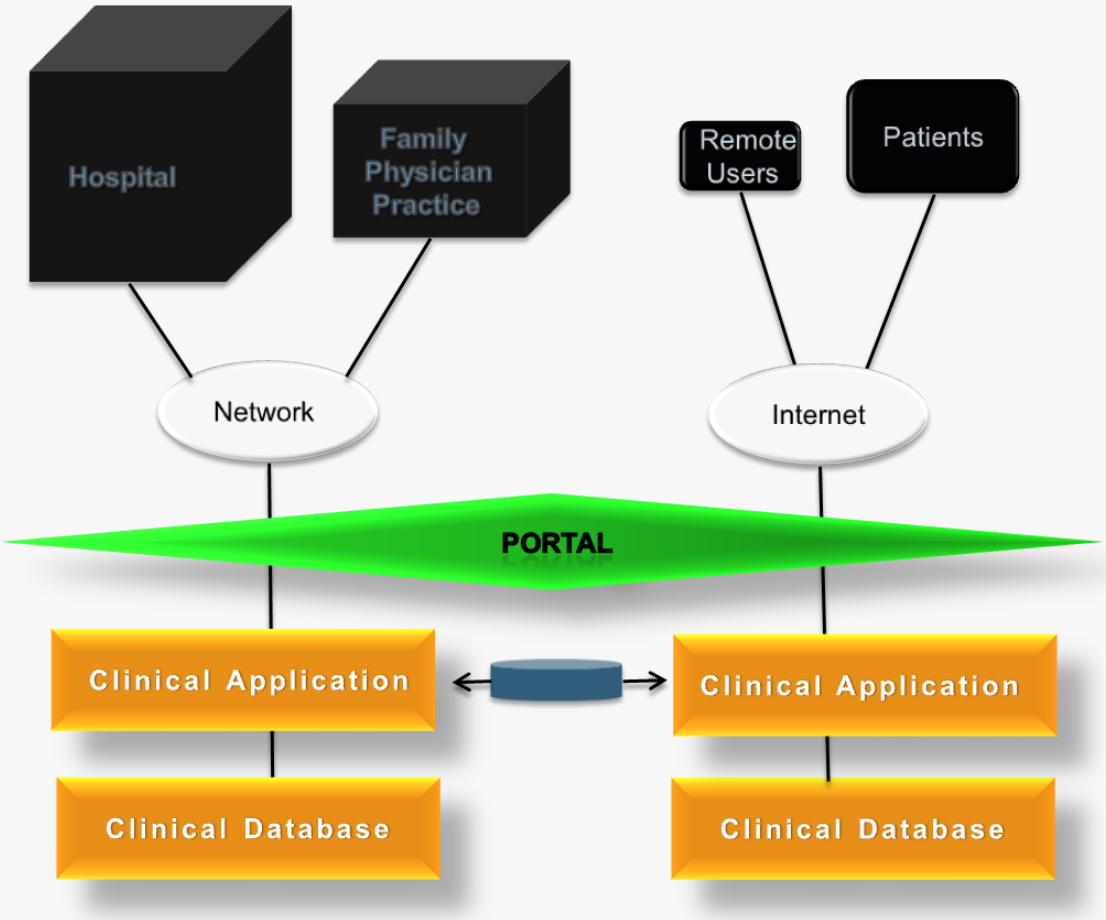



*Figure 5*

## WEB SERVICES MODEL

This model will help hospitals and medical establishments to forget about their everyday IT needs and allow them to share the records effectively in different regions. The effective consolidation of applications for different care providers for a region in a single place will allow other regions with a similar model to quickly access the required data about a patient. This can be done by providing access to the patient's data through the portal over the Internet or by allowing some sort of integration between different regional managed centers.

The information governance issues associated with this model can be sorted out using the authentication and authorization model suggested in the central repository model. The managed services model  will provide access to detailed records that are not supported by the central repository model, as it can provide access to only the summary records of the patient.

Service Oriented Architecture's Enterprise “Service Bus” approach allows these different regional managed centers to be accessed through a portal on the Internet or even through programmatic access using protocols, such as Web services as shown in Figure 6.

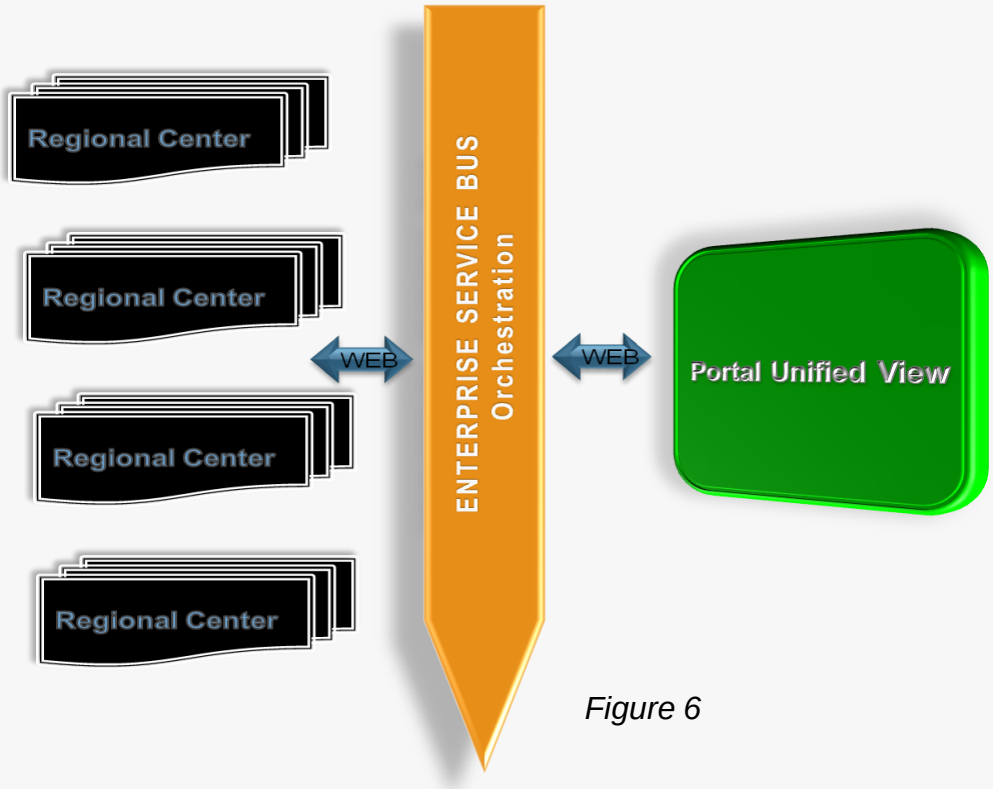



*Figure 6*

Information and communication technologies are increasingly becoming integral part of inpatient, outpatient and administrative areas of healthcare. The speed of technological advances stands in contrast to the requirement for a reliable, long-term and easy access of clinical data. EHR provides easy access of clinical data. However, successful deployment of EHR depends on maturity of standards used.

The healthcare sector is distributed and unstructured. Therefore, the standardization of interfaces from the conception level down to the technical levels is of great importance. The interoperability standards that form the basis of an Electronic Health Record must support the secure storage and exchange of useful and clearly understandable health information with appropriate secure access by authorized people. The most important standards that are of relevance to EHR are related to messaging, data dictionaries and clinical terminology.

## HL7

Health Level Seven (HL7), is an all-volunteer, non-profit organization involved in development of international healthcare informatics interoperability standards. HL7 is also used to refer to some of the specific standards created by the organization (e.g., HL7 v2.x, v3.0, HL7 RIM).

HL7 and its members provide a framework (and related standards) for the exchange, integration, sharing and retrieval of electronic health information. v2.x of the standards, which support clinical practice and the management, delivery and evaluation of health services, are the most commonly used in the world.

"Level Seven" refers to the seventh level of the International Organization for Standardization (ISO) seven-layer communications model for Open Systems Interconnection (OSI) - the application level. The application level interfaces directly to and performs common application services for the application processes. Although, other protocols have largely superseded it, the OSI model remains valuable as a place to begin the study of network architecture.

## HL7 MISSION

The  HL7 Mission is to create the best and most widely used standards in healthcare. HL7 provides standards for interoperability that improve care delivery, optimize workflow, reduce ambiguity and enhance knowledge transfer among all of our stakeholders, including healthcare providers, government agencies, the vendor community, fellow SDOs and patients. All of the processes exhibit timeliness, scientific rigor and technical expertise without compromising transparency, accountability, practicality or our willingness to put the needs of the stakeholders first.

Derived from collaborative efforts with members, government and non-government agencies and other standards development organizations, the Strategic Initiatives are comprised of five high-level organizational strategies that are supported by a detailed tactical plan with clearly defined objectives, milestones and metrics for success.

## MESSAGING

A number of organizations in the healthcare sector have clinical messaging for interoperability of clinical applications in their individual settings. However, the sites that were planning or had implemented clinical messaging within the organization had no National standards and had defined their own message sets. If this continues in future, then it will not be possible to attain interoperability across organizations and between EHR components. Therefore, it is important that we standardize clinical messaging of all the necessary message types.

Message definition proposals should come from existing suppliers as well as from the existing regulatory organizations. At the moment, suppliers have no route to influencing what standards are put in place (and when) to fill gaps that are present. Involvement of suppliers in defining the message standards along with regulatory organizations responsible for deployment of EHR will allow the suppliers to fill in the gaps in their applications. Organizations that have some message standards have some advantages over organizations that do not. If some message standards are subsequently found to be incomplete or incorrect, they can be revised over a period of time. Accreditation is a way to ensure that systems comply with the required set of message standards.

We have identified that HL7 v2.x is used in a number of sites for interfacing between source systems but, due to difficulties with HL7v2.x, it was identified that it cannot be used for integrating source systems with EHR. HL7 v3 can be used as a strategic messaging standard for interfacing source systems with EHR and it is gaining greater support from suppliers worldwide. Some stability and standardization issues have arisen with the use of HL7 v3, but it is recommended to consider it as a mechanism for interfacing source systems with EHR. The use of HL7 v3 to interface source systems with EHR need not preclude the use of other messaging standards in interfacing of EHR if a National messaging standard (e.g. HL7 CDA) is already in place.

## DATA DICTIONARIES

Many organizations use different data dictionaries which are more oriented towards base data types and administrative information and does not meet the needs for clinical data standards, message sets or existing National dataset definitions. Many sites have created their own standards. Implementations of National datasets are important for creating a mechanism that will help to deliver the National plan of an EHR.

There are a variety of dictionaries existing today, mainly standard drug dictionaries used across different care settings in addition to locally defined formularies. We need to improve methods of representing medications within EHR to cope with this variance. A common representation for medications should be one of the important goals of implementation of an EHR.

## CLINICAL CODING

The regulatory agency as part of EHR compliance should ensure that initial EHR information requirements are grounded in what is possible with current coding schemes. Currently different clinical settings have widespread usage of local codes and different existing coding mechanisms such as OPCS-4, ICD, etc. The use of different coding mechanisms make it difficult to perform grouping operations on clinical events and show a summary of the health record of the patient, which is the main goal of EHR.

Standards such as SNOMED, are too ambitious in their scope and actually difficult to implement and map to the realities of the domain. Standard terminology and nomenclature, standard message sets, sets of valid values, reference masters and standard ways of expressing schemas or a subset of it need to be defined by the involved regulatory for use by multiple providers in multiple heterogeneous systems to bring uniformity in recording and presenting data.

Although, there are no easy ready-made solutions to overcome this variance in coding mechanism, we should have accreditation standards that progressively "raise the bar" on what suppliers must achieve, year-by-year. As it might be counter-productive to insist on a mandatory support of an existing standard such as SNOMED CT, consideration must be given to have a phased implementation of standard coding mechanism for only procedures and diagnosis in initial stages.

# EHR CERTIFICATIONS

In order for eligible professionals (EPs), clinics, hospitals and Integrated Delivery Networks (IDNs) to receive meaningful use incentive funds, EHRs **must** be certified, per regulations put forth by the Office of the National Coordinator for Health Information Technology (ONCHIT) or (ONC).

Currently, ONC recognizes a variety of Authorized Testing and Certification Bodies (ATCBs) eligible to test for and designate that EHRs are certified for meaningful use quality reporting. These ONC-ATCBs are the only organizations which can designate that an EHR is certified for meaningful use incentive capture.

## ONC-ATCB

The meaningful use Final Rule established a temporary certification process that will transition into permanent certification status in 2012. That means that current ONC-ATCB 2011/2012 certification for meaningful use coincides with the Stage 1 meaningful use reporting criteria.

After that time period, increased reporting standards will commence as Stage 2 and then Stage 3 meaningful use criteria, still backed by ongoing incentive funding. In terms of reporting criteria, the current Stage 1 requirements are divided into core and menu items. With the commencement of Stage 2 - all Stage 1 menu items are projected to become core criteria, as new criteria is also added and another round of certification keeps pace.

The ONC plans to sunset temporary certification on December 31, 2011, to allow permanent certification (completely administered by private entities already designated by The ONC as certification testing bodies) to take over the process without The ONC oversight.

The Final Rule emphasizes that The ONC plans to continue to work closely with the National Institute of Standards and Technology (NIST) to formulate the tenets of ongoing reporting criteria and certification.

## CCHIT CERTIFICATION

CCHIT® has been recognized by the U.S. Department of Health and Human Services (HHS) as an Authorized Testing and Certification Body (ONC-ATCB) for the purposes of certifying that EHRs are capable of meeting the government developed criteria to support meaningful use.

The Certification Commission for Health Information Technology (CCHIT) is an independent, nonprofit organization with the public mission of accelerating the adoption of robust, interoperable health information technology. The Commission has been certifying electronic health record technology since 2006 and is approved by the U.S. Department of Health and Human Services (HHS) as an ONC-ATCB. The CCHIT

Certified program is an independently developed certification that includes a rigorous inspection of an EHR's integrated functionality, interoperability and security using criteria developed by CCHIT's broadly representative, expert work groups. These products may also be certified in the ONC-ATCB certification program.

## CCHIT GOALS

- Reduce the risk of Healthcare Information Technology (HIT) investment by physicians and other providers
- Ensure interoperability (compatibility) of HIT products
- Assure payers and purchasers providing incentives for EHR adoption that the ROI will be improved quality
- Protect the privacy of patients' personal health information

# EHR SUMMARY

EHR plays a huge role in providing a single longitudinal view of patient record. Sound architectural principles and usage of uniform standards through regulatory agencies will ensure successful deployment of EHR.

EHR can streamline hospital administration, enable better and faster patient-centered care, reduce errors and help to lower healthcare costs. Because of these benefits, the adoption of EHR by healthcare practitioners and facilities has been growing. The introduction of government-sponsored financial incentives for the meaningful use (MU) of EHR is accelerating this trend.

The benefits justify the introduction of EHR, but the conversion to EHR is not worry-free unless adequate precautions are taken. After eliminating physical stores of paper and film based records, it becomes essential to safeguard the continuous, immediate availability of electronic records in order to ensure the ongoing provision of timely, effective medical care.

Yet, system downtime—whether planned or unplanned—is unavoidable and, given enough time, the corruption or accidental destruction of some data may be inevitable. Thus, healthcare facilities that replace physical records with EHR must implement a full-spectrum solution to protect data and application availability. That solution should include disaster recovery, high availability and Continuous Data Protection to safe-guard against all threats to the availability of critical health information.

SUCCOR CONSULTING GROUP

www.MySuccor.com