Electronic Health Records:

A Global Perspective

A Work Product of the

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EXECUTIVE SUMMARY

Healthcare information technology (IT) is a sleeping giant. Although healthcare budgets contribute to the bulk of worldwide industrialized government spending, healthcare IT lags far behind the technological capabilities of other global businesses including banking, telecommunications and the media.

The HIMSS Global Enterprise Task Force (GETF) was asked to investigate efforts to implement the electronic health record (EHR) in a host of countries around the world. GETF looked at a battery of electronic health record (EHR) components within each country, including security, quality, financing sources and barriers to adoption. Four common threads that affect EHR implementation and produce a kinship between every effort around the globe were identified:

- Funding
- Governance
- Standardization and interoperability
- Communication

Local and nationwide efforts to realize EHR systems were intermittently reported in all the countries we studied. When analyzing these efforts, the common threads listed above helped to explain the success, barriers or implementation failures experienced in each country.

The need for this analysis is readily apparent. It allows us to harness the strength of the information and then deploy it to key decision makers in any of the countries studied to help in their efforts to build a successful EHR system. The information gathered here over many months from some of each country's leading experts can be used to predict the future success of efforts in the U.S. to embed IT into the world of healthcare, whether these efforts are local, regional, national or globally implemented.

In the final analysis, we explain how the U.S. lags can benefit in the implementation of standardized and interoperable EHRs, and how we can avoid some of the mistakes while capitalizing on the successes of other countries' efforts.

As shown in the following chapters on each country studied, we focused on each nation's overall healthcare system, their IT status and strategies, national or regional approaches, connectivity issues, standards and stages of implementation. We also reviewed the critical factors of governance, funding, public policy, and legal and regulatory issues that affect the success of EHR adoption in each of these countries. As expected, these are all key indicators that determine where the U.S. stands in comparison with other countries.

Funding

Funding for healthcare IT can be through national or local governments, the private sector or combinations of both. For example, Canada Health Infoway—an independent not-for-profit corporation—leads the national effort with all 14 federal, provincial and territorial governments as shareholders. By 2007, the government of Canada had invested $1.6 billion CAD in *Infoway*. By March, 2008, *Infoway* had committed nearly than $1.5 billion CAD in co-investment within the jurisdictions.

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Australia's national approach combines both centralized and decentralized components in order to create interoperable electronic health information and this infrastructure. Building on their experience from Health*Connect*, the Council of Australian Governments created the National E-Health Transition Authority (NEHTA). NEHTA is a not-for-profit company limited by guarantee and jointly funded by all state, territorial and national governments. To date, NEHTA has received $160 AUD million in funding.

England has led the world in its willingness to invest in information technology for healthcare. The National Programme for IT (NPfIT) was initiated in 2003 and was originally budgeted to be £6.0 billion over 10 years, but the National Audit Office estimates the figure to be £12.4bn over 10 years and other officials have been recently quoted in papers as estimating the figure to be close to £20.0 billion. The investment is intended to deliver a number of major initiatives that will enable the envisioned EHR (e.g., new network infrastructure) as well as national applications that will utilize the EHR (e.g., electronic transfer of prescriptions, electronic outpatient scheduling). The EHR portion of the program is called the Care Record Service and it includes three components: Personal Demographics Service (PDS), Summary Care Record (patient's clinical information, such as allergies and adverse reactions to medicine), Secondary Uses Service (SUS), which uses data from patient records to provide anonymised and pseudonymised business reports and statistics for research, planning and public health delivery.

In Wales, funding is highly leveraged through the nationally agreed concept of "common by design." This enables incremental development of national EHR capabilities and encourages local investments for the national benefit. One Trust has been developing the clinical portal while another is establishing funding programs for local EHR deployment. The "Informing Healthcare Program" (IHC) provides the overarching vision and architecture as well as creating the standards for privacy policy, security and interoperability. By design, these components will converge into a national solution that will be deployed across all Trusts.

EHR funding in South Africa, Sweden, Germany, France and the Netherlands continues to be a problem in many countries due to the significant cost of implementation. However, each country is moving forward with plans for appropriate funding. All are providing government funding to support committees that are developing EHR strategies for a national system. Sweden, France and South Africa have already moved toward a government-funded national system while the Netherlands has not yet formally committed to this model and Germany avoids direct government interaction into its healthcare system.

Other countries are at an earlier stage in EHR development and are making progress, despite the lack of a formal national program. Japan, for example, currently does not have a government-centered EHR; however, some local, regional and single hospitals have installed digital patient records and share data between hospitals, clinics and patients. Norway is conducting research that is expected to lead to a national EHR program. The Research Council of Norway awarded Norwegian University of Science and Technology (NTNU) a contract to establish The Norwegian Electronic Health Record Research Centre (NSEP).

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Like Japan, Israel does not have a national EHR program. Implementations, however, are widespread in both the public and private sectors, driven by both the need for excellence in healthcare and competition. In a survey of 26 general hospitals in Israel, 21 of them (91.3 percent) use electronic medical record (EMR) systems.

India, Singapore and the U.S. depend mainly of funding from the private sectors. India has one of the fastest-growing IT healthcare sectors in the world. Much of it, however, is for export and there is still great disparity in healthcare delivery and use of IT systems between wealthy cities and poor rural communities. With medical tourism increasing in popularity, India's private sector is driving EHR implementation as the result of a hypercompetitive market.

Governance

Strategic national leadership and governance leads to better plans for interoperability; yet even with these national attempts in place, barriers are difficult to surmount. Germany, for example, has a distributed strategy model, but their hospitals compete against each other for patients and services. This does not lend itself to an organized integrated solution.

Unlike other countries, the U.S. has been slow to direct EHR development through a federal structure relying instead on efforts within the private sector. For example, funding from the Office of the National Coordinator for Health Information Technology (ONC) has been issued in the form of grants awarded to collaborative groups of stakeholders within the private sector to help develop a national EHR infrastructure.

Standards and Interoperability

All countries suffer from a lack of healthcare IT standards creating interoperability barriers for healthcare IT adoption at local and national levels.

France, Sweden, the Netherlands and other countries are attempting to standardize EHRs either through their own national standards or by using a variation of the Health Level Seven (HL7) standard so that interoperability can also occur between their countries. Denmark, Norway and Sweden already collaborate in the exchange of electronic health information.

South Africa is in the process of selecting an EHR vendor utilizing a request for information (RFI) process. Depending on the system selected, there should be interoperability through the use of global industry standards such as HL7 and DICOM (Digital Imaging and Communications in Medicine) that have been used in the healthcare IT market for years.

Israel has at least 27 different types of systems in use in Israeli hospitals, with more than one type generally used in any given hospital. In more than 98 percent of hospital departments, physicians now use EHR systems. In addition, more than 90 percent of hospital departments use EHR systems for clinical admissions and discharges, and 45 percent of them use it daily for follow-up and progress notes.

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Hospitals in Japan started to utilize computerized practitioner order entry (CPOE) systems in the early 1980s and it is now widely used. The installation of EHR systems, including medical digital imaging reference functions, continues to increase within hospitals and clinics. However, data is still not easily shared between hospitals.

Interoperability of England's EHR program (National Programme for IT; NPfIT) is based on messaging services using HL7 v3 RIM and enabled by standards such as SNOMED CT and Clinical Document Architecture (CDA).

Canada created a national framework, the EHR Solution Blueprint, to guide the development of an interoperable EHR across all jurisdictions, with each jurisdiction allowed to determine its own implementation strategy**.** Like Germany, Canada developed national consensus for a distributed model approach; health data comes from different operational applications in any given jurisdiction. In Canada, data is replicated into the interoperable Electronic Health Record (iEHR) via the Electronic Health Record Infostructure (EHRi). In this model, the pan-Canadian EHR consists of many EHRs resulting in a peer-to-peer network of message-based interoperable EHRs deployed across Canada.

To maintain its focus on interoperability and standardization, Canada Health *Infoway* uses the EHR Solution Blueprint to define how standards, including nomenclature and messaging, are used to ensure semantic interoperability. The Blueprint is a flexible business and technical design framework that allows solutions, components and best practices developed in one jurisdiction to be reused in another. It ensures that all EHR solutions can seamlessly and securely exchange patient health information. *Infoway* has also created a Canada-wide effort, the *Infoway* Standards Collaborative, to support and sustain health information standards. Nine specific pan-Canadian Standards Groups contribute, review, validate and harmonize standards in support of the nine *Infoway* Programs (Registries, Infostructure, Laboratory Information Systems, Diagnostic Imaging Systems and PACS, Drug Information Systems, Interoperable EHR Systems, Telehealth, Public Heath Surveillance, and Innovation and Adoption). The predominant standards used to support semantic interoperability between the EHRs, and between EHRs and point of service systems are HL7 v3, DICOM, LOINC and SNOMED CT.

In the U.S., regional and jurisdictional efforts to promote EHRs have emerged in the form of Regional Health Information Organizations (RHIOs). Unlike Canada's coordination on a national scale, America's RHIOs have struggled to achieve government and other stakeholder support and funding as independent organizations. Of the more than one hundred RHIOs started across the country, only a handful has succeeded in exchanging electronic data.

In Australia, NEHTA's mission is to set the standard, specification and infrastructure requirements for secure, interoperable electronic health information systems. The Australian, state and territory governments then adopt these standards into their own e-health systems. A national interoperability framework (IF) has been developed for e-health systems. Within this framework, EHR design principles are being established for shared use by authorized clinicians and consumers. The IF is seen as a way of aligning various enterprise and solution architecture activities. Nomenclature and messaging standards are being reviewed, validated and developed if necessary to fit the Australian context. National directories are also being created to accurately identify medicines,

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medical products, devices and consumables. Lastly, NEHTA is using a centralized approach to patient and user identification with unique personal and provider identifiers being planned at the national level. This common national approach will set the necessary foundations for the widespread and rapid adoption of e-health across the national health sector.

Communication

Perhaps the greatest barrier to creating interoperable standards in healthcare IT is the gap in communication that exists between and within countries. Whether coordinated and funded by the national government or "boot-strapped" by local agencies, a failure to communicate activities within a country can lead to implementation failures. Some countries have focused their efforts on thorough and continual communications to guide EHR implementation. For example, the Canadian effort emphasizes communication with stakeholders and inter-jurisdictional collaboration enhanced by knowledge sharing. To this end, *Infoway* created the *E-Health Knowledge Way* – a gateway to English and French language resources for all topics related to the implementation of the EHR. This includes pan-Canadian forums and toolkits for implementation with most of the information available worldwide.

HIMSS, as the worlds' leading organization in healthcare IT, can be instrumental in linking communication and promoting EHR efforts within and between the countries of the world.

U.S. Efforts

When compared to some countries, the U.S. seems to fall behind in many distinct and important categories of EHR implementation. The U.K., Australia, New Zealand, Denmark and Canada already have standards that are agreed upon and mandated by national or private entities; funding via national sources or a mix of private and public funds; and good communication between vendors and systems (e.g., interoperable systems). The U.S., on the other hand, is still working towards developing its standards. This is complicated by the fact that there are so many vendors to choose from as compared to other nations. Although this tends to widen the gap in standards, functionality and usability, the Certification Commission for Health Information Technology (CCHIT) is focused on standardizing functionality and the Health Information Technology Standards Panel (HITSP) is focused on developing standards for interoperability.

The U.S. government has introduced legislation to support implementation of EHRs. The U.S. government is providing funding for healthcare IT/EHR via grants from ONC and grants to the states and they are significant.

Communications between vendor systems in the U.S. are both complex and not standardized, even in the face of "standard" messaging and indexing such as HL7 and the Systematized Nomenclature of Medicine Clinical Terms (SNOMED). Systems still require interfacing between disparate proprietary codes and data repositories before they can be useful to the larger provider, payor and patient/consumer communities.

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As in all other countries, security and privacy are high level issues in the U.S. Information about health is sensitive and can be safeguarded in systems with appropriate security mechanisms far better than paper charts. As a community, having an EHR record for every patient can improve both quality and safety.

At a minimum, in order for the U.S. to successfully deploy a national, interoperable EHR system, it first needs to mandate those standards, find adequate funding sources, establish governance structures that limit the bureaucracy that currently exists, and implement clear and consistent communications to all key stakeholders. All the efforts underway to rectify these problems cannot be accomplished through the patchwork of varying organizations that exist today. Effective healthcare IT should be no different from technology in banking, retail or other industries.

The Future

Driven by the internal need for better and more cost-effective healthcare, EHRs will become standard in all developed and developing countries of the world

In nearly every nation, government mandates, initiatives, incentives and funding drive the adoption of a national healthcare IT system. In other countries, including the U.S., IT adoption will depend on a combination of government support and competition within the private healthcare sector.

The major barrier to EHR adoption, from the top government level down to the private sector, is cost. Most healthcare organizations struggle with the high cost of hardware, software and communications systems. Although not likely to disappear completely, a "software-as-a-service" model, wider use of IT, new entrants into the market and improved technology will drive down the costs associated with implementing EHR systems.

In addition to cost, fear of technology and change will continue to hamper EHR adoption at the clinical user level. Over time, continued education, trust, security, standardization, improved functionality and usability, and growing familiarity with healthcare IT will ameliorate these fears.

In most countries, a national approach to EHR adoption will be from the top-down, an approach that works best in a system where there is a single payor such as the federal government. In countries where the national government takes a more passive role in healthcare IT, grass roots promotion from multiple stakeholders will be necessary. In either case, providing incentives to healthcare organizations and providers will be of paramount importance in their adoption of EHR systems.

Reference

Reuters World Report. Jan 9, 2008-02-03.

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OVERVIEW OF TASK FORCE AND WHITE PAPER

Audience

The intended audience for this white paper includes all industry leaders and other stakeholders in the healthcare industry, including:

- Chief information officers, chief technology officers, chief architects, procurement executives and chief medical officers
- Pharmacy benefits managers and mail order pharmacy organizations
- Researchers and scientists for patient safety, privacy and research
- Software developers
- Clinicians
- Payors from both the private and public sectors of healthcare
- Patients

HIMSS Global Enterprise Task Force

Chartered in 2006 under the auspices of the HIMSS Enterprise Information Steering Committee, industry leaders from around the world joined the GETF to examine global electronic record programs and to promote knowledge sharing across borders.

The objectives of the GETF are:

1. To identify and describe significant healthcare information solution efforts being pursued in one or more industrialized nations.
2. To identify those aspects of a solution that differ from one nation to another and to determine, through Return on Investment (ROI) in finance and quality, which represent best practices.
3. To identify the common threads in national EHR adoptions that led to success or failure and then open communications between all stakeholders.
4. To incorporate best practices into a road map for the development of a successful solution in the U.S. and to avoid the pitfalls that have had negative impact in other countries.
5. To understand the funding, architecture, and delivery systems of solutions in other countries, including network models and central versus local data repositories and then determine their U.S. applicability.

Many geographies are of interest; however, this first edition is focused on the geographies where participating members live and work or locations where members previously worked on or managed part of the EHR program. Additional geographies will be addressed in future white paper editions.

Collectively, the membership has expert knowledge of the design, implementation, maintenance and support of EHR systems in numerous countries around the globe. They represent various stakeholder groups from government as well as the public and private

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sectors, including healthcare payors and clinical caregivers. Wherever possible, findings in each country were validated by third parties.

In order to identify the commonalities, best practices and barriers within and between countries, the GETF examined each of the following topics.

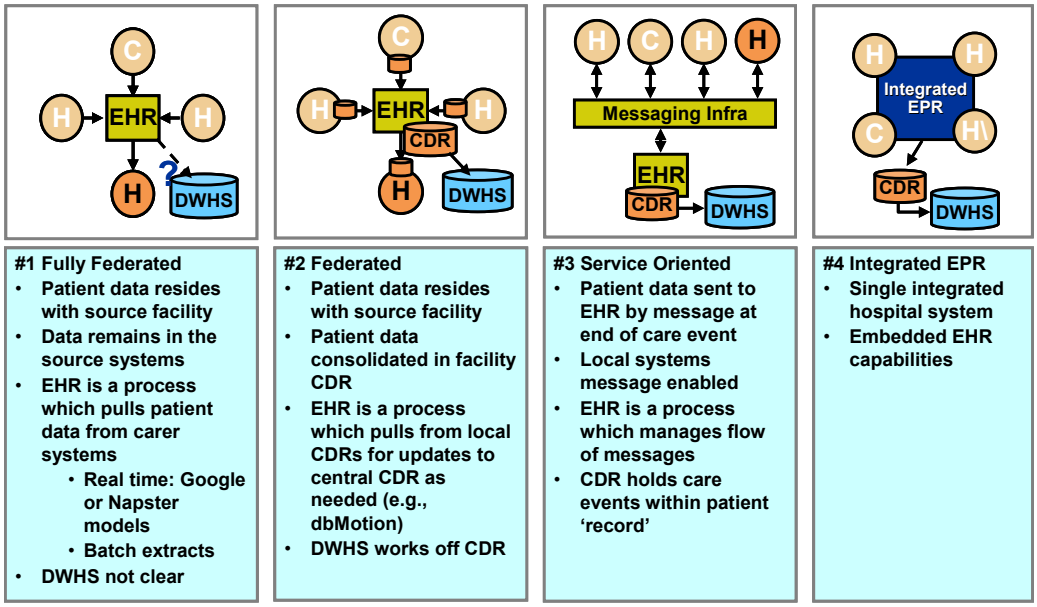
National EHR Program

National IT/ICT Status & Strategy

This section describes existing IT/ICT status and strategy for the future implementation of a national EHR system. It addresses the extent to which primary care providers (PCPs) have access to and utilize patient information systems (IS), the availability of broadband and high speed Internet services to assist those systems, the current deployment of IT across all healthcare provider communities, the current connectivity between healthcare providers and payors (national and private) and what standards have been implemented to promote the exchange of data.

National/Regional EHR Approach

This section describes how the country approached acceptance, adoption, deployment, operation and support of a national EHR and health information exchange (HIE) system. We have explored a variety of architectural models for the delivery of EMR/EHR and data warehouse solutions in healthcare business around the world. The following diagrams and descriptions provide a categorization of those models:



#1 Fully Federated
- Patient data resides with source facility
- Data remains in the source systems
- EHR is a process which pulls patient data from carer systems
  - Real time: Google or Napster models
  - Batch extracts
- DWHS not clear

#2 Federated
- Patient data resides with source facility
- Patient data consolidated in facility CDR
- EHR is a process which pulls from local CDRs for updates to central CDR as needed (e.g., dbMotion)
- DWHS works off CDR

#3 Service Oriented
- Patient data sent to EHR by message at end of care event
- Local systems message enabled
- EHR is a process which manages flow of messages
- CDR holds care events within patient 'record'

#4 Integrated EPR
- Single integrated hospital system
- Embedded EHR capabilities

Source: Capgemini

This section describes the information and messaging models (clinical and transport), service-oriented architecture (SOA), and user authentication and access controls employed by a country. It attempts to identify the ownership of patient records and whether or not a country allows for personal health records (PHRs) to be accessed by patients.

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EHR Governance

Legal/Regulatory

This section described the legal and/or regulatory mechanisms that either enable or hinder the implementation and deployment of EHRs and HIE. Patient privacy, security and other issues such as kick-backs and self-interest referrals are also addressed.

Healthcare Policy

This section describes the policies and procedures in place to enable or hinder the implementation and deployment of an EHR and HIE. This includes governance of data quality; data usage; storage; messaging standards; provider/payor participation; patient participation; participation by non-traditional health organizations (e.g., clinics in retail stores, retail shops); implications for IT/ICT industry; use of off shore resources/services; and other aspects related to technology usage.

Technology

The architecture of the EHR system is addressed in reference to patient demographics; provider demographics and identification; health record services; interoperability/ontology services; messaging/integration services; security services; presentation/portal services; patient/clinician alert services; secondary use/reporting services; and population surveillance services. This section also explores health community application services such as booking, referrals, assessments, orders/results, e-prescribing and patient transfers. Patient/individual services such as PHR and telemonitoring are discussed along with integration to other non-health communities such as social services, education and prisons. Finally, any integration beyond country borders is referenced.

Adoption

This section attempts to describe the progress made in the adoption of EHR, PHR and HIE services among secondary/tertiary providers, PCPs, diagnostic facilities such as labs and radiology, other care providers such as long-term care, home care, ambulance and retail store-based clinics, patients/individuals; public health services; and others. Where systems are mature, examples of success and how adoption was enabled is described.

Outcomes

Where known, all metrics regarding the EHR/PHR/HIE implementation are described. If full implementation has not been completed, then the components of the EHR system that have been implemented are reported.

Benefits

Where it can be reported, the total time to implementation is described along with any financial ROI; qualified benefits such as healthcare quality, data quality and preventive health; and quantified benefits including immunizations, medical errors, utilization and length of stay.

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Implementation Experiences

Insight is provided to the implementation programs that are either complete or ongoing including the pitfalls encountered, best practices uncovered and project/program management.

Next Steps

This section describes the next steps to be taken within the EHR/PHR/HIE program.

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EUROPE

GERMANY

Overview of Germany's Healthcare System

While the industrial and commercial activities in Germany have been focused on cities in the west (Frankfurt, Hamburg, Cologne, Munich, Stuttgart), the average population of the eastern states is older and has higher per capita health-related cost. In regards to absolute and per capita income, cities in the southwest experience high income, high population density and low unemployment while those in the northeast have been subject to low income, sparsely populated areas and high unemployment. Interestingly, health-related costs per capita follow an inverted distribution across the country. With a population of about 80 million people overall, the statutory health insurance system in Germany covers about 70 million insured persons.

In addition to the statutory system, private insurance options range from add-on services on top of the statutory coverage to full substitutes with far better treatment (e.g., no waiting times) and medication options. The statutory health insurance plan covers primary care visits, emergency visits, prescribed medications, dental care, hospital treatment and rehabilitation care. In the recent years, a small fee (40 €/year) has been introduced plus a small percentage of the medication cost has been charged as a co-payment. However, the national health insurance covers generally every kind of health-related cost. Treatment and medication for children are completely free, provided one parent is insured under the statutory scheme. This coverage costs about 14 percent of the person's gross income and is offered through about 200 health insurers.

The statutory health insurance is highly regulated and dictates the reimbursement value of each single medical service or item as "points"; in recent years, however, that reimbursed amount per point has been reduced. Hospital bills are directly paid by the insurer, while GP treatment and medication is paid for by statutory reimbursement funds (per state) who receive a flat fee (about € 2000/p.a.) for each insured person from the respective insurance carrier.

There are no governmental subsidies to this system; instead all insurers, hospital associations and the 22 statutory reimbursement funds update their contracts and reimbursement terms with little government influence. Together, these entities comprise the "Selbstverwaltung" (self-administration) which is dominated on one side by the position of reimbursement funds and on the other by health insurers. Since the national overall budget for GP and medication is limited and reimbursement is relative to the overall expenditure, there are no incentives in place for GPs to reduce utilization for services, medication prescriptions or card-fraud.

Germany has more than 100,000 GPOs (General Practitioner Offices) and more than 2000 hospitals, all of which have to face the decreasing values of reimbursement through the statutory scheme. For several years now, hospitals have been reimbursed with flat payments by diagnosis-related groups (DRGs) based on ICD-10 codes (with German-extensions, ICD10 German). Six big private hospital groups have been built in the last few years in order to improve cost-effectiveness, but the majority of hospitals are

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state/city-owned and most of them have severe difficulties covering their expenditure through the current DRG reimbursement system.

Over the next few years, the major issues will be:

- The aging of the population and its related shifts in income vs. health-cost;
- The “Gesundheitsreform” (Health Reform) which is a rearrangement of all business terms to reflect patient responsibilities and to include a greater part of the population in the statutory scheme; and
- Nutrition-related diseases/metabolic syndromes.

National EHR Program

The overall health IT project (telematics) in Germany is known as the “electronic health card” or “elektronische Gesundheitskarte”; however, it generally refers to all applications in e-health. The card is the only thing visible to the patient; therefore, it has received the most scrutiny under public discussion. Other important IT-applications will be more or less centralized. These applications will include insurance coverage, e-prescriptions, emergency data sets, medicine interaction cross-check and electronic referral letters.

Following an order from the German Ministry of Health (BMG), the Gematik mbH - a limited liability company - was founded and is controlled by the major stakeholders in German healthcare:

- Statutory funds
- German hospital societies
- Health insurers
- Other health associations

Since 2005, Gematik has governed the national health telematics project that is designing, requesting RFPs (requests for proposals) and certifying the EPA ("electronic patient folder") that is planned to be stored on a few central servers with records referenced by the future German health card ("eGK").

National IT/ICT Status & Strategy

Regional and local GPO networks receive additional funding of about 500 €/p.a. for each patient who has agreed to have his medical history shared across the network. Hospitals may participate in such networks and receive electronic referral letters. To date, less than 20 percent of the GPOs are member in such a network.

In nearly all of Germany, broadband access between 1 to 6 MBps is available and competition among providers ensures good quality at an affordable price.

There are two test regions for the national health telematics systems, but only about 10 percent of providers have agreed to participate in such tests. Some extra contracts exist between one health insurer in the west of Germany with Belgium and Netherlands-based insurers since they are allowed to exchange insurance/coverage data across borders. Data formats for exchange are mostly proprietary and designed by the IT provider for that network.

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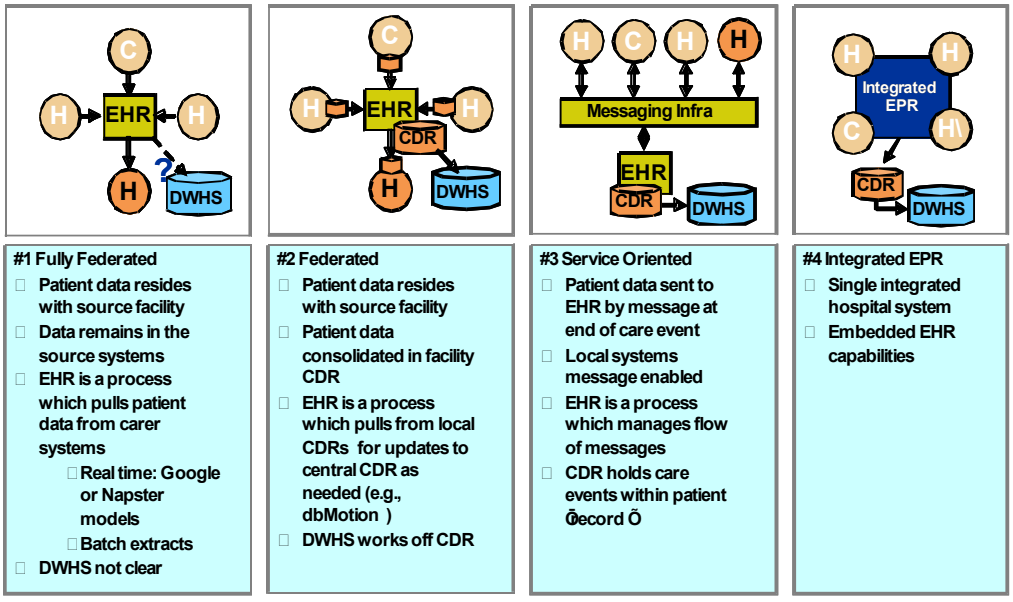
Gematik observes European or international standards and participates in the national group towards ISO TC 215.

National/Regional EHR Approach

The electronic patient folder that includes information on longitudinal, person-related medical history is designed to be stored in one of a few centralized servers. The personal health card will serve to identify, authenticate and possibly authorize access to that patient's data.

Gematik develops all specifications and test cases, operating a test lab for demonstrations. Gematik also publishes RFPs and moderates the selection of the related offers. Since RFPs are run by region (reflecting the 16 states), there is a large market for products and services within the health telematics project. Currently, GPs fear that this project will increase costs or, even worse, increase their administrative time spent on each patient. Therefore, most are opposed to the "health card" project. Despite public response in the media, patients are not concerned about the health card concept. "Healthy persons," however, are worried about security breaches of their health records while "sick" patients are reluctant to get better treatment and regard the "health card" as support for their health.

To allow for country to country comparisons, the approach being followed by Gematik would fall under category #3 "Service Oriented" in the following diagram:



About ten basic transactions are implemented using signed code within the card-reader. This allows interfacing GPO/HIS software to use and navigate the health telematics infrastructure. In addition to transport encryption, there will be an x.509-based end-to-end encryption between user and service-provider.

Though interoperability would require a common "domain" information model, the information models will be different for each single application and are still under development. The basic foundation is the HL7 v3 RIM (ISO 21731) with many added adaptations and extensions. Messages and interfaces within the telematics infrastructure

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will be generated from the respective information model. User identification, authentication and access control will be based on personalized active security cards.

Additional authorization features will be implemented on top of card-based security measures and personal PINs. Ownership of the personal health cards is shared between patients and healthcare providers. The health cards store certificates and keys for decryption, providing a signature for personalization and a unique variant for encryption. The card also stores some objects, like insurance coverage statements, emergency data sets and content or references for e-prescribing. The devices used to read the cards will also contain "personalized" information that will enable them to perform their own cryptographic identity.

EHR Governance

Legal/Regulatory

Patient privacy dominates other aspects of the EHR ("EPA") in Germany. Insured persons must first give their basic consent to start their personal EPA. They then have the option to hide, or block, any single entry in the EPA, making its usefulness for medical purposes questionable. Without adequate clinical information, medical professionals sometimes refuse to assume liability and, therefore, reject the entire record and the telematics project altogether.

Concerns about potential kick-backs and self-interest referrals have not yet been addressed in the design of the EPA.

Regulatory Aspects

Since 2005, several German healthcare laws were changed to enable cross-sector care and handling patient data in electronic form.

Security of e-health is reviewed at the federal level by the National Agency for Security in IT ("BSI") and the Federal Data Protection Officer ("BFD"). At the state level, security is checked by security officers in the 16 states whose opinions often differ. For example; the State Data Security Officer in Northrine -Westphalia refuses to permit testing of access to emergency data and will only allow access in the case of a real emergency.

The national e-health project is influenced by several national agencies. Since federal electronic networks are involved, the National Agency for Networks (Bundesnetzagentur) reviews and influences the e-health-related designs of Gematik. Tax involvement (part of billing information on e-prescription) requires that the German Ministry of Finance also review and comment on the e-health project. The Ministry of Justice also reviews and comments on the electronic signature used by solutions designed by the e-health project.

Although the health care and its infrastructure meet the definition of a medical device, the BMG does not consider the e-health project as such. Therefore, its regulation does not fall under the laws of the Medical Device Directive (EC law, similar to FDA). The health card and its infrastructure together clearly are a medical device according to applicable law, since they

- Physically store and process diagnosis-/treatment-related data;

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- Have been launched by gematik with the promise to store/process medical data; and
- Do not have any considerable problem-resolving community other than gematik, medical professionals and patients.

Nevertheless BMG repeatedly denied the consideration as a medical device.

The government has mandated that healthcare providers collect anonymous outcomes data and send it to a national organization responsible for clinical quality improvement. This encompasses both clinical and billing data and is based on the DRG system utilizing version 10 ICD with German extensions "ICD10GM."

From a regulatory perspective, patients are not involved in the national project. On their behalf, six national and 16 state agencies regulate the design of the national EHR system.

Healthcare Policy

There are several barriers to optimizing patient benefits through the use of the e-health card:

- Physician buy-in has not been universally achieved. GPs balk at having to enter their own card and PIN number before each patient entry and they see no point in having to enter electronic information into the emergency data set or e-prescribing system.
- The German healthcare system does not reward clinicians for disease prevention, reducing costs in ambulatory procedures, using lower-cost medications or reducing e-health card fraud. Instead, clinicians benefit financially from caring for patients with acute disease, writing expensive prescriptions and engaging in complex medical procedures.
- None of the announced health IT applications support either disease prevention or "assisted ambient living." Instead, the health card is used merely to facilitate existing administrative procedures through the use of technology.

Technology

Detailed designs for elements of EPA are currently under development and different release versions can be obtained from www.gematik.de.

Adoption

Currently, there are two test regions in Germany. Each has 10,000 patient cards being tested offline for insurance coverage checks. Neither centralized services nor security certification has been implemented as yet.

Outcomes

Metrics of EPA usage have been proposed and will measure:

- Overall number of insured persons with at least some data included in their EPA;
- Overall number of (signed) data entries in all EPAs; and

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- Average number of (signed) data entries per insured persons in respective EPA.

Benefits

A study by Booz-Allen-Hamilton suggests that insurance companies will benefit from cheaper administrative procedures about ten years after roll-out. Since the national budget for GP and medication is limited and reimbursement is relative to overall utilization, there are no proposed savings to be gained by reducing ambulatory procedures, card fraud or inappropriate medication. Moreover, GPs and pharmacists will incur significant costs in purchasing telematics devices and lost time due to learning security-related procedures (card/PIN handling).

Implementation Experiences

In 2005-2006, Gematik invited industry and academia to consult on design aspects of the healthcare telematics. Through industry associations, several consultants provided technical expertise to Gematik. However, since the share-holders of Gematik and BMG's "architecture board" heavily influence all elements of design/implementation and are influenced by political connections, decision-making is time-consuming and can be changed at any point in time. Since mid-2006, Gematik has hired more employees with technology expertise in order to increase its understanding of health software applications.

Next Steps

A national German e-health card rollout will begin in 2009. The first application will be card-based insurance coverage checks (offline) followed by online insurance checks against the insurance's data center. Subsequent steps will include e-prescription and emergency data sets.

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About the Contributor

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THE NETHERLANDS

Overview of the Dutch Healthcare System

The Netherlands has a population of over 16 million people. With 400 inhabitants per square kilometer, it is densely populated. The fertility rate in the Netherlands is 1.7 children per woman, well below the 2.2 rate required for population replacement. The life expectancy at birth is 79 years, which means that the Dutch population is aging and the total workforce will be decreasing within 10 years. The Randstad (or Rim City, i.e. a city at the rim of a circle, with empty space in the centre) is one of the largest metropolitan areas in Europe and comprises the four largest Dutch cities (Amsterdam, Rotterdam, The Hague and Utrecht) plus their surrounding areas. Almost half of the population of the Netherlands, 7.5 million people, live in the Randstad. When contiguous cities are taken into consideration, it has a population of over 10 million, almost two-thirds of the entire Dutch population.

The Dutch healthcare system is a €55 billion/year industry. More than 90 percent of modern Dutch healthcare institutions are owned and managed on a private not-for-profit basis. The remainder are public university hospitals and a growing number of smaller, focused, commercial clinics. In 2005, a new financing system for hospitals was introduced. Known as the Diagnosis Treatment Combination system, or "DBC," it allows healthcare providers and payors to negotiate volume, price and quality of healthcare services at the local level. The introduction of the DBC system marks the shift from supply to demand-based funding. The system is set to be fully operational by 2010.

In 2008, a similar system will be introduced for the behavioral health, forensic medicine and disease management of chronic conditions

In 2006, Denmark's general hospitals had a bed capacity of 44,784 and its academic hospitals a capacity of 6,624. The number of beds per hospital varied between 138 and 1,368. In the past three years, total bed capacity has been decreased by five percent which conforms to the vision of the Ministry of Health (VWS) that the number of beds can be reduced by year 2015 from three for every 1000 inhabitants to roughly two.

The gatekeeper for the Dutch healthcare system is the general practitioner (GP). There are five GPs for every 10,000 patients with a total number of 8,100 GPs throughout the country.

For the Dutch government the top three issues facing the country's healthcare system are:

- Cost containment;
- Patient safety and quality of care; and
- Human resource management (i.e., finding solutions for a decreasing workforce).

Because of the gradual transition towards a market economy, the main goal for most healthcare providers is to develop relationships with both their patients and referral sources.

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National EHR Program

National IT/ICT Status & Strategy

The Netherlands is one of the most densely cabled countries in the world and the Internet distribution is at 73.3 percent, making it the fifth highest in the world. This infrastructure provides a firm basis for the national IT strategy, the main elements of which are:

- Standardization of messaging (HL7 v3);
- Identification and authentication; and
- Gradual implementation of semantic interoperability.

The Dutch government does not intend to develop a centralized EPR system, choosing instead to store medical data at the several local sources where they were captured. It should become possible to combine relevant medical data from these local sources into a national virtual EHR system.

Nearly all GPs and most other primary care clinicians have adopted EHRs and all hospitals are equipped with electronic IS. One problem with these systems, however, is that they were developed from financial and administrative perspectives. Unlike the U.K. and other European countries, they are neither patient-centered nor process-focused. In order to change the focus of the national EHR system, therefore, changes are envisaged which include:

- A patient summary from the GP that can be accessed at any time (Deputising Practitioner Record, aka “Waarneemdossier voor Huisartsen ” or “WDH”); and
- A patient prescription history (Electronic Medication Record, aka “Elektronisch Medicatie Dossier” or “EMD”).

A pilot project to implement the EMD and WDH has been successfully completed in four regions of the country. In 2008, the Dutch government expects that IT vendors will adapt their local systems to be able to connect to the national EHR system thus starting the national roll-out. Once these are incorporated into the national EHR, the government will continue to expand the system to include more information that can be shared among different healthcare entities.

The functioning of the national EHR system is based on a central system called the National Switch Point (or “LSP”). This system allows healthcare practitioners to use a “pointer index” to locate existing patient information on the several regional or local systems in which the information is stored.

National/Regional EHR Approach

The present architecture of the Dutch national EHR system (AORTA) can best be described as a “Federated” model or category #2 on the chart. AORTA is creating the infrastructure to enable intercommunication between the central and local healthcare entities. It will also support the local healthcare systems used by GPs, pharmacies and hospitals to exchange patient data and connect facilities. Also, it will provide essential services on a national level, including security frameworks and messaging standards. Patient data will remain in the local source systems where the EHRs support the healthcare processes.

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The Dutch government appears to be following a path towards developing distinct services under an SOA concept. Recent policy decisions dictate that all private and government healthcare entities comply with the e-government program and enable their systems to be interoperable within the national framework. This will require local systems to register a patient only once using a central registration number under a secure authorization process. Several services have already been developed under this system:

- Digital Identity of patients and companies (DigiD): DigiD is a shared system in which Dutch government authorities can verify the identity and electronic signature of patients and companies when accessing electronic services.
- PKIoverheid: designed for safe electronic communication between local healthcare entities and the national system. PKI guarantees high-level security for information sent through the Internet. It can be used for safeguarding Web sites (SSL), submitting valid electronic signatures, high-level authentication at a distance and message encryption.
- The Government Service Bus: supports messaging logistics and incorporates standards to address and send messages reliably.
- Personal Internet Portal (PIP): for patients to access all public services. The PIP is profile-based and, using the patient's personal data, provides real-time status of any tests or services.

EHR Governance

Legal/Regulatory

Existing legislation regarding health data protection starts with the patient-provider relationship. It does not allow for centralized storage of patient health information. The EHR architecture, including all new systems and services, are being developed in close consultation with the government legal department and the institution that governs the protection of personal data.

General privacy laws and a separate law related to patient rights are being applied to healthcare but patients have the right to opt-out or to constrain other users through role-based authorizations where providers are allowed access to certain kinds of data.

New legislation is being prepared, known as the "EHR Act," which requires health professionals to keep appropriate records of the health status and the care provided for every patient. It also mandates that all individual electronic systems be connected to the National Switch Point, where patient health information is both exchanged with other health professionals and is available for the patient to view and to permit/withdraw authorizations.

Healthcare Policy

The current healthcare system reform is being driven towards a more competitive market in which both providers and payors compete for patients. While this shift limits the influence of the national government on joint ICT investments and infrastructure, it has also been a barrier to sharing data between those competing organizations. The EHR Act was designed to overcome that barrier.

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Access to data is limited to healthcare practitioners who are identified in the national healthcare practitioner registry ("BIG register"). Their ability to retrieve data is constrained by privacy laws in which data may only be used for the provision of healthcare.

At the present time, the main focus of the national EHR system is to provide continuity-of-care. Other functionalities, such as nationally accepted clinical guidelines, are not yet envisioned.

Healthcare organizations, as well as their software systems, must be certified and are required to comply with security and privacy regulations based on European and Dutch laws regarding privacy and patient rights. Over time, all legal requirements will be met.

Technology

The focal point of the national EHR system is the National Switch Point mentioned earlier. Based on an Intersystem's Ensemble platform, it facilitates the exchange of clinical information between EHR systems and consists of:

- Patient identification repository;
- Repository with a pointer index to local clinical information;
- Authentication mechanisms for health professionals and their systems;
- Access control mechanisms used by health professionals; and
- Communication "agent" allowing the information change.

Unique national patient identification is achieved by using the national Civil Service Number (BSN). Mandatory identification at the point-of-patient care is facilitated through the use of a legal identification document. Provider authentication occurs within a central registry through a (PKI-based) Unique Healthcare Practitioner Identification-card ("UZI-card"). All healthcare practitioners have the option to request an UZI-card that can facilitate their communication with the national infrastructure. Since the national system is role-based, the UZI-card enables access control by including the role assigned to the healthcare provider

Patient information in the Netherlands is stored locally at its source. Therefore, data exchanged via the national system must be collected through a central "Act Reference Registry" based on the HL7v3 information model. HL7v3 queries lead to the collection of HL7v3 messages or HL7v3 CDA.

The security model for patient information is based on SSL + PKI user authentication. Although WSDL/WS are used, the architecture is messaging-based, not services-based. The messaging model is HL7 v3 with its core based on international v3 models from 2004 or later releases. The system does not intend to create any new standards but to re-use the existing standard to its fullest while contributing to its further development. For transport, SOAP over HTTPS is used and is also based on HL7v3-WS.

The national EHR infrastructure does not require that specific systems be used by healthcare providers. Instead, the government has established specifications for interfacing stand-alone EHR systems with the national portal. Although these specifications cover only the necessary exchange elements, adherence to these guidelines

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qualifies the healthcare provider to connect to the national infrastructure as long as his/her system has been qualified by the national government. By the end of 2007, only 14 software vendors had systems that were qualified to participate in either the EMD or WDH process. Some of the major GP, pharmacy and hospital system vendors have not yet been qualified which places the hope for a national, unified system sometime in the future.

Adoption

The Dutch government realizes that the main barrier to developing a national virtual EHR system is not the technology involved, but the ability of healthcare providers to work together. Because a clear business case for sharing data is still lacking, most individual healthcare providers have resisted EHR adoption. The years 2008 and 2009 will be crucial with respect to adoption since the first two chapters of the national EHR in 2007 have been limited to four regions as pilot implementations. Known as the "Deputizing Practitioner Record," the pilot focuses on GPs and their combined regional out-of-hours offices only. The formation of regional out-of-hours offices has been a key driver for adoption since no patient information from participating GP practices is available without them. A similar pilot is being envisioned for use in emergency situations such as from ER departments and hospitals.

Ideally, the Electronic Medication Record should be populated with medication information from all pharmacies, including hospitals. Moreover, they should be viewable by all doctors who prescribe medications. However, EHR adoption by community, secondary and tertiary hospitals has been low and, therefore, their in-hospital pharmacies do not participate. All pharmacies have been hesitant to share the information they hold and there are no incentives in place for them to do so. Without financial incentives, hospitals and pharmacies cannot offset their investment in systems and data integrity.

Outcomes

Benefits

Implementation of the pilot for the first two chapters of the EHR and WDH are estimated, by some stakeholders, to result in the following cost reductions:

- Administrative = €2.8 million
- Patient transfer = €.23 million
- Contact duplication = €.28 million
- Prescription medication service improvement = €.12 million
- Medical prescription errors reduction = €6.75 million
- Work Absences = €3 million

Implementation Experiences

The Dutch government conducted a proof-of-concept test for the National Switch Point in 2003, confirming the viability of the Switch Point and use of HL7 standards. The test also demonstrated the synergy between different ICT-vendors.

In 2004, the government formalized the EHR architecture documents and completed the formal European Tender for the National Switch Point in 2005. This resulted in a system that became operational in early 2006.

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By 2007, production-pilots were successfully completed in four regions and included e-prescribing (including the medication record) and the WDH. The main obstacles to a roll-out following the pilots have been a lack of cooperation from ICT vendors who need to adapt their systems to the standards and requirements of AORTA as well as a lack of cooperation from GPs and pharmacists. During the last three years, ICT vendors have employed outdated EDI standards in their implementation of regional networks. These networks have similar functionality to the national EHR roll-out, but do not have the rigorous privacy architecture required by the national system. In addition, the national EHR system will have a large impact on the way healthcare providers collaborate with each other and with the network. Healthcare providers have been willing to invest in regional systems that improve their position in the regional network and enhance their relationship with their patients. They do not necessarily see the benefits of investing in a national EHR system.

As of January, 2008, four regions are on the brink of rolling out one or both of the national EMD or WDH systems. Three of these regions have already added a regional switching point to the AORTA architecture and have expanded the functionality of their systems. The success of the AORTA implementation will be determined by the value it brings to healthcare providers.

Next Steps

Several new chapters for the national EHR system are currently being developed, including exchange of pathology and laboratory results, e-prescribing (as an enhancement to the EMR), an electronic diabetic record and the emergency record.

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About the Contributors

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GREECE

Overview of Country Healthcare System

On the Balkan Peninsula in southeastern Europe, Greece is mostly dry and mountainous, with a large mainland and more than 1,400 islands (see Figure 1 below for a map of Greece).

Greece's public health system (*IKA*) provides free or low cost healthcare for those who contribute to Greek social security, plus their families and retirees (including those from other EU countries). Members are charged 25 percent of the actual cost of prescriptions, although there are higher charges for non-essential medicines plus substantial contributions for many services, including eyeglasses, dentures and other treatment. Essential dental treatment is largely free.

For those who do not qualify for healthcare under the public health system, it is essential to have private health insurance. This is recommended in any case where the person can afford it, owing to the inadequacy of public health services and long waiting lists for specialist appointments and non-urgent operations in some areas.

The official Statistical body of Greece is the National Statistical Service of Greece (NSSG). According to the NSSG, Greece's total population in 2005 was 11,082,752 (486,632 males and 5,596,119 females). As statistics from 1971, 1981 and 2001 show, the Greek population has been aging the past several decades. The birth rate in 2003 stood at 9.5 per 1,000 inhabitants, twenty-eight percent lower than the 14.5 per 1,000 birth rate in 1981. At the same time, the mortality rate increased slightly from 8.9 per 1,000 inhabitants in 1981 to 9.6 per 1,000 inhabitants in 2003. In 2001, 16.71 percent of the population was 65 years old and older. 68.12 percent were between the ages of 15 and 64 years old and 15.18 percent were 14 years old and younger. The average life expectancy in Greece is 78 years.

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Figure 1. Map of Greece

National EHR Program

National/Regional EHR Approach

EHCR (Electronic Healthcare Record) is the main architectural framework used in Greece and serves as the acronym for the Greek EHR program. Greece also refers to EHRs under the title EPRs. The EHCR is considered to be one of the key services enabled by the Healthcare Information Infrastructure (HII). Heterogeneous, autonomous systems are designed to support specific data types and manage individual EHCR segments. The seamless integration of distributed EHCR segments requires interoperability of heterogeneous, autonomous IS and middleware capable of facilitating interoperability and communication of information through standard messages.

EHR Governance

Legislative Law 1397/83 declared that: the state has a responsibility for providing healthcare to all citizens, “regardless of their financial, social or professional status.” The main objectives of the legislation were to provide equal distribution of health services and sufficient coverage of needs, to improve quality and to emphasize each region separately. Figure 2 provides an overview of the healthcare system on Greece.

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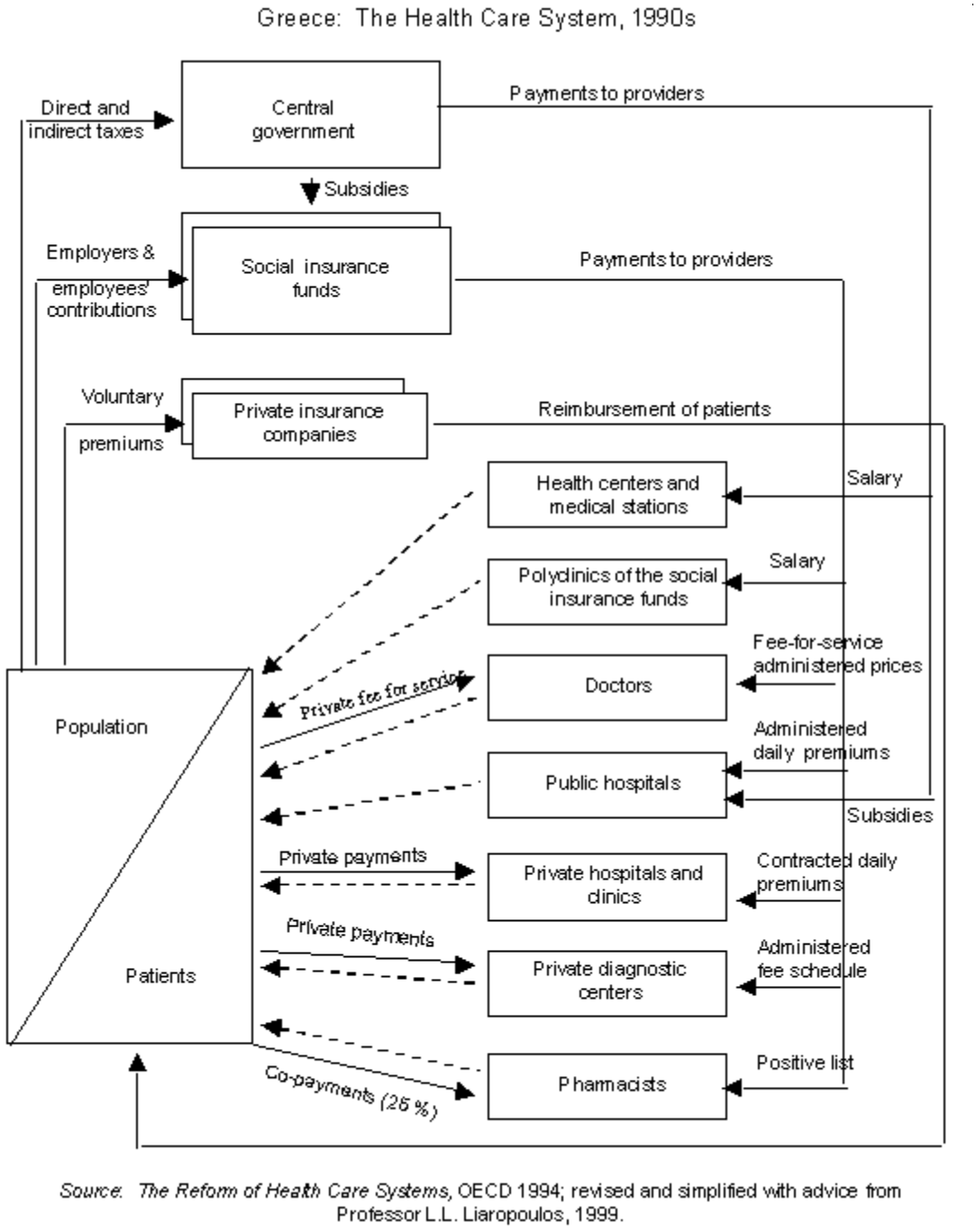

Source: The Reform of Health Care Systems, OECD 1994; revised and simplified with advice from Professor L.L. Liaropoulos, 1999.

Figure 2. Greece Healthcare System

Healthcare Policy

The Ministry of Health and Welfare is the leading body for developing and financing health policies. The Ministry is responsible for provision and financing of the National Health Service (NHS Greece) as well as health and social services for the poor, the elderly and the disabled. A small part of health and social services is provided at the regional and local levels by municipal authorities. Local authorities, working through the Ministry of Health, play a limited role in the administration of 128 NHS Greece hospitals and 176 rural health centers. The Central Health Council and Committees for AIDS, Drugs, Cancer, etc., play an advisory role to the minister.

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The current management structure arranges the various services of the Ministry of Health and Welfare under its three Directorates:

Directorate General of Health:

- Public health
- Environmental health
- Primary healthcare
- Development of hospital units and blood donation
- Mental health
- Medicines and pharmacies
- Health professions
- Medical care of civil servants.

Directorate General of Welfare:

- Social housing and development of welfare units and professions
- Family and child protection
- Social work and welfare
- Elderly and disabled people.

Directorate General of Administrative Support:

- Personnel
- Education
- Organization and procedures
- Informatics
- Finance

Organizational structure and management 11

- Property evaluation
- Biomedical technology
- Technical services
- International relations
- Health education and information
- Civil planning for emergency
- European Union (EU) and other project development.

The Ministry of Health and Welfare, through its central and regional services, has the responsibility of planning and implementing health-related activities for public health, medical care and social welfare. The Ministry also coordinates health-related program activities of private institutions and individuals. The central administration consists of the minister, two under-secretaries of state and two secretaries general (one for health and one for welfare) on the political side. There has been discussion about establishing a new general directorate for NHS Greece management that would take over the responsibilities related to healthcare services from the three Directorates, particularly the minster and the under-secretaries. The main factor driving this change is that, under the present structure, there is no clear vision for public health and healthcare.

The EHR in Greece consists of compositions created during the various instances of healthcare service provision. Each composition contains all data recorded at each place and time of care delivery, in each single session with a particular healthcare professional.

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During a patient's lifetime, numerous compositions may be created at different healthcare institutes for different reasons. All these are uniquely identified and can be linked together to constitute the patient's lifelong EHCR. Compositions are the minimum groupings of patient-record data that can be safely transferred between different locations without altering the meaning initially conveyed or violating any rules that may apply to EHCR communication.

Technology

Centralized systems are primarily used in Greece. However, there are examples of efforts to set up distributed systems so as to share information with other members of the EU.

System security is being addressed with the installation and operation of a Public Key Infrastructure (PKI). The PKI will provide proper user authentication and digital signature mechanisms at the application level. The PKI registration, certification and key services mechanisms will be installed at a central point, most probably at the regional hospital.

Local Computerized Medical Records Management resides within health centers. Patients who visit a health center for a consultation are treated and their computerized medical records (CMRs) are stored locally in an existing database. All medical personnel have direct access to the patients' medical records that they, as clinicians, have entered into the system. Even if they have not directly entered the information, clinicians can gain access to the patient's record through the use of a health card provided by the patient (patient card). This mode of operation covers approximately 90 to 95 percent of the daily practice per health center.

An application called DICTATe has been installed and is being used in the health centers. The key components of the DICTATe system include:

- Modified PDA that supports speech dictation, text input and wireless communication;
- Wireless communication infrastructure to facilitate secure, real-time exchange of data with the handheld PDA; and
- Server application that performs voice-to-text conversion, medical-language processing and communication with both the clinician's PDA and the hospital's electronic records system. This server application is also applying some of the latest advances in structured document representation, automated speech recognition and natural language processing to convert the doctor's input into a structured format.

Outcomes

Most of the aspects of the new system have been spectacularly successful: for example, the number of hospital beds has increased from about 32,000 in 1983 to more than 52,000 today, while the number of doctors —including dentists— exceeds 54,000.

A recent study by the World Health Organization ranked the Greek health system as 14th out of 191. In an effort to further improve its healthcare system, the Greek government is pushing ahead with major healthcare financial investments.

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Benefits

The current benefits of the progress made to date could not be determined; however, the objectives and benefits of the health system have been defined as follows:

- Creation of a coherent policy to improve healthcare with intersectional coordination and a strong emphasis on public health (promotion, prevention, etc.);
- Decentralization of the system;
- Encouragement of citizen participation by providing equal access from both a financial and geographic standpoint as well as by establishing organizational structures permitting citizen participation;
- Improvement in the management and quality of care through incentives for improved performance and the creation of specific budgets for education;
- Creation of incentives for cost-effective delivery of healthcare, by enforcing budget limits and by reducing waste (in the prescribing of drugs as well as in the provision of excessive diagnostic tests and in doctors' visits);
- Updating facilities where necessary;
- Providing continuity of care through family medicine; and
- Promotion of primary healthcare.

Next Steps

There are still many problems that exist in various states of resolution. Greece has identified, and is focusing on, the following areas of concern:

- Social insurance funds and providers (especially in urban areas) with different organizational and administrative structures who offer overlapping, uncoordinated services;
- Inequalities with respect to contribution rates among the different funds as well as inequalities in the range and quality of services provided;
- Deficiencies in the health service infrastructure and weak public sector response to the contemporary needs of medical science. This results in the public provision of a limited range of services, forcing insurance funds to increasingly outsource services to private providers that are not offered by the public system;
- A serious lack of properly trained medical and nursing personnel. The specialty of general practice is accorded low professional and social prestige and, as a result, there is a serious shortage of GPs. There is an estimated need for 5,000 GPs; today, however, only 560 exist. These shortages are covered by pathologists, pediatricians, doctors with no specialization and rural doctors, resulting in corresponding limitations in the quality of PHC services delivered;
- Serious shortages in medical and nursing personnel at the health centers and clinics;
- Low salaries and lack of incentives result in an unwillingness among doctors to staff the health centers. This leads to low productivity and arbitrary limitation of working hours;
- The absence of a family doctor system and referral system, especially in the urban centers, precludes continuity of care and increases system ineffectiveness;

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- Limited availability of services during the night hours, especially in the urban centers, forces patients to use hospital out-patient departments or private doctors;
- Low trust in the healthcare system induces many patients to seek a second opinion, very often from private doctors. This creates additional expenses, overloads the system and partially cancels out the character of free healthcare; and
- Lack of quality control programs, especially in prescribing and referring to private diagnostic centers, results in high-cost examinations and burdens the insurance funds with unjustifiable additional expenses.

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ENGLAND

Overview of Country Healthcare System

Britain's NHS was established after the Second World War amid a broad public and political consensus that healthcare should be made available to all. A new system of healthcare, based on social insurance, was thus introduced and the previously split private and public hospital structure was nationalized into a unified NHS. The basic principles of this government-funded system remain in place today, although some charging of related services such as dentistry does occur. Today, the private healthcare market occupies only five percent of the total healthcare business.

The NHS supports a population in England of approximately 51 million, with approximately 7 million of those residing in London. The empowered authorities that deliver healthcare into the primary care sector are known as Primary Care Trusts (PCT). They play a central role in the local community and regulate general practitioners (GPs), pharmacists, dentists and midwives. Every citizen is expected to have equitable access to these primary care services based on their needs.

Secondary care services are provided by a broad range of providers, focusing on the delivery of acute care. The care is regulated by NHS England Trusts and includes a full range of inpatient, emergency and outpatient hospital services. Management and integration of these services is provided through strategic health authorities, other health organizations and local authorities who are currently involved with the configuration of hospital services. In 2004, the NHS England controlled approximately 145,000 acute beds. (www.nhsconfed.org)

Statistics

NHS England Funding

- NHS England net expenditure has increased from £34.66 billion in 1997-1998 to a planned £90.70 billion in 2007-2008.
- The money spent in England by the Department of Health on health services per person has risen from £1170.30 in 2003-2004 to a planned £1,624.30 in 2007-2008.
- In 2006-2007, the NHS England ended the financial year with a net surplus of £515million. Across the NHS, the gross deficit was £917 million, down from £1.3 billion for 2005-2006.
- The NHS England is currently projecting a surplus of £1.8 billion for the 2007-2008 financial year. The gross deficit for the second quarter of the year was £201 million.
- Of the extra NHS England funding in 2005-2006: 52 percent was spent on higher pay costs; 17 percent on extra drug costs; 7 percent on capital costs and 13 percent on more activity and improvements.
- Further analysis from the King's Fund for 2006-2007 has estimated that 40 percent of the additional funding was used for pay and a further 32 percent was consumed by higher prices and costs associated with NICE (clinical practice) recommendations, clinical negligence and capital costs.

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NHS England Organizations

In the NHS England, there are:

- 171 Acute Trusts (including 65 Foundation Trusts)
- 152 Primary Care Trusts
- 74 Mental Health Trusts (including 18 Foundation Trusts and 16 PCTs providing MH services)
- 12 Ambulance Trusts
- 10 Strategic Health Authorities
- 11 Care Trusts (including 1 PCT and 3 MH Trusts) - Care Trusts work in both health and social services and are established when the NHS England agrees to work in partnership with local authorities to provide services
- 10,500 GPs practices in the U.K.

NHS England Staff

- The NHS England currently employs 126,000 doctors, 398,000 nursing staff and 36,751 managers.
- The number of doctors employed by the NHS England has increased by an annual average of 3.9 percent since 1997.
- There were almost 40,000 more doctors employed in the NHS England in 2006 as compared to 1996.
- There were 82,500 more NHS England nurses in 2006 as compared to ten years earlier.
- 3,950 more practice nurses were employed by GPs in 2006 than in 2001.
- 84 percent of NHS England staff is directly involved in patient care.
- Since 2000, the number of frontline staff within the NHS England has risen by 20 percent. This rise includes a 29 percent increase in doctors; a 19 percent rise in the number of nurses; and 10 percent more ambulance staff.
- Medical school intake rose from 3,749 in 1999-2000 to 6,326 in 2004-2005, representing a rise of 69 percent.
- Between 1999-2000 and 2005-2006, the number of NHS England commissions of pre-registration nurses training increased by 31 percent.

National EHR Program

National IT/ICT Status and Strategy

There is a wide range of maturity in the implementation of IT/CT across different organizations throughout England, most of them governmental. Although ICT is used in every organization, the ways in which it is used vary from minimal to highly capable and innovative.

Across organizational boundaries, the level of integration of clinical IS ranges from near-zero to well-developed IT support for extensive collaboration. The latter, however, is still in its early stages of development and is rarely sustained beyond specific projects and initiatives.

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While some national initiatives such as digital imaging are progressing steadily towards widespread adoption, others (e.g., national and regional care record management) are only just emerging and are not yet embedded in routine practice.

In the primary care sector, provider/payer integration is well established and growing in importance in other areas.

Many elements of strategy and policy attention are conducted on a UK-wide basis in order to raise general standards of IT implementation and information governance through a combination of incentives and regulation. Other elements are conducted separately within the Home Countries (England, Scotland, Wales, N Ireland).

In England, the availability of broadband and high speed Internet services to healthcare practitioners is very good and is managed as a single national secure network. Therefore, it is easier to conduct standardized transactions over the Internet as opposed to other countries without a single secure network. Standardization continues to grow in importance, with increasing realization that interoperability is not just a technical consideration but vital in coordinating clinical and IT implementation.

As NHS England continues with the National Programme for IT (NpfIT) a number of IT systems and services will be further deployed. The services are being implemented with the use of external suppliers in three categories of programs: National Infrastructure Service Providers (NISP), National Application Service Providers (NASP), and the Local Service Providers (LSPs).

The NISPs are delivering NHSmail and National Network for the NHS (N3). N3 will provide improved connectivity across the NHS, by replacing the existing network infrastructure. This effort will provide IT infrastructure and broadband connections to link IT systems reliably and securely.

The NASP services being implemented include several initiatives as described here. The EHR initiative is called the NHS Care Records Service (NHS CRS) <http://www.connectingforhealth.nhs.uk/systemsandservices/nhscrs>. This is a secure service that links patient information from NHS care settings across England (e.g., GPs, hospitals, clinics) electronically so authorized NHS staff and patients have the information they need to make care decisions. Patients will be able to access a summary of their own health and care information, known as their Summary Care Record via a portal service. In addition to the EHR services for patient information sharing, the Choose and Book <http://www.chooseandbook.nhs.uk/> service has been deployed as an electronic referral service which is intended to offer patients greater choice of hospital or clinic and more convenience in scheduling their first outpatient appointment. Another service that has been contracted for implementation is the Electronic Prescription Service (EPS) <http://www.connectingforhealth.nhs.uk/systemsandservices/eps/whatiseps> which is suppose to allow a patient's prescription to be sent electronically from their GP to the pharmacy which in turn makes prescribing and dispensing safer and more convenient. One of the more successful endeavors has been the Picture Archiving and Communications System (PACS) <http://www.connectingforhealth.nhs.uk/systemsandservices/pacs> which enables sharing of digital x-rays and scans.

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LSPs have been responsible for the implementation of new application services within the local care settings. These applications include new solutions such as GP systems, new hospital systems, and a new diagnostic application. These applications must conform to NHS NPfIT interoperability standards and the LSPs are accountable for the implementation as well as integration to the services provided by the NISPs and NASPs, most importantly the National Care Record Service.

National/Regional EHR Approach

A single NHS England procurement covered the provision of national infrastructure (the Spine) to support interoperability together with a number of national applications and services. The Spine is a national, central database where summary patient records are stored. It comprises a central health record repository, access control, messaging hub and a portal for clinical users. The summary clinical record aspect of this central provision is one of the last aspects to be implemented. When fully implemented, local systems will automatically upload a defined profile of important information to the summary patient record on the Spine. The earliest systems to upload records are GP (primary care) systems in regions selected as implementation pilots. One negative aspect of this implementation is that it is taking longer than expected to reach consensus on the scope and usage of the central clinical record between the commissioning authority and suppliers as well as between adopting organizations and clinicians.

Stakeholders (including the UK Government) are finding that their optimistic visions in the beginning of the program have been tempered by the realities of trying to implement a very large and complex system engineering and deployment project in a relatively short period of time. Despite the problems, however, some elements of the deployment have already achieved success, including implementing critical prerequisite facilities for managing patient identity and demographic information; controlling access to identified patient information; and then integrating them with a national electronic prescription system and other administrative services.

The Summary Health Record—a healthcare repository used by the EHR systems to deposit and retrieve patient information—is being implemented in phases to support different user groups and go-live clinical usage is planned to increase gradually from 2007 forward. This central summary EHR has a service architecture implemented using messaging specifications based on HL7v3. Developed by the NHS England agency Connecting for Health, this specification, called the “Messaging Implementation Manual,” is published directly to the contracted supplier community of the NPfIT (and also made available to HL7 member) .

Business-level and technical protocols for the central summary record have been developed alongside clinical content models and corresponding message wire formats for a wide range of clinical communications relevant to primary and secondary healthcare. The most advanced of these implementation processes is for the “GP Summary,” an extract from the patient’s primary care record. At the time of writing, these GP Summary records are in the early adopter stage of go-live clinical usage.

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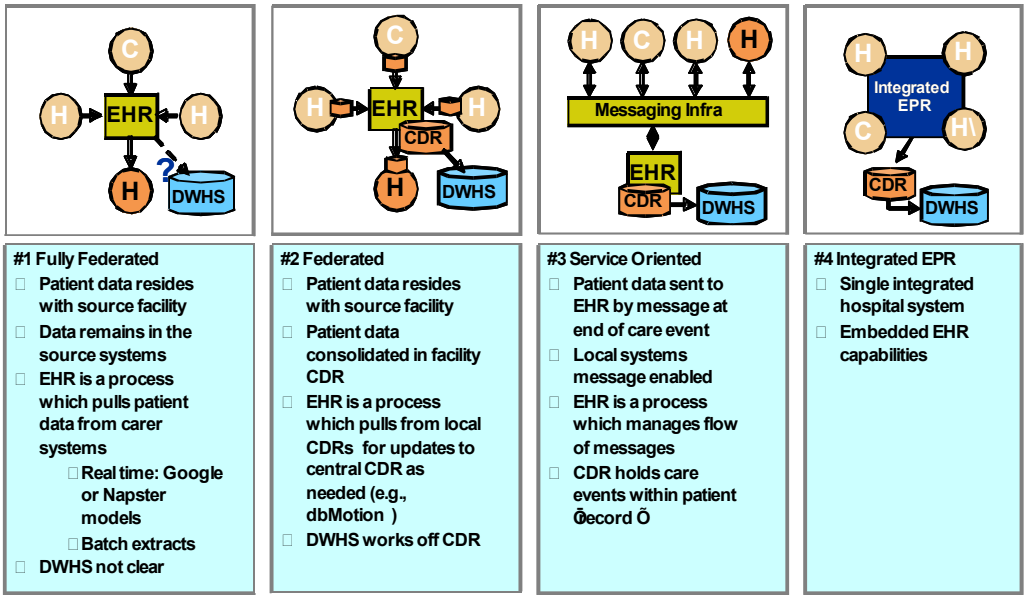

Currently, England's national EHR most closely resembles category #4 as shown on the chart above—the "Integrated Electronic Patient Record (EPR)"—a single integrated system. The National Care Record Service stores and maintains ownership of a summary record; its usefulness is directly tied to the maturity and utility of the health IT infrastructure that has been developed at local care provider locations (e.g., hospitals, GPs, mental health, ambulance, prisons, etc.). To bridge the gap between the National Care Record Service and local clinical systems, regional EHRs are beginning to develop.

In England, two-factor user authentication is used along with smartcards that are issued to all users. Although there has been some concern about ease of use, there is general acceptance of the process. Access control is handled by a combination of simple role-based access and the concept of a "legitimate relationship" between patients and the clinical workgroups (physicians, nurses and others) involved in their care. Patients may access their own health record summaries through a portal called "HealthSpace," not unlike some of the proposals submitted in the U.S. for the development of provider led PHRs.

EHR Governance

Legal/Regulatory

The principal regulatory authority over EHR in England is the U.K. Government Department of Health. Authority is then delegated through various regulatory mechanisms, some of which are managed through agencies of the "NHS Connecting for Health" such as the Care Record Development Board (http://www.connectingforhealth.nhs.uk/crdb).

Kickbacks and self-interest referrals do not appear to be an issue in the U.K. since such opportunities are limited in a largely public-funded system. Abuse, when it occurs, is dealt with through disciplinary procedures for employed staff and the disciplinary powers of the professional licensing bodies.

Privacy and security are governed by Department of Health (DoH) regulation and policy in the context of and European data protection legislation. Fear of liability has not been a

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factor in inhibiting the use and sharing of electronic records. The use of secondary data for aggregated reporting is governed by a separate regulatory framework and resides in a separate subsystem on the Spine.

Healthcare Policy

Considerable numbers of policies in the NHS England and DoH govern how providers, health insurers, public health authorities and researchers participate in HIEs. Additional protocols about sharing electronic information are specified as needed, especially when it comes to using existing data in new and/or innovative ways. Policy in the U.K. is published as "The Care Record Guarantee: Our Guarantee for NHS Care Records in England" (http://www.connectingforhealth.nhs.uk/crdb/docs/crs_guarantee.pdf).

The rights of patients whose information is stored in EHRs are governed by NHS England policy and data protection legislation. There continues to be lively public debate over patient privacy; can an individual prevent the government from keeping his or her data in the centralized EHR database? Liability for providers who are using EHR has not surfaced as an issue. In all cases, general professional standards still apply. Each physician is obligated to perform under a commercial contract with the NHS England as a "National Service Provider." The major obligation of the NHS England is to act as the prime contractor of a consortium providing the Spine, infrastructure and associated services of the EHR system. Under the general NHS England contract with physicians, there are numerous additional contracts. Some are regionally based and some provide special services that cover different aspects of the National Programme.

Technology

The Spine acting as a central Summary Record contains only a small percentage of the information held in primary and secondary care systems. Although not in itself an EHR system, it is commonly referred to as England's EHR. The role of regional repositories has yet to emerge, though they are beginning to be scoped and implemented on a large scale.

The information model of the Summary Care Record is a fully conformant NHS England specialization of HL7v3 Clinical Document Architecture (CDA), except for the GP Summary that is based on the HL7v3 Clinical Statement Pattern. All Spine messaging is HL7v3 based, though the timing of its development means that it is only partly aligned with normative versions from HL7.org.

In England, EHR user authentication uses the Sun Identity Server along with smart cards for single sign on and SAML for exchange of user credentials. Patient and provider identity verifications as well as access to the Care Record Repository are deployed as services. At the present time, record update only occurs when the entire clinical documentation or GP Summaries are replaced in total, although a full archive and audit record is kept of all transactions.

Services along the NHS EHR Spine are provided through a single virtual endpoint and are supported by a message handling service that employs ebXML dependability patterns and Web services within a service-oriented system architecture. All clinical data on the Spine uses SNOMED CT coding that is maintained proactively by the NHS England as it introduces new codes and subsets to enable health coverage.

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The NHS Spine Project began in 2003. Live use of supporting systems is currently well established and clinical records have started to phase in from 2007.

Total cost and ROI are difficult to measure. Although some hard figures are publicly available, the ancillary costs of implementation at non-Spine endpoints as well as the nature and extent of any savings associated with using the new infrastructure are not widely known.

Software cost is split between framework services such as the Spine Directory and Demographics Services, the Summary Care Record and the many adaptations necessary to local systems such as EMR/EPR. There are no published costs available for software, hardware, implementation, training or attempts to establish interoperability across disparate systems. Contracts call for payment based on results and all costs are met by the NHS England, either directly (via central funding) or indirectly (via individual organization budgets). Some integration costs have been absorbed by vendors as a cost of continuing participation in the market.

Integration with non-health communities is beginning to gather momentum and social care integration pilots are getting under way in 2008. These are natural successors to pilots in broader scope multi-agency information sharing that have already been underway for a number of years, some of which are now beginning to bear fruit in terms of sustainable, legislation-backed interoperation.

Adoption

The adoption status of the National Summary Care Record has been described above. While moving forward at a steady pace, regional and local organizations vary in their IT maturity and adoption of EHR/EMR systems. Primary care has been, and continues to be, a leader in the adoption of EHR as the result of many years of policy requirements and financial incentives from the NHS England (as the single payer source in the U.K.) and GP practices (as independent businesses). Successful adoption has also been attributed to leadership by highly committed physician champions and carefully targeted communication, regulation, assistance and incentives on the part of the NHS.

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About the Contributors

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WALES

Overview of the Wales Healthcare System

With a population of 3 million people, Wales is one of four Home Countries that comprise the U.K. Healthcare is provided predominately by the National Health Service Wales (NHS Wales) and is free of charge to the individual.

Health funding and policy are made at the central government level by the Welsh Assembly. NHS Wales receives its allocation as part of the negotiation between Westminster (seat of U.K.'s central government) and the Wales, Scotland and Northern Ireland governments. The sum available for health and health services in Wales forms part of the 'block grant,' the total funding for all areas for which the Welsh Assembly has responsibility.

Wales spends over £4 billion every year on its health services and this figure is expected to rise. Corporate governance in healthcare is led, directed and controlled by health bodies such as NHS Wales Trusts and local health boards.

Primary care services are provided by approximately 1,800 GPs in health and surgical centers throughout the country (www.wales.nhs.uk). NHS Wales Direct also offers primary care services through a 24-hour nurse telephone helpline. Nurses provide on-demand information and advice to patients about health, illness and healthcare services.

There are 14 NHS Trusts in Wales that manage 135 hospitals with 15,000 beds. Most patients have access to a District General Hospital (DGH), but there is also a network of community hospitals across Wales that provide more limited services. Wales has one main teaching hospital—the University Hospital of Wales based in Cardiff.

The NHS Wales provides mental health services in partnership with government social services departments. It is also responsible for all emergency, paramedic and patient transportation services throughout Wales.

Although the general health of the Welsh population is improving, it is still lower than other European countries and its death rate is higher (*Health Status Wales 2004-2005,* Welsh Assembly Government Chief Medical Officer). Cardiovascular diseases—especially heart attack and stroke—are responsible for the majority of deaths followed by followed by cancer and respiratory disease. Together, cardiovascular disease and cancer account for two-thirds of all mortality.

The Minister of Health and Social Services of the Welsh Assembly Government is ultimately responsible for the National Electronic Health Record Initiative. It has created the IHC and placed it under the auspices of the Director, NHS Wales. IHC programs are designed to increase electronic connectivity of care across the country. At the core of this initiative is the implementation of the Individual Health Record (IHR).

Wales Individual Health Record (IHR) Program

Strategy

The goal of the Welsh IHR is to shift the focus of HIS from healthcare organizations to individual patients. Information services are, therefore, built around the needs of patients

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(patient-centric) rather than expecting patients to navigate through the labyrinth of organizations involved in their care. By providing both access to information and information-based services (i.e., care advice and care alerts based on health status), the NHS Wales anticipates that the system will focus on both wellness and prevention of disease and directly involve the patient in his own care. The available comprehensive information will include health data supplied from all sources throughout the patient's lifetime. The management of that information will rest with individual clinicians and institutions, including the hospitals and GP practices that are responsible for the creation and maintenance of the patient's EHR. This concept of collaboration through connectivity is central to the design of the IHC.

Electronic health data will be delivered by four primary architecture components:

- The Life Long Record (LLR)
- The Individual Health Record (IHR)
- The Welsh Clinical Portal (WCP)
- MyHealthOnLine

The Life Long Record

The LLR will be stored and maintained locally by the GP. Each patient is assigned to a GP to be his/her primary care giver within the NHS Wales. The hospital can coordinate inpatient care with the GP by providing a Discharge Summary or Outpatient Letter. These letters are being transformed into electronic messages with the patient's diagnosis, treatment, prescriptions, key test results and outcomes from the hospitalization. Some of this information will be coded through existing and evolving standards while other information, such as clinician progress notes, cannot. The ultimate goal is for all clinical information to be standardized and exchanged electronically. This model makes the GP accountable for manually populating and maintaining the LLR with data received from other care providers.

The Individual Health Record

Whereas the LLR contains detailed patient information collected from all sources, the IHR contains the patient's current summary information.

Most of the patient's healthcare data will remain within the GP's LLR and the Hospitals' Patient Care Record (PCR), including patient location and scheduling while in the hospital. The IHR, however, contains a higher level of information such as:

- Personal details, including demographics such as name, date of birth, address, special needs, primary language spoken and emergency contacts;
- Care relationships, listing all healthcare providers involved in the patient's care;
- Summaries of health events that occur in urgent care settings like hospital admission and discharge summaries, referrals, diagnostic tests performed and procedures completed; and
- Current health status, including current medications and diagnoses.

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The Clinical Portal

The WCP will facilitate the exchange of patient information between GPs, hospitals, outpatient laboratories, radiology centers and other healthcare providers. Data is accessible from both the IHR and LLR.

As an example, while in the hospital, the patient's information will be recorded and maintained in the local facility system known as the Personal Care Record (PCR). At the time of discharge, the clinician will authorize the final record and then send an electronic discharge summary to the IHR and LLR.

MyHealthOnLine

MyHealthOnLine is a portal that can be used by the individual and/or his designated sponsor (e.g., family member). Through the portal, the patient will have access to a number of information services including the LLR. Eventually, the patient will have the ability not only to view his health record and test results, but also to enter information about health events outside of the NHS Wales such as treatments outside of the country, self care and use of over-the-counter medicines.

Messaging and data exchange must conform to a basic set of standards that include provenance (credentials and attribution of the document) and purpose (documents that exchange information with the LLR and IHR).

The information stored in both the LLR and IHR is owned by the patient but held in his behalf by the "custodian" of that record. As is the case in England, Welsh citizens can opt out of the health record program. All requests to access the electronic patient information must come from an authorized user controlled first through authentication and then by determining permissions. Permission is granted on the basis of several factors including the role of the requestor; the nature of the request; and limits set by the individual patient. Any misuse of patient information is determined through audits and subject to professional, employment and legal sanctions.

Technology and Status

The IHC has made significant progress towards developing the services necessary for a national electronic record system. The conceptual architecture has been defined and many of its elements and concepts have been piloted or implemented. These implementations have gained support from healthcare stakeholders, allowing IHC to improve its architecture in the process. The IHC thus continues to make significant progress by utilizing a combination of budgets within the local health community as well as providing incremental national funding.

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Table 1, developed from the 2007 IHC National Architecture Standards, lists the key IHC/IHR initiatives along with their current status and future objectives.

Table 1: Extract from IHC's National Architecture Standards Document, September, 2007

Architectural Element	Current Status	Future Objectives
LLR/ IHR Information services that provide the information and support the activities for the overall health and care of patients across all care providers over time.	IHR implementation has started with the provision of a primary care record into the Out of Hours (OOH) Government Service.	Pragmatic migration to a comprehensive LLR and IHR across all emergency and elective care settings for acute and chronic conditions. The sources of information will expand over time until the full vision is reached.
WCP The country-wide standard portal enabling entry into the care management system and exchange of information. Technically, the portal will be created using Web development tools within a standard enterprise portal development technology.	Currently testing at three early-adopter Trusts and already piloted in Cardiff and Carmarthen. Other Hospital Trusts and Health Solutions Wales (HSW) have agreed to collaborate.	To provide a single user interface for most secondary care clinicians, replacing existing clinical workstations. The portal will allow clinicians to: • create, exchange, and manage clinical communications • view an individual's records • schedule and document care • track progress • request investigations and prescribe treatment
PCR Provides a detailed record of a patient's care provided in a specific care setting. It brings together information from other sources such as PACS or pathology systems, or allows it to be created directly through the use of the clinical portal before integrating it into the record.	The first version of the clinical portal will request information from appropriate hospital systems. Future versions will establish the PCR as a set of services and information standards.	NHS Wales organizations will need to contribute relevant information to the appropriate PCR through the use of standard messages. The clinical portal will provide all NHS Wales clinicians with access to the PCR.
Patient Identification Each individual will have a single, unique, lifelong identifier that can be readily obtained and used in all healthcare records.	NHS Wales numbers are employed in communications between organizations. Significant investment has been made to increase the use of the NHS Wales number in existing IS and health records.	Services will become available to link identifiers

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Architectural Element	Current Status	Future Objectives
Welsh Demographics Service (WDS) Information services include the allocation of NHS numbers for Welsh residents and newborns, the management of primary care registrations, tracing or finding NHS Wales numbers and other national identifiers as well as the availability of demographic information.	WDS is in place in existing systems. The Welsh Administration Register is the definitive source of national demographics	WDS will be realized as a SOA model
MyHealthOnLine Provides patients with access to their records, enabling them to take an active part in managing their care.	The first pilot provided basic facilities for patients to record information about their care including a special module to record progress during maternity. A second pilot is planned.	This will become the standard process for patients to view their health information and interact with healthcare providers.
Electronic Referrals A single mechanism for the secure direction and real time communication of structured patient information between service organizations.	Project looking at possible use of SCI Gateway (existing NHS Scotland solution).	Will be delivered via the clinical portal; any existing solutions must migrate to this service.
Access to Care Information Facilitates access to high quality comprehensive information for health services staff and the public.	Map of medicine being rolled out via a structured Websites for clinician and patient access	Access will be incorporated into clinical portal and MyHealthOnLine
Messaging Fabric Provides collaborative and interoperable functionality using the principles of a SOA and defined service interfaces. The Messaging Fabric will be the mechanism by which communication between service interfaces will be achieved.	An interim version of the Messaging Fabric is being established for the first phase of the clinical portal	The Messaging Fabric will become the standard means of communication between IS, including those outside NHS Wales, using SOAP protocols. Additional WS* standards such as WS-Security and WS-Addressing will be integrated to the SOAP protocol.
Clinical Document Metadata Clinical documents will have header and body	Generic Information Framework for Individual Records (GENIFIR) is being developed in stages.	HL7 v3 CDA will be used to the extent it is viable for NHS Wales.

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Architectural Element	Current Status	Future Objectives
components and, where appropriate, conform to the HL7 CDA. The body will enable communication of free text, semi-structured and structured clinical data.		
Clinical Coding and Terminology Intent is to move towards a more coherent and consistent use of clinical coding and terminology following a pragmatic approach, with priorities based on the practical, immediate needs of clinical safety, efficiency and improved patient experience.	The approach recognizes that there is no single coding system that is suitable for all purposes. Currently, coding and terminology systems used are largely heterogeneous and unplanned.	A limited number of large code sets will be mandated, with systems using the most appropriate of these.
Message and Service Definitions Approach based on multiple information services working together, as embodied in a SOA. In this approach, the emphasis is on information services rather than IS, separating what the IT does (service) from how it is put together (system).	Pilot projects exist in the following services areas: pathology requesting and reporting; waiting list enquiries; admission and appointment status; patient identification and demographics; and user authorization and authentication.	The intention is to develop generic messages where, for example, one message design is able to handle queries about the whole Admission/Transfer/Discharge (ATD) process and beyond. Normative standards will be used where applicable: HL7 CDA, SCI, CEN TC251, ENV 13606.
Security of Data All IS will preserve confidentiality, integrity and availability of information. • Confidentiality: ensure access to only those authorized; • Integrity: safeguard accuracy and completeness; • Availability: ensure authorized users have access to information and associated assets when required.	Following standards set by BS7799 / ISO27001. Enforcement will be supported by continuous monitoring of access audit trails. Misuse of health data will be investigated in conjunction with existing professional standards of conduct related to information privacy.	NHS Wales Security Policy and ISO27001 will be followed.

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Architectural Element	Current Status	Future Objectives
Staff Authentication and Authorization A national comprehensive service for the identification and authentication of staff in NHS Wales will provide for single sign on and other integration between eHealth applications and then link to a National Directory.	Development will occur incrementally with the first implementations being part of the clinical portal and Welsh Demographics Service.	Organizations will be advised to use national authentication and authorization services for access to local services in order to facilitate single sign-on.
User Directory A single source for NHS Wales staff identification and authentication will be used for all national applications.	All organizations will move user identities into the National Active Directory by March 2009. All new national applications must have user identities stored in the Active Directory.	National Active Directory will become the primary source for all user identifiers
National Network A single robust broadband network that provides ubiquitous IP communications across NHS Wales.	Single wide-area network in place. Code of Connection provided by service provider. This is a Multiple Protocol Label Switching (MPLS) based on Virtual Private Network (VPN). All NHS Wales organizations in Wales will connect directly or indirectly.	Will become a closed VPN within Wales when the new public sector wide network is implemented.

NHS Wales IHR Approach

NHS Wales IHC program employs a highly collaborative approach to its strategy. Since 2005, IHC has hosted numerous events at which leading clinicians and healthcare leaders meet to review the IHC program, its conceptual architecture and clinical implications, and then reach consensus for its implementation.

The development and implementation of the NHS Wales LLR/IHR follows a set of priorities based on the following principles:

- Focus on achieving benefits at every possible point in the implementation
- Effectively utilize the information already stored in current healthcare IS
- Deploy services that facilitate exchange of patient data through the Web portal
- Prioritize scenarios including:
    - Support of urgent and unscheduled care such as GP after-hours

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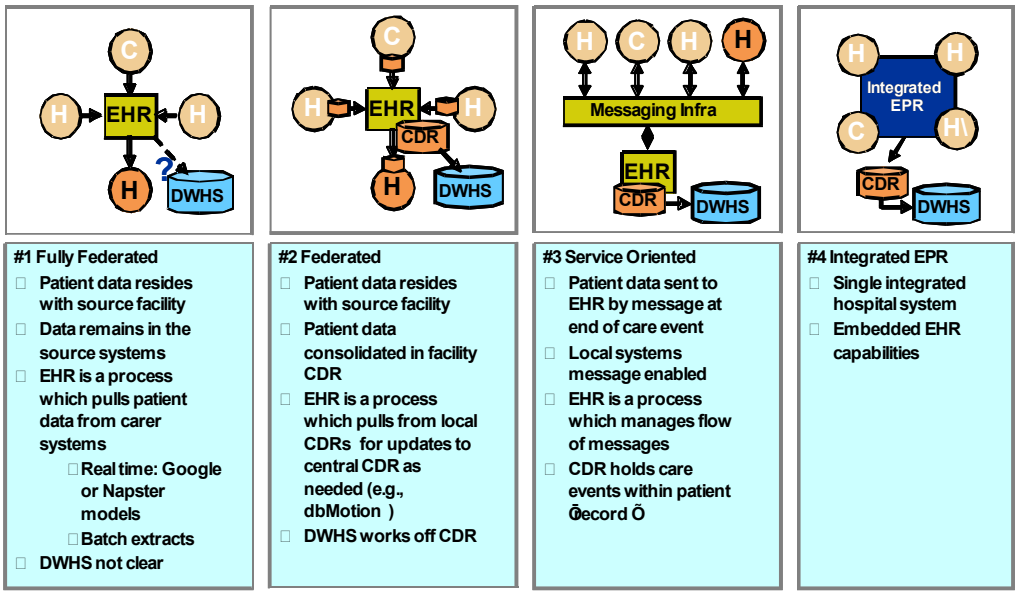
- Support of scheduled care whenever “internal” information services fail; for example, when “the notes can’t be found.”
- Support of self-care through direct use of the IHR by the patient
- Identification of long-term conditions (e.g., chronic diseases) and unified assessments

The conceptual architecture used by NHS Wales IHC to implement the LLR/IHR best represents a “Federated Model” – category #2 in the chart below. This approach was determined to be the most effective given the existence of variable legacy systems and the cost/time involved in replacing them within the hospital and other healthcare settings.



Governance

Legal/Regulatory

The patient legally owns his health record while the clinician is its custodian. Although regulation makes this clear, patients do not normally perceive themselves as owning their records and care-givers often behave as if they do.

As is true in most countries, the privacy of health data is taken very seriously in Wales. All process and technical design activities address privacy requirements including the creation of “sealed envelopes” that contain sensitive personal and health-related information. Patients can employ these sealed envelopes to provide information on an as-needed basis.

Healthcare Policy

In 2003, a national review of health and social issues recommended restructuring health and social care delivery. It suggested that an integrated system be developed to promote health and wellness instead of always focusing on acute and intermittent care. The review recommended that patients take more responsibility for disease prevention and early intervention, and made funding information management and technology a high priority of the Wales Assembly Government. Since then, government health policy has focused on improving health and wellness through the delivery of integrated and better informed

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healthcare. The IHC was created to develop the information services necessary to enable this policy.

In 2004, through the "Making the Connections" document, the Welsh Assembly Government described its plan for public services. Its plan included bringing patients onto center stage and facilitating the full use of all healthcare resources.

In 2005, the "Designed for Life" document described the Welsh Assembly Government's plan for future healthcare in Wales through 2015. The overall goals were to improve overall health and to reduce and eliminate inequalities in healthcare by encouraging patients to take a more active role in their healthcare. The document recommended engaging service users and clinical leadership to provide quality assured clinical treatment and evidence-based medicine. It suggested building accountability into the healthcare delivery system, taking a more corporate approach so that organizations would work together to promote health.

Adoption

As noted in the table of key elements, adoption has been relatively limited across Wales. But the concepts of the IHR have been validated in the "Out of Hours" implementation of the IHR. In this after-hours setting, the electronic solution has been adopted by primary care clinicians who provide care through the night when patient health information was formerly unavailable.

Next Steps

Over the next 12 months, IHC will focus on four major areas:

- Providing clinicians with access to the IHR whenever they deliver urgent, unscheduled patient care.
- Migration of data into the LLR maintained by GPs and assimilating GP systems into a nationally hosted environment.
- Development of the WCP and PCR Service to support continuity of care for patients with long-term conditions.
- Empowering patients by allowing them to see their health records through MyHealthOnLine.

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The key documents which provided information regarding the NHS Wales' IHR program can be found on the Informing Healthcare Web-site (www.wales.nhs.uk/ihc).

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SCANDINAVIA

DENMARK

Overview of Country Healthcare System

Denmark is a part of Scandinavia, and is located to the north of Germany. Denmark has a population of a little over 5.4 million people. Most of its territory is accounted for by the Jutland peninsula, up from continental Europe towards her Scandinavian partners, Norway and Sweden. Copenhagen is Denmark's largest city with a population of roughly 600.000 inhabitants (1.6 million in the near region). Aarhus is the second largest city with an estimated 300,000 people and the third largest is Odense, placed in the middle of the island of Funen with about 200.000 inhabitants.

Queen Margrethe II involves herself directly in national affairs. Her constitutional duties as head of state involve foreign tours, regular meetings with government, and diplomatic functions. Political power is vested in the Folketing, a 179 seat parliament elected by universal adult suffrage, whose seat is in the Christiansborg Palace in Copenhagen. Denmark has two tiers of local government – regions and municipalities. The country is divided into 5 regions, each with an elected county council and council chairman responsible for policies on primarily hospital matters. There are 98 municipalities, whose responsibilities are protection of the environment, local roads, nursing homes and home care, social services, and schools. The Danes tend to be avid followers of political events, frequently paying close attention to the debates in the Folketing that are carried on live television.

The state and municipalities levy taxes to finance health care. Countrywide reimbursement of 'public' money is done between the operating actors.
In January 2007, the regions and municipalities were re-established as part of a major reform of the local government structure in Denmark. Fourteen (14) former counties were merged into five (5) regions, and two hundred and seventy-five (275) municipalities were merged into ninety-eight (98) larger municipalities. The reform has (and will have for years to come) a major impact on the general IT market situation in Denmark.
As a result of the reformation, all local authorities are struggling to get consolidated organizations, infrastructure, systems and strategies in place. There are more than 3,500 hospitals, pharmacies, home care agencies, general practitioners and specialists practicing in Denmark.

The Danish healthcare sector is basically operated by the following entities:

- The State/Government agencies (and the Association of Regions - 'Danish Regions' and the Association of Municipalities) – responsible for central regulations and services and cross sector initiatives.
- General Practitioners (GP), specialist clinics and a few minor private hospitals – all operated as private business units.
- Regions – responsible for all public hospitals.
- Municipalities – responsible for nursing homes for the elderly, home care activities and the emerging health centers (rehabilitation and preventive care).

The citizens of Denmark are concerned with availability (waiting times to obtain a specialist appointment), efficiency and quality of health care services. Information

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technology may offer new opportunities to reduce strain on the health care delivery system and help improve conditions.

In 2003, a report from the EPJ Observatory cited that the hospital IT budget increased, on average, from one percent (1%) of total budget in 2002 to two-point-eight percent (2.8%) in 2003.

National EHR Program

National IT/ICT Status & Strategy
Denmark and Norway are examples of two (2) Nordic countries that focused early on building national networks. Now that they have been built the focus has shifted towards providing patient centric healthcare services across organizational boundaries with a focus on security, regulation, standardization, and applications.

The EHR market has evolved through the initiatives of the National Healthcare Informational Technology (IT) strategy together with regional and municipality procurement processes of specific systems. In 2003, the Ministry of Health approved an IT strategy for the entire health-care sector for the period 2003 to 2007. In 2006, the Minister of Health promoted changing the existing strategy to a more coordinated governance structure. The changes were initiated in 2007 with the formation of a formal central independent organization, The National EHR Organization with deep connections to the State (e.g., the National Board of Health), the Danish Regions and the National Association of local authorities in Denmark.

All of the national databases are based on proprietary models while regional EPRs are based either on regional/local models (Systematic, Acure), European pre-standard HISA (WM-DATA), HL7 (CSC Scandihealth), or European pre-standard EHCRA (CSC Scandihealth). G-EPJ, which is sponsored by the National Board of Health, has been partially implemented in different solutions.

The collective health IT architecture consists of a number of different elements;

- National healthcare network: VANS operated EDI network, and Internet-based network for other traffic.
- Healthcare portal: Service oriented application using services from other applications.
- National registers, from legacy mainframe registers (National Patient Register) to Service-Oriented Applications (Personal Medical Profile and e-Journal).
- Regional and local EPR systems: Older versions such as traditional Windows client server systems and extended legacy mainframe systems. There are new developments from all major suppliers to include J2EE service oriented systems.
- Home Care records solutions: Windows based systems which are being converted to Service-Oriented systems.

In Denmark, EHR financing vary from the local to national levels:

- Regions and Municipalities own their healthcare institutions and finance their EHR systems.
- State and Associations of Local Authorities either finance or co-sponsor central or cross-sector services and projects.
- GPs act as individual business units and purchase their own systems.

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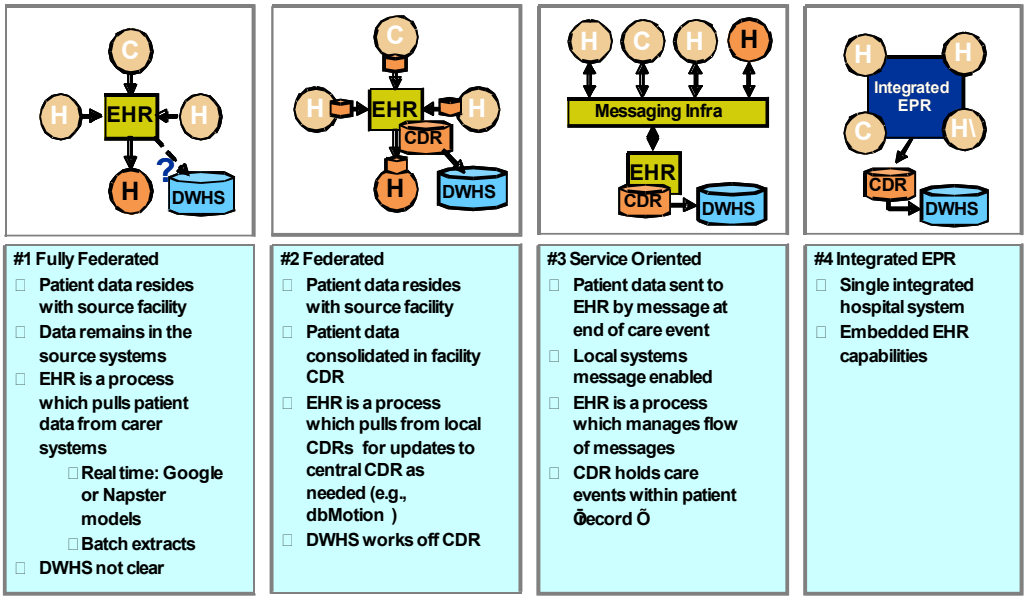
None of the major EHR vendors that supply hospitals have shown interest in the general practitioner office market segment. Therefore, the ambulatory sector is serviced by approximately 15 small local EHR vendors supplying those systems.

The main system suppliers for municipality purchases of home care systems are Rambøll, Zealand Care and CSC Scandihealth. The primary system vendors for regional procurement of EPR systems are IBM (Acure), LogicaCMG/WM-data, Systematic and CSC Scandihealth.

National/Regional EHR Approach



The existing NHR EPR approach is primarily Service Oriented #3. It consists of a national healthcare network supporting about 50 different types of messages. There are different types of centralized databases imbedded in the national framework and a couple of them serve as a CDR in different areas.

Other centralized services are also available in the national network including the national healthcare portal and drug prescription services.

The new Danish healthcare IT strategy is also Service Oriented #3. It has been expanded, however, to include not only the CDR but other services as well. Part of the new strategy is to align requirements to local systems while centralizing certain mature functionalities (approaching a category 4 on certain elements). The new strategy contains a much stronger governance structure, coordinated by the National EHR Organization with the ability to intervene in local projects.

The national network, MedCom, became a permanent organization within the Danish structure in 1999. It coordinates several Service Application initiatives along with all technical and legal aspects related to them, including:

Hospital and Home Care Communications: MedCom established its Local Authority Project (2002-20005). Among its goals was to achieve large scale use of MedCom's

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standards for communication between hospitals and home care. All home and residential care are covered by local authorities.

E-Prescribing: MedCom's message standards are also used by primary care physicians for e-prescribing. The Danish Health Portal allows patients to refill their prescriptions directly on line just like it is possible for the home care employees to renew the prescriptions of the elderly from the home care solutions.

The Danish National Health Portal: The Danish National Health Portal went live in 2003. It is a combined portal for patients and healthcare professionals. The infrastructure of the Health Data Network is also the basis for the development of the Danish Health Portal. It is the main access point to the primary health portal of the Danish Health Authorities and enables communication and services to be delivered between patients and their health professionals. Additionally, the Health Portal provides a reliable place for patients to obtain advice on health, medical treatment and disease prevention.

Medical Reports: MedCom standards have also established templates for over 40 types of clinical reports based on consensus of healthcare professionals. This includes Patient Discharge Summaries from hospitals.

Personal Electronic Medication Profile: The Personal Electronic Medication Profile (PEM) is a national database of drugs prescribed by GPs and is now being expanded to include hospital prescriptions and admission from home care and nursing homes. This Solution is run by the Danish Medicines Agency.

Security: All healthcare systems require user identification and authentication passwords. There are strict rules regarding logging of the use of the systems, i.e. read, write, change, delete. A national digital certificate and signature solution is available for patient and healthcare-professional access into the National Health Portal. Within local systems, however, the typical security model is role-based. Denmark does not yet have a national role model, but it is expected to create one as part of the new national strategy. In order for a clinician to access a patient's electronic medical record, there must be an active treatment relationship with the patient. Patients can also restrict access rights to their records but, similarly to other countries such as the UK, access may be gained in emergencies through a 'break the glass' functionality.

EHR Governance

Legal/Regulatory

The Danes recognize that the use of technology in healthcare has the potential to improve welfare while simultaneously improving the efficiencies of the health delivery systems. The government is highly focused on the risk of creating systems that allow violation of confidentiality and security. To address these issues Denmark enacted the Patient Rights Law, a departmental order from the National Board of Health. The law addresses consent and exchange of information between healthcare parties, handling of personal information, identification of patients, hospital-based IT-security, and the handling of data by public authorities.

In Denmark, data is normally considered owned by the authority responsible for the system into which the data was entered, even if entered by the patient himself. Legislation gives the patient right of access to documents, including electronic medical

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records. The management of that patient data, however, is performed only within specialized applications or applications that have specialized functionality. Provider liability associated with EHRs does not appear to be a specific issue in Denmark. Entry of clinical information into the GP-system is still at the discretion of the General Practitioner or practicing specialists. All services are reported to the National Health Board. If a doctor provides more treatments or makes more referrals than the average of his peers, the National Health Board may restrict reimbursement to that physician. If a GP or practicing specialist prescribes more medicine or has an aberrant pattern of prescription, the National Health Board contacts the doctor for explanation and may restrict his prescribing rights.

Healthcare Policy

Although there has been some success in creating standards for healthcare IT in Denmark, an even greater effort is still needed to ensure interoperability. The National Panel for Standardization of Medical Informatics has published a popular booklet on Danish and European standardization work. Additionally, there is a Danish Standardization Committee. HL7 is expected to play a key role in the revised national Healthcare IT strategy. The major hospital vendors in the Danish market claim that their products are prepared for HL7, but to date, no installations have been completed. LOINC and SNOMED are not used in Denmark at this time but it is expected that the Country will adopt SNOMED in the future.

Specifically relevant to MedCom, an open standard for EDI-mail has been developed to ensure compatibility with existing VANS- based communications and interoperability between the new IP- based network and the VANS- based network. It is currently possible to send any kind of EDI communication (XML, EDIFACT, HTML, HL7, DICOM) between the two systems. The National Healthcare Network is based on EDIFACT messaging and their newer XML equivalents. EDI messages go most often through VANS suppliers for transportation. Use of the internet is only permitted in closed and secure networks but is seldom used any more.

G-EPJ represents an ambitious attempt by the National Board of Health to establish a new healthcare reference model to support problem-oriented, interdisciplinary medical practice and records. This initiative was a core part of Denmark's National Healthcare IT strategy. In reality, it has struggled with the model development of G-EPJ, especially in systems implementations and support from practicing clinicians. G-EPJ has been mapped into HL7 in order to integrate the Danish IT-solutions into a global framework.

The normal way of viewing an index type application is by storing a copy (extract) of the information in a central repository. Such centrally-located databases exist for the National Patient Register, the Personal Medicine Profile, and the e-Journal. Data may also be stored locally for full EPRs and home care solutions.

Guidelines have been established to govern the acquisition of a new application and the services to implement it. Procurement of products and services above 200.000 EUR are regulated by European Union procurement rules which, in practice, requires that most procurements be made through public formal tenders.
With regard to outsourcing, systems operation is often outsourced, yet major internal IT department outsourcing is almost non-existing.

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Technology

Health care services across the Nordic countries benefit from their collaborative efforts around technology. For example, Norway, Denmark and Sweden have linked each of their national networks (KITH, MedCom, CARELINK respectively) to form the Nordic Healthcare Net. Additional examples of collaboration include the Nordic Center for Classifications in Healthcare, the Harmonization of EHR Architecture (healthcare interest) and the Collaborative Network of Nordic eHealth Competence Centers.
The following denotes the number of years of operation for the systems/initiatives:

- National Patient Register, 30 years
- Personal Electronic Medication Profile (PEM), 2 years
- E-journal, 4 years
- Sundhed.dk, 3 years
- Patient access (phase one), 2 years

The first dedicated EPR and home care solutions have been in place for 12-15 years while the first GP systems have been available for more than 20. Routine tasks are carried out electronically by healthcare professionals on a daily basis. These include hospital admit/discharge/transfer functions, medication administration, clinical process (including clinical planning, documentation and monitoring of results and vital values), scheduling and physician order entry.

Adoption

MedCom is a national healthcare data and information network set up in 1994 to enable secure electronic communication between all healthcare professionals and the social care sectors of Denmark. One hundred percent of emergency physicians, 92% of general practitioners, 65% of all specialists, 100% of hospitals, 100% of pharmacies, and 98% of Laboratories use MedCom for electronic communication. MedCom's "Internet X-Ray Image and Description Search project also provides healthcare professionals with direct Web access to essential patient information stored in the Diagnostic Radiology system of another county or hospital. The MedCom message standards are also used for e-reimbursement from public insurance organizations to GPs, specialists, pharmacies, and dentists. In addition, the MedCom message standards are also used to generate eDischarge letters and referrals between hospitals, GPs, specialists and physiotherapists. It can be used for submission of eLaboratory, ePathology, eMicrobiology, and eRadiology requests and reporting of the results to GPs, specialists, and other Laboratories and Radiology departments in both State and private hospitals. Finally, eCorrespondence (free text letters) between clinicians and eMunicipalities, including hospitals and community care centers, are facilitated by utilizing MedCom standards too.

Patients can use the Danish National Health Portal to book appointments with their general practitioners. However, most general practitioners have not yet published their schedules on the web site and, therefore, most appointment bookings are still done through phone contact.

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Outcomes

The investments in IT in Denmark are mainly driven by the pressure of its citizens through their political representatives. These constituents demand a modern, coherent healthcare service system that can avoid errors and duplications, decrease waiting time and improve clinical outcomes to rival the best seen in other North European countries. In recent years, numerous research studies and surveys have attempted to document the ROI of implementing EHR/EPJ in the Danish healthcare sector. Several studies confirm significant time savings resulting from electronic communication, allowing more time for the care and treatment of patients. This is particularly true in hospitals. In addition, financial savings have been predicted to be as high as 84 million EUR annually. One 2004 study, 'The cost benefit of electronic patient referrals in Denmark' suggested that "... full adoption of electronic referrals will result in a potential annual savings of 3,512,146 Euro or 0.65 EUR per capita."

Other studies suggest that electronic health records save 50 minutes per day in each general practitioner's office that phone calls to hospitals are reduced by 66% and that 2.3 minutes are saved per message. This translates into 60 million EUR saved per year. An additional savings of 22.5 million EUR, or 25 thousand person months, can be saved in human resources.

Benefits

Based on experiences using MedCom standards, electronic communication enables direct reuse and automatic validation of data prior to sending it. It also removes the human error resulting from incorrect re-entry of data and flawed interpretations of hand writing. A 2004 study entitled "The cost benefit of electronic patient referrals in Denmark" found that 217,160 hard-copy referrals per year that are sent to hospitals via the postal service take an average of 1.33 days longer to reach the hospital than an electronic or fax referral. This extends patient waiting time and, for patients who are unfit to work creates a cost to society. General practitioners estimate that between 5% and 10% of patients referred to the hospital are classified as unfit for work at an average cost to society at 939 EUR per day. This suggests that the increased patient waiting times caused by mailing referrals could cost Denmark's society 1,343,026 EUR per year.

MedCom standards allow hospitals to use electronic referrals, send discharge summaries and avoid data re-entry. The professional quality of referrals has risen as a result. Interestingly, forty-five percent (45%) of MedCom messages are referrals. Through MedCom standards, access to specialist's and retrieval of their reports has significantly improved.

The introduction of electronic medication systems has already reduced the number of medication errors in Denmark. In addition to catching potential errors, the system also sends documentation of medication errors to risk managers so that errors can be avoided in the future. Moreover, medication errors and other unintended events are anonymously reported to a national database, run by the National Health Board.

Implementation Experiences

Prompt, complete and valid information regarding the entire period of patient care is perhaps the most important benefit derived from MedCom. This has improved

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communication and resulted in positive organizational change in the Danish healthcare industry.

However common across all countries, barriers still exist in Denmark's healthcare system, due to bureaucracy and the fact that laws lag behind technology possibilities. Even after technical problems are solved, it remains to be seen whether or not organizations can overcome IT adoption challenges. Budgets are increasingly strained, causing government to make choices as to its funding in healthcare. Finally, a lack of common standards continues to plague the healthcare information technology field despite continuing efforts to improve the situation.

Next Steps

Little is known about the next steps to be taken within the EHR/PHR/HIE/EPJ program. What is known is that hospital biochemistry and immunology departments will soon be able to receive electronic MedCom requests from GPs through the Danish National Health Portal.

New frontiers in healthcare information technology will soon be realized in Denmark. One such frontier is home care. As the Danish population ages, care in the home is increasing and will present new opportunities and challenges for the use of information technology. To date, all 98 municipalities have invested in homecare solutions, consisting of functionality for administration, planning and clinical documentation.

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NORWAY

Overview of Country Healthcare System

Norway wraps around northwestern Scandinavia, stretching 1,752 km from southernmost Lindesnes across the Artic Circle to the North Cape. As of 2005, approximately 75 percent of the population lives in urban areas. The country has been a NATO member since 1949 and is the celebrated home of the Nobel Peace Prize.

Since the 1970s, the economy and its welfare policies have been buoyed by the sea – from its oil extraction in the North Sea to its strong growth in the fishing industry. Norwegians' benefits include, among other things, government sponsored university education and free medical care. The country's social welfare programs are politically sacrosanct. Even when the longstanding rule of the left-leaning Labor Party came to an end in 2001, the new centre-right government still continued the social welfare programs.

Two referenda on Norway's membership in the EU ended in a "no" vote although a 2004 poll suggested that support for membership had risen to above 50 percent. For many centuries, Norway was forced to cede sovereignty and its citizens became minor inhabitants in someone else's kingdom. In 1905, a constitutional referendum changed that and established a Norwegian constitutional monarchy with Haakon VII on the throne. Haakon VII's descendants rule Norway to this day with decisions on succession of the monarchy remaining under the authority of the Storting (Parliament).

The state provides healthcare funding to the counties and municipalities but municipalities can, and increasingly do, levy additional taxes for this purpose. The 434 municipalities are responsible for the management of primary care, but the state has a more extensive role and has been responsible for the 72 hospitals in the regional hospital service since 2002.

National Healthcare Reform has organized the hospital sector into four regional health authorities; North-Norway, Mid-Norway, South-East Norway and Western Norway. These four regional heath authorities are required by law to cooperate with one another with regard to IT. Like other Nordic countries, all care providers are regulated to document what they do.

The citizens of Norway are concerned with the availability (including wait times), efficiency and quality of the healthcare services. While IT may not immediately improve these areas, it may offer new opportunities to reduce strain on the healthcare delivery system.

Central financing for Te@mwork2007 provided 222 million NOK over the course of three years. Additional contributions from participating partners (e.g., hospitals) are estimated to be far greater than 222 million NOK already pledged. Funding for the National Health Net and electronic communication has been a priority for several years and accounts for between 38-39 percent each of the central financing budget.

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National EHR Program

National IT/ICT Status & Strategy

Denmark and Norway are two examples of Nordic countries that focused on building national networks early and are now addressing activities to increase communication across those networks. These activities must consider any issues pertaining to security, regulation and standardization as well as the applications themselves.

Norway's progressive national IT strategy encompasses a massive patient-centered, cross-government initiative designed to give businesses and patients access to digital public services. Communication to electronically deposit and retrieve information is structured to work through a national Internet portal.

Norway is committed to leadership in customer service through a "virtual service centre" and the continuation of Høykorn, Norway's support program for broadband and "digital competence." Te@mwork2007 is the latest (2004) e-health roadmap drafted by the Directorate for Health and Social Affairs. It calls for the expansion of electronic communication across the nation to promote access by patients and their relatives into such service agencies as pharmacies, municipal health and social services.

The national healthcare network now includes all hospitals and a significant proportion of PCPs. The network facilitates telemedicine and the interchange of electronic messages (lab reports, referral and discharge letters and radiology reports). It also offers government-level security for safe access to the Internet for Web-browsing and e-mail and is now widening its spectrum of services.

All hospitals, with one exception, have implemented an EHR system. There are three hospital EMR systems used throughout Norway. The hospitals in North-Norway and the smaller hospitals in South-East Norway use DIPS. Very few hospitals use the Infomedix system from TietoEnator. The hospitals in Mid-Norway and the larger hospitals in South-East Norway use Siemens Doculive. In 2007, the Western Norway Regional Health Authority was in the process of replacing its current vendor.

The primary EHR systems used in GP's offices are Winmed, Profdoc Vision and Infodoc. All four of these systems are designed as multi-user systems to be run on a local network.

Another electronic resource is the Practice-Related Electronic Knowledge (PEK) initiative. PEK is a subproject of the National Health Library and provided access to clinical guidelines for nurses and clinicians.

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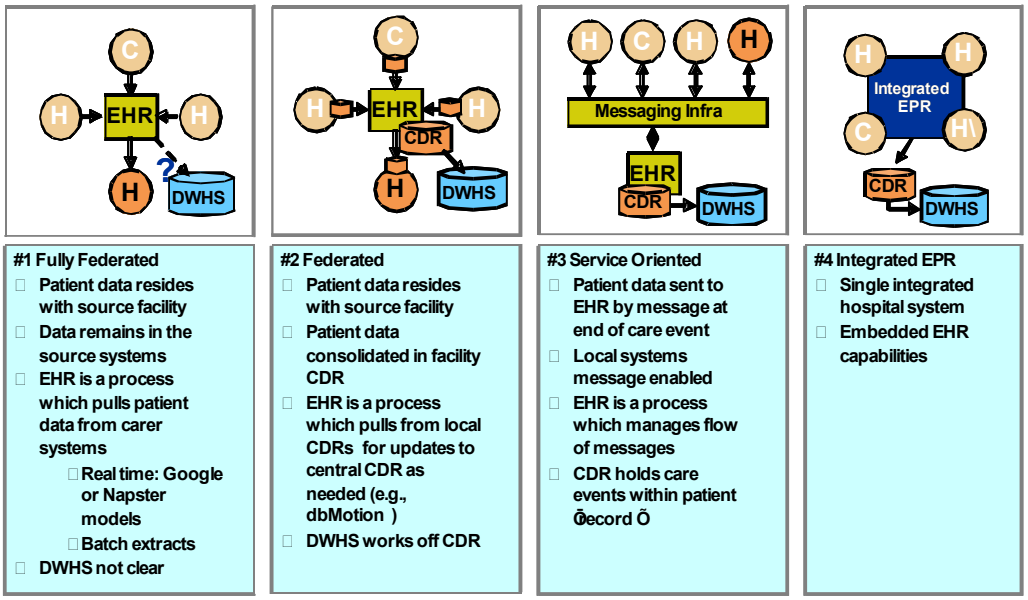
National/Regional EHR Approach



The hospital EHR systems are centralized systems. The healthcare authorities' plan to develop a service oriented architecture (#3) that will incorporate EHR standards. The proposed changes are under the jurisdiction of the "Nasjonal IKT," a HIT group established with stakeholders from the four regional health authorities.

EHR Governance

Legal/Regulatory

The Norwegians recognize that the use of technology in healthcare has the potential to improve welfare while simultaneously improving the efficiencies of the health delivery systems. They have enacted strong legislation concerning the confidentiality of personal information. In 2000, Norway passed Act No. 31 (Personal Data Act) relating to the processing of personal data in order to protect that information. In 2001, focusing on healthcare, Norway passed Act No. 24 (Personal Health Data Filing System Act) relating to Personal Health Data Filing Systems and the Processing of Personal Health Data. The purpose of this Act is to give public health services and the public health administration the right to retrieve patient information without violating his/her right to privacy. Both Acts define the liability of healthcare providers who participate in the electronic exchange of information.

In 2004, the Norwegian Research Council funded an "anonymization" project by the Department of Computer and Information Science at NTNU. The project focused on the GP's office and was designed to protect patient confidentiality by anonymizing both structured and unstructured text in the EHR. Studies such as this led to the enactment of the Patient Rights Act which regulates the privacy rights of patients regarding the information contained in EHRs. This Act confers ownership of EHRs to the patient and, therefore, gives him/her the right to inspect the information contained therein.

Healthcare Policy

The terms on which providers, health plans, public health authorities and researchers participate in HIEs are regulated by the Personal Data Act and the Personal Health Data

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Filing System Act. As indicated above, the Patient Rights Act regulates the privacy rights of patient regarding their information contained in EHRs.

Kickbacks and self-interest referrals are not perceived to be a problem in Norway and, therefore, are not regulated.

Every Norwegian is assigned a GP who typically cares for between 1,200–1,800 patients. When a patient needs specialty care, his GP has to write a referral letter. In theory, the GP is obligated to restrict access to specialists; in practice, however, it is the patient who decides.

Public awareness of privacy issues is high and there have been incidents regarding breaches in security that have reached the front pages in the newspapers. The Norwegian Data Inspectorate is responsible for compliance with federal laws regulating privacy and security and the government has announced that new regulations will follow, further restricting access to patient information. It will soon be prohibited for a healthcare person to read the EMR of a patient who in not under his care unless directly given the authority.

In 2006, the government began a legislative research study to determine what negative impacts on e-health, if any, resulted from the Personal Data Act, the Health Registries Act and others. That same year, the Directorate launched a code of conduct study to determine how the different healthcare organizations should treat patient health information in order to comply with the National and European Data Protection Act. As a result of these investigations, technology has been developed that can check for and track unauthorized entry into clinical e-records.

The Norwegian Centre for Informatics in Health and Social Care (KITH) was founded to stimulate the use of IT in the health and social sectors. Since 2003, there has been a test and acceptance scheme provided by KITH to ensure that all EPR systems conform to standards in the KOKOM program including codes, classifications and terminology. Unlike other European countries, Norway has not yet adopted SNOMED, HL7 or LOINC.

The Department of Telemedicine at University of North Norway **(**UNN) was established in 1993 and it became the Norwegian Centre for Telemedicine (NST) in 1999. This organization focuses on developing and implementing telemedicine in new areas.

Technology

At the 2007 E-Health Conference in Iceland, Liechtenstein and Norway adopted a common commitment to pursue structured cooperation on cross-border electronic health services throughout Europe.

In order for GPs to be reimbursed by the Norwegian social security system, they must adopt standardized EHRs. Billing elements that must be included are the unique personal identifier of the patient: gender; date of birth; address; the date, time and type of the healthcare encounter; and the diagnoses using the International Classification for Primary Care (ICPC).

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Norway is known for its broad and innovative use of telemedicine, including such services as: teleradiology, otorhinolaryngology, telepathology, ophthalmology, teledermatology, telecardiology, teledialysis, prenatal, emergency service, teleoncology, telecare, teleodontology, teleendocrinology, telesurgery, psychiatry, solutions for patient empowerment, maritime telemedicine and distance learning programs.

Norway provides digital signature software to all healthcare providers using PKI. This program was created by the National Insurance Service and is made available throughout the healthcare sector.

The "E-Resept" (e-prescription) program is charged with the task of establishing a national, fully electronic information chain for prescription drugs and medical supplies. The EPR systems for both GPs and hospital-based physicians will be modified to produce electronic prescriptions through XML and will require digital signatures using a PKI-based smart card. The Norwegian Medicines Agency will support e-prescribing through a downloadable dataset covering all drugs and medical supplies (prescription and dispensing support). This dataset will be integrated directly into the EPR and will be synchronized with data from the pharmacies' computers. This will create a single source of information to ensure uniform data quality on all prescriptions.

Most Norwegians have Internet access. It is less common, however, among older adults and low-income families. Making EHRs available to patients through the Web has raised many security and confidentiality questions and mass Web health record access may not be available for some time. As a prelude, the government has instituted a pilot project known as "The Individual Plan". This is a "lighter weight" application than an EHR and there has been less resistance to its implementation. Patients have had access to their records in the Individual Plan since 1999 when the Norwegian government enacted legislation to provide electronic data for patients who need coordinated long-term care and assistance. Although initiated by the central government, the municipal/town authorities are responsible for creating and maintaining the Individual Plan. In this program, the patient (Plan Owner) owns his record.

A Web-based system called "SamPro" was started by the Ministry of Health, despite the fact that some Plan Owners do not have access to the Web. SamPro is a mini-version of an EHR and, in addition to the Web, a telephone for personal entries can be used to update the record.

Norwegians have other means of accessing information. For example, MedAxess provides a secure electronic communication system between the patient and his PCP. In addition, the Ministry of Modernization has established multiple portals including a patient portal, MyPage, a Security Portal and the Public Procurement Portal.

MyPage enables patients to view information, such as addresses and the names of their PCPs, that is held in various healthcare agencies. The patient can use MyPage to correct information or submit an application for change.

The use the Internet for health information will continue to grow. The Directorate for Health and Social Affairs showcases the Norwegian Healthnet as a means to ensure continuity in services and preventive care.

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Adoption

More than 99 percent of GPs use an EMR-system for a majority of their clinical and administrative tasks. Studies have demonstrated that an increasing proportion of lab reports, referral and medical discharge summaries are electronically exchanged via the National Healthcare Network.

Outcomes

Although use of EMRs among Norway's GPs is almost 100 percent, relatively little use has been made of this resource for quality improvement and research. The three main EMRs (Winmed, Profdoc Vision and Infodoc) do not provide a simple, flexible way to extract data so they must use third party software called QTools. The use of QTools is a starting point for Norway to begin extracting and reviewing data in the interest of quality healthcare improvement.

The National Centers for Expertise will contribute to Teamwork 2007 as will KITH, NST, KOKOM and the EPJ centers. Each will have a central role in developing Norway's national EHR system to develop a focus on quality in the future.

Benefits

A 2006 study by Lareum was conducted at six hospitals to which 64 physicians, 128 nurses and 57 medical secretaries responded. It found that physicians reported diminished efficiency using EHRs when compared to the use of paper-based records. Nurses reported using EHRs the least and mainly for retrieval of information instead of entering or storing information. While physicians entered their daily progress notes into the EHR 85 percent of the time and used it extensively to retrieve information, they did not use the EHR for entering or storing patient data – similar to what was found with the nurses.

Many Norwegian hospitals have implemented EMRs and weaned themselves from paper-based clinical workflow. Two studies of hospitals that have implemented EMRs concluded medical secretaries benefited from the change even more than physicians and nurses.

In 2005, another study focused on the experiences of patients who exchanged secure electronic communication with their PCPs. The study was designed to examine privacy versus the usability of the system. Fifteen patients who used MedAxess were interviewed. The researchers concluded that, despite a perceived need for secure electronic patient-physician communication, security barriers exist that can diminish the overall usefulness of patient access to an EHR. A dual approach is, therefore, necessary to improve patient interaction with the electronic healthcare system. First, patients need to be better informed about security issues and, at the same time, user interfaces must be modified to improve patient access to their records.

Implementation Experience

Data security and other legal issues pose enormous challenges to the adoption of healthcare technologies. They create barriers that can inhibit the diffusion of EHR. Such

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barriers to the finalization of Te@mwork2007 may be economic, legislative or organizational in nature.

Throughout Norway, old paper records are being scanned in order to make all records available in digital form. This is not a simple task since, in addition to old paper records, new paper records such as lab results and referral letters are still part of the system

The patient specific data contained in the EMR is also a source of medical knowledge for researchers. The Department of Computer and Information Science at NTNU has developed techniques and methods to semi-automate the anonymization of medical information contained in the physician office EMR. This ensures that data may be stored and retrieved without violating patient confidentiality. The government achieved this level of security in 2004 and has since focused on the use of abbreviations, legibility and sensitive data elements in a patient's record.

As countries across the globe plan for the utilization of technology, potential barriers to its adoption include health and social sector bureaucracy. In addition, since laws and regulations lag behind technology adoption, technical solutions may not always lead to organizational change.

Budgets and funding for EHR are being increasingly strained in Norway, with ever-increasing demands to shift contributions to healthcare delivery systems stressed by an aging population.

Finally, a lack of common standards continues to plague the healthcare IT field despite continuing efforts to improve the situation.

Next Steps

Within Norway's EHR/PHR/HIE programs, the Ministry of Modernization plans to implement a Web-site for patients to view their prescriptions registered in the Reseptformidler (Prescription Broker). Other major goals of the e-prescription program are to improve the quality of the prescription chain, reduce medication error and duplication rates, and improve the availability of prescription drugs. The e-prescription program will also provide NAV (the Norwegian Labour and Welfare Organisation) with the electronic documentation needed to reimburse pharmacies for prescriptions.

Norway will continue to focus on the secure exchange of electronic health information. To the end, it will continue to develop interoperability, facilitate messaging and widely promote the use of the PKI for security.

Finally, as the population of the country ages, the government will focus on the delivery of home care and how the EHR infrastructure can expand into this sector of healthcare.

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ASIA PACIFIC

INDIA

Overview of India's Healthcare System

Picture this: At a world-class hospital in New Delhi, a cardiovascular surgeon performs endoscopic cardiac surgery using the world's most advanced telerobotic surgical system. Less than 40 kms away, a traditional (non-qualified and untrained) birth attendant manages a childbirth at a home in the capital's slum.

The case in point reflects one of the numerous stark realities pertaining to the delivery of healthcare services in India. With a population of approx 1.13 billion[1] the world's largest democracy has a varied healthcare landscape. When it comes to healthcare, PricewaterhouseCoopers have suggested that there are two India(s): one that provides high-quality medical care to middle-class Indians and medical tourists; and the other (in which the majority of the population lives) in which limited or no access to safe, quality care is available.

Medical tourism is exploding in India. The country's private health sector attracts a continuous influx of patients from overseas and "corporate hospitals" offer world-class medical treatment at fees that are 10-15 times lower than anywhere else in the world.[2]

The rest of India suffers from historically poor public heath infrastructure and grapples with intransigent healthcare issues such as burgeoning HIV-AIDS cases and other chronic and degenerative diseases.

Healthcare in India is governed by the Ministry of Health and Family Welfare through its three departments; the Department of Health, the Department of Family Welfare and the Department of AYUSH (Ayurveda Unani, Siddha and Homeopathy). Healthcare services are provided through both the public (state and federal) and fee-levying private sectors.

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The Indian healthcare infrastructure consists of:[2]

- 15,000+ hospitals (two-thirds of which are public owned)
- 875,000 hospital beds (40 percent of which are private)
- 500,000 doctors (18,000 new doctors are admitted into the delivery system annually)
- 737,000 nurses
- 170 medical colleges
- 23,000 primary health centers
- 132,000 sub-centers

Major corporate hospitals' and their bed capacity in India are as follows:

- Apollo: 40 hospitals with approximately 6,000 beds
- Fortis Healthcare: 12 hospitals with approximately 1,900 beds
- Max Healthcare: 7 hospitals with approximately 800 beds
- Wockhardt Hospitals: 10 hospitals with approximately 1,500 beds
- Manipal Hospitals: 5 Hospitals with approximately 1000 beds

The private sector accounts for approximately 80 percent of healthcare expenditure. Of the remaining 20 percent; more than three-fourth is funded by respective state governments.[3,4] Today, the Indian Healthcare sector is valued at approximately $34 billion and comprises six percent of GDP.[5]

At present, medical tourism and health insurance markets are the key growth opportunities within the Indian healthcare sector. In their joint study (carried out in 2006) the Confederation of Indian Industry and McKinsey estimated the Indian medical tourism sector to be $350 million annually. More than 180,000 tourists are treated every year at Indian facilities and the number is growing at 25-30 percent per year.[5] As a result, the government is encouraging a variety of incentives aimed at boosting this sector.

Recently, there has been a liberalization of the Indian healthcare sector to allow growth in the private insurance market. This market is expected to grow to $5.75 billion by 2010 but its growth has been slow. In 2001, there were over 19 Indian insurance companies operating in partnership with an international insurer.[6] By 2005, the percentage of the population covered under private medical insurance was still below one percent.[5] According to PricewaterhouseCoopers, the Indian healthcare sector can be viewed either as a glass half empty or a glass half full. For companies that view the healthcare sector as a glass half full, there is enormous potential but the challenges faced are substantial. These include a weak and inadequate physical infrastructure, inability to provide health insurance to all who need it, a lack of availability of trained medical and paramedical personnel and limited geographic availability of public health facilities who suffer from operational inefficiency.[7]

National IT/ICT Status & Strategy

The Information Technology Act was passed in May 2000 and enforced in October 2000. The Act covers e-commerce, the creation and use of digital signatures, transactions,

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contracts and the facilitation of electronic records. It is influenced by the Model Law on Electronic Commerce (UNCITRAL).

India is gradually positioning itself at the global level as "an IT superpower" and "destination BPO". Its IT and outsourcing sectors reached $22 billion in annual sales in 2005 and employed more than 700,000 workers. It is estimated that the global worth of this sector will increase to $110 billion by 2010 and will employ 2.3 million workers.[8] India's adoption of IT is matched by growing positive change in public policy on infrastructure and sponsorship. Advancements in IT are further being fueled by the increasing rate of PC and Internet penetration in the country as a result of the following factors:[9]

- **Improved telecom infrastructure:** In 1995, India was ranked 14th in the world in the number of main telephone lines (12 million) in operation. By 2001, the country had moved into seventh place with 35 million telephone lines. By 2003, 49 million lines were in operation.
- **Increased affordability of teleservices:** In 2000, there were few private sector fixed-line telephone service providers. Government-owned Bharat Sanchar Nigam Limited (BSNL) enjoyed a monopoly until 2000 and Videsh Sanchar Nigam Limited (VSNL) had a monopoly until 2002. Today, the list of private telecom operators includes Tata, Bharti Tele-ventures Limited and Reliance Telecom Limited. As a result of growth in the private sector, telecom tariffs for both inland and overseas communications services have fallen dramatically.
- **Increased teledensity:** As a result of increased availability of infrastructure, lower cost of communications services and increased affordability of personal computers, the number of fixed telephone lines per citizen (teledensity) has increased from 2.5 percent in 2000 to nine percent in 2005; PC penetration has increased from 4.3 per 1000 people in 2000 to 14 per 1000 people in 2004.
- **India's broadband policy**: Although unveiled in 2004, India's rate of adoption of high-speed broadband Internet access has been slow. By the end of 2006, there were only 2.1 million broadband subscribers – a penetration of less than 0.2 percent. The Broadband Policy, set by the Department of Telecommunications, called for a penetration of broadband subscriptions of three million users by 2005, nine million by 2007 and 20 million by 2010. The preferred mode broadband delivery has been through DSL (Digital Subscriber Line). Internet Service Providers (ISP) typically use fiber optics; approximately eight lakh route kilometers (~ 0.8 million) of fiber has been laid.[10]

In 1997, the Indian government positioned itself as one of the early adopters of healthcare IT among developing countries when it launched its "Development of Telemedicine Technology" project.[11] The Department of Information Technology at the Ministry of Communications and IT, and the Department of Space have been the government's healthcare IT flag bearer agencies. They have been joined in their promotion of IT by the Ministry of Health and Family Welfare in an attempt to apply IT in Indian hospitals within the public sector.

In 2002, the Department of Information Technology established the Committee for Standardization of Digital Information in order to facilitate implementation of telemedicine systems. The result was the publication of the "Recommended Guidelines and Standards for practice of Telemedicine in India".[12] These guidelines delineated the

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steps necessary to implement a telemedicine program and its importance to India. They not only defined telemedicine but also suggested standards for hardware, software and clinical devices including security aspects and telemedicine process guidelines.

The Ministry of Communication's Department of IT recognized the need for a standard health IS across the country, principally to meet the needs of service providers and consumers who record, use, transfer and disseminate health information. To this end, the Department established another initiative to prepare the ground for Information Technology for Healthcare (ITIH). In 2003, the Department published a "Framework for Information Technology Infrastructure for Health in India."[13] This framework is centered on the philosophy that "information is determinant of health" and that "healthcare is one of the key areas that can benefit from the use of IT." The framework encompasses:

- Billing formats
- Clinical standards
- Data elements
- Minimum data sets
- Health identifiers
- Messaging standards
- Education framework
- Legal framework

In 2006, the Ministry of Health and Family Welfare created a National Task Force on Telemedicine. Within this task force, a subgroup on telemedicine standards has been working on preparing guidelines for the national EMR. These guidelines are in the final approval process by the government. Despite innovations in HIT and its support by the government, its published recommendations on adoption of guidelines, standards and frameworks have not yet been made mandatory.

EHR Governance

Legal / Regulatory

Since there are no legal/regulatory requirements for adoption of standards, implementations at various hospitals are neither interoperable nor are they transportable. Although vendors claim that they are working towards interoperable systems, several hospitals have deferred EHR investments until a stable, interoperable framework emerges across the country. Instead, they have been making cheaper investments in billing and inventory management systems which have two-way interfacing with popular office automation tools.

Healthcare Policy

Many hospitals are maintaining electronic records locally. The scope of data captured, however, is limited to basic demographics, registration and billing. Larger hospitals that store clinical data electronically store discharge summaries with information on procedures, orders and investigation reports. Despite the system's ability to also store detailed reports and clinical interpretations electronically, many hospitals do not use it. As a result, clinical follow-up is either very limited or not feasible. Industry analysts feel that the goal of hospitals in India is more to adopt the general concepts of EHRs but that they are not utilizing all of its capabilities.

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Adoption—National (Public Sector)
Indian healthcare policy makers recognize the role that IT can play in improving the reach, quality and safety of healthcare. They decided to start this process by establishing telemedicine centers in pubic hospitals. The idea to introduce IT in public hospitals with telemedicine and e-health was also based on the potential of these applications to address challenges like uneven distribution and shortage of infrastructural and human resources. Accordingly, these linkages connect smaller hospitals in remote parts of the country to secondary and tertiary level hospitals. At present, India has over 500 telemedicine nodes in the country with more than half of them in the public sector.[14] Many of these nodes utilize systems developed by public-owned government agencies such as the Centre for Development of Advanced Computing (C-DAC) and the Indian Space Research Organization that provides a satellite-based communications channel for healthcare IT.

Because EHR implementation is not federally mandated, public-sector hospitals have been slow to adopt EHRs. Although the first EHR implementation in a public sector hospital began in the late 1990s, few hospitals have implemented a system. Most EHR adoption occurs voluntarily in large, tertiary level centers.

The Ministry of Health is turning its attention towards the lack of government policies for EHR adoption. Based on the rate at which developments in the domain are taking place, it is likely that publicly owned health sector will soon see mandates for a quick, widespread adoption of IT.

Adoption—National (Private Sector)

The implementation of IT in the healthcare system is dismal when compared with IT adoption in other sectors of the Indian economy. The size of the Indian healthcare IT market is approximately $100 million[15] yet the total expenditures for hospital IT is less than one percent of their operating budgets and one to two percent of their annual income[15] with a large part of the expenditures going towards hardware.

Unlike the slow rate of EHR adoption in the public sector, privately owned hospitals are implementing them aggressively. They use their systems to capture all relevant patient data, unlike public hospitals that tend to use only parts of the systems. Private hospitals maintain the data in a repository so that it can be readily available once a universal, interoperable EHR initiative is mandated by the government.

The key IT applications that are being implemented in the private healthcare sector include hospital IS, PACS and telemedicine programs. So far there are no instances of EHRs that completely integrate clinical information with patient demographic and financial records. Instead they are used mainly for storing and retrieving data. The use of EHR for reporting, modeling and improving clinical decision making is not yet a priority.

EHR implementations at various hospitals in the private sector can be classified as follows:

- Small hospitals (up to 100 beds):
    - IT applications are virtually non-existent. Although some hospitals are using computers and customized, simple IS for administrative tasks (such

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as for official correspondence, billing and inventory management), they are not used for processing clinical information.

- Medium hospitals (100 to 500 beds):
  - This segment has the fastest growing rate of IT adoption, but hospitals are still mainly adopting low cost quasi–HIS for billing, registration, pharmacy and other basic modules.
- Tertiary hospitals (more than 500 beds):
  - Most of these hospitals already have HIS implementations in place. If not, efforts are underway.
- Super-specialty hospitals:
  - Some super-specialty hospitals are demanding specific EMR systems that have the functionality to provide clinical information such as vital signs and clinical images (radiographical and analytical).

Local vendors are meeting most of the EMR solution requirements in India. Therefore, large, global vendors such as Cerner and Eclypsis have not yet entered the market. IT vendors in the healthcare domain include:

- HIS: Carework, C-DAC, IBA Health, SRIT, TCS, Wipro
- PACS: Agfa, GE, Siemens, SRIT, Vepro AG, 21st Century Health Mgmt. Solutions Ltd.
- Telemedicine: C-DAC, Prognosys, SRIT, TeleVital
- IT Applications: Microsoft, Mphasis, SRIT, Satyam, SAP, TCS, Wipro

Presently, IT adoption in Indian healthcare is estimated to be only five percent.[16] It is also estimated that IT investment in Indian healthcare could reach $500 million U.S. by 2010.[15] Most of the major hospitals in the private sector are already using telemedicine and mobile medical care as competitive differentiators to reach patients in rural India. This is especially true for specialty services such as cardiology and oncology. These electronic outreach programs not only create an awareness of IT in the rural patient population, but also promote branding for the hospitals involved. Private hospitals also spend time and money on educational programs designed to promote health and better manage diseases in these areas.

Next Steps

Unlike other countries the Indian public sector lags behind the private sector in HIT. The public systems have yet to open up to HIS/EMR implementations, although there are a significant number of implementations of HIS/EMR in tertiary level hospitals within the private sector. Although the healthcare IT market in India has been estimated at a compound annual growth rate of 18 percent, the adoption rate within India is dismally low.[17] Many barriers to adoption exist and these challenges and constraints are unique to India's population and environment.

So far, medical e-records have been shown to be effective in beginning to manage patient care. However, the functionalities within these systems needs to be enhanced.[18] IT systems in some hospitals are being used only for showcasing state-of-the-art IT applications or as frilled features. Unfortunately, their usage is not fully aimed at enhancing the quality and safety of healthcare delivery.

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The key challenges facing India's healthcare IT sector include:[17,19]

- Lack of awareness:
  - Many hospitals in India have still not realized the importance of implementing HIS and the government has not convinced them that IT drives efficiency.
- Lack of policy:
  - No clear, coordinated government policy exists to mandate EHR adoption.
- Minimal government funding:
  - Almost non-existent central government funding for HIT has contributed to the lack of HIT adoption in government health facilities and a lack of trained medical informatics professionals. Pressing issues such as the lack of quality rural healthcare and education have taken priority in terms of government spending and investment
  - At the local levels, governments and municipalities have been financially drained by cost of healthcare. Like the central government, they consider healthcare IT as an expense rather than an investment.
- Lack of computer literacy and IT decision making:
  - Low computer literacy among clinicians and public officials and, to a large extent, in the private provider community represents another major challenge to IT adoption. In the majority of the cases, the officials who assess hospital IT requirements are administrators who have little or no technology backgrounds.
- Lack of infrastructure and coordination:
  - There is a lack of supporting infrastructure and coordination between the public and private sectors.
- Legacy systems:
  - Except for very few privately owned large hospitals, most patient records are still paper based and, therefore, difficult to convert into an electronic format.
- Lack of standardization and interoperability:
  - Most local HIT systems do not adhere to standards for information exchange. This is further complicated by all the customizations that have been done on these systems. In addition, the use of multiple local languages by patients and some health workers contributes to the lack of interoperability.
- Privacy issues:
  - The Supreme Court of India has not addressed patient confidentiality and the specific privacy rights for healthcare information.

India has not yet felt the pressing need nor has it addressed the drivers for the implementation of a uniform, interoperable, national EHR system. The country has not even clearly defined the stakeholders who would benefit most from such a system. In general, the Indian healthcare industry has not yet matured enough to design a system that will incorporate the best-of-the-breed standards for EHRs.

The Future

Medical insurance coverage is predicted to become one of the greatest drivers for the adoption of a national HIT system. Once coverage reaches a critical mass, the need for electronic communication between regions and the nation will become apparent. In

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addition, international accreditation from ISO and Joint Commission International (JCI) is demanded by medical tourists and will drive the adoption of standards and interoperability required to fuel the rising medical tourism market. To date, however, only five hospitals have become accredited (JCI SOPs).

The drivers with the most potential to propel EHR/HIS implementations in India include the growing industries of corporate health, medical tourism and health insurance.

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NEW ZEALAND

Overview of Country Healthcare System

New Zealand and its larger neighbor, Australia, developed their healthcare system on the centralized model of universal healthcare found in England; public sector healthcare funded by the central government and a much small number of private healthcare systems.

The public healthcare system provides services to 77 percent of New Zealand's population of more than four million residents (Source – Statistics NZ, NZ Population Clock). Twelve and a half percent of New Zealand's population are 65 years or older and the majority of the population is of European ethnicity (78.5 percent), followed by Maori (14 percent), Asian (9 percent) and Pacific Island peoples (6.6 percent).

Public healthcare funding is managed through the New Zealand Ministry of Health which directs national funding to District Health Boards (DHBs). Twenty-one DHBs have been created since January 2001 when the New Zealand Health and Disability Act was enacted. On a local basis, the DHBs are responsible for healthcare spending and management for the population within each district. Regionally, the 21 DHBs are represented by four large geographical regions: North, Midland, Central and South.

New Zealand consists of two major islands (the North Island and the South Island). The majority of New Zealand's population (76 percent) resides in the North Island with approximately one third living in New Zealand's largest city, Auckland. More than half of the South Island's population lives in the Canterbury region, of which Christchurch is the largest city.

More than 50 percent of all New Zealanders live in urban areas represented by the five largest DHBs: Auckland (North DHB region), Hamilton (Midland DHB region), Napier-Hastings (Central DHB region), Wellington (Central DHB region) and Christchurch (South DHB region).

The Ministry of Health has set priority objectives for the population's health, all of which can be implementing by using electronic records. These include:

1. Reduced smoking
2. Improved nutrition, reduced obesity and an increased level of physical activity
3. Reduced rate of suicide/suicide attempts
4. Minimizing harm caused by alcohol, illicit and other drug use to individuals and the community
5. Reducing the incidence and impact of cancer
6. Reducing the incidence and impact of cardiovascular disease
7. Reducing the incidence and impact of diabetes
8. Ensuring access to appropriate child healthcare services including well child, family healthcare and immunizations

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Based on statistics from the New Zealand Health Information Service, there were 445 hospitals in New Zealand in 2002; 85 publicly funded and 360 private. The total number of hospital beds was 23,825 with 12,484 in public hospitals and 11,341 in private care. There were 572,232 inpatient discharges (with an average length of stay of 8.3 days) and 250,154 day patient discharges (a person admitted and discharged on the same day) from public hospitals.

National EHR Program

The New Zealand Healthcare IT strategy has not recommended a single, centralized, national EHR system. Since 2005, DHBs have moved to support an interconnected information delivery network. All 21 DHBs have entered into a shared service agreement for IS (e.g., finance and/or patient management systems), corporate support (e.g., health provider contract management) and contracting or clinical data analysis.

Physician Adoption Rate

New Zealand physicians have embraced EHRs. A study published in 2005 (Didham R, Martin I, Wood R, Harrison K. Information technology systems in general practice medicine in New Zealand. *N Z Med J* 2004; 117) reported the electronic Patient Management System (PMS) adoption rate for GPs was almost 90 percent. This high adoption rate—combined with the existence of the unique National Health Index (NHI) number, the Health Intranet and Health Link systems—have established the infrastructure to support the building of a complete EHR national system. Source: Healthcare and Informatics Review Online

Data Collection
Regional data collection strategies capture individual healthcare data from patients to support the NHI and MWS (Medical Warning System). This information is used to provide data to various health databases including: the National Minimum Dataset (NMDS), the Mental Health Information National Collection (MHINC) and the National Booking Reporting System (NBRS).

Standardization
In 2004, The Health Information Standards Organization (HISO) listed priority focus for the following standards that have been promoted into the EHR system:

- Ethnicity
- Health Provider Index
- LOINC Laboratory Codes
- Primary practice management systems
- HL7 messaging
- Referrals and discharges
- E-Labs
- E-Pharmacy
- Primary care clinical performance indicators and referred services management
- Chronic disease management templates
- NHI and national collections
- Secure broadband and email connectivity.

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Architecture: A National/Regional EHR Approach

In 2005, New Zealand Ministry of Health released its Health Information Strategy for the development of a distributed EHR system linked by a nationwide, secure broadband network; however, it did not pursue the creation of a centralized system. The Ministry of Health, DHBs and primary care organizations all subscribe to the New Zealand Health Network. This consists of VPNs operating and linked nationally under the guidance of the Health Network Code of Practice standards. (Source: http://www.moh.govt.nz)

This system of EHR starts at the levels and expands regionally and then nationally; the most detailed stored patient information, however, remains at the local level. Broadband networks then retrieve and share this information with other authorized network users. Within three to five years of its implementation, all community healthcare providers will be connected to a secure health information network. All primary and secondary care providers will interact electronically around key events, such as discharges and chronic care and disease management. The New Zealand strategy also calls for the development of a health provider index, e-pharmacy and e-lab systems, as well as an electronic patient referral system.

The recent decision by Australian states to adopt HL7 and the common New Zealand and Australia GOSIP profiles represents an opportunity to create a Common Economic Region (CER) Standard for Healthcare Systems Interconnect. This CER Standard would provide a basis for cross-Tasman healthcare exchanges between the two countries.

Funding

The Ministry of Health has provided $1.4 million (NZ$) in funding for key national HIT systems. These local and regional systems will communicate with each other through a national system of interconnected links.

Operations

New Zealand's approach to the implementation of a nationally-connected EHR system and HIE is summarized by category #3 "Service Oriented" as shown in the following diagram from the previous included chart:

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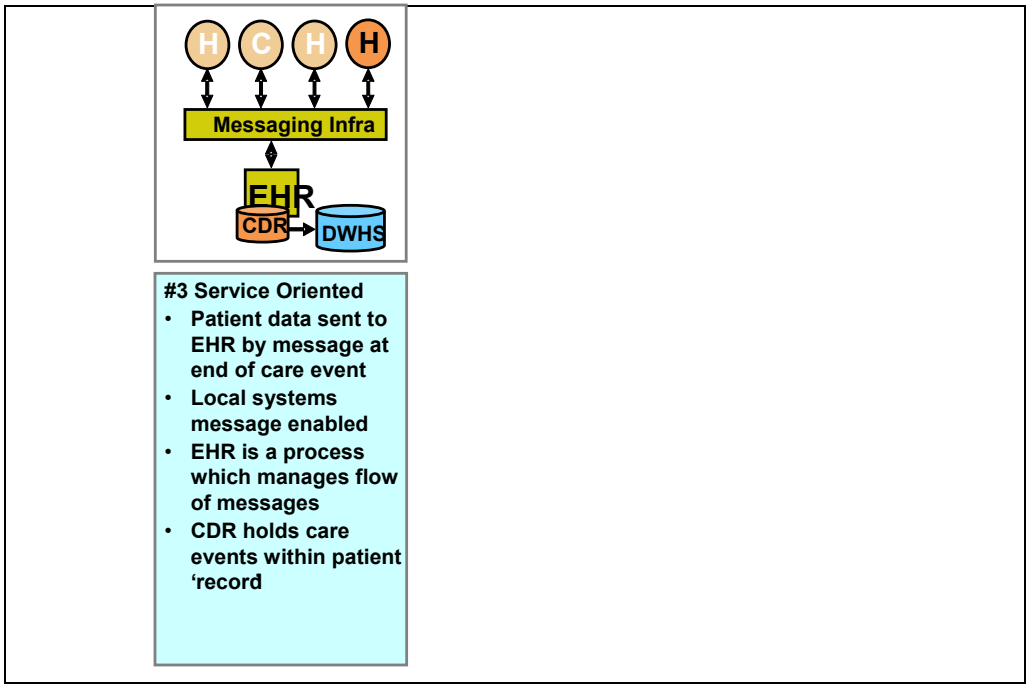

The national system is driven by standards that have been developed through the collaborative efforts of NZ GOSIP, IEEE, EDIFACT working group 9 and TC 251. For example, real-time updates and queries throughout the New Zealand Health Information System (NZHIS) national system are supported by the HL7 Interface Standard for encoding transaction messages. (http://www.moh.govt.nz). In this service-type model, transactions are pushed from the local and regional healthcare systems to the New Zealand Health Information Service (NZHIS) during every patient point-of-contact care event at the same time that local patient records are updated. The contents of each data file are then checked against the business rules and loaded into holding tables. A record is also kept of the number of existing records that have been affected by this file. This includes any event that has been added or deleted, any record containing error or warning messages and any other operating information including processing time. Diagnosis codes, including Diagnosis Related Groupings (DRG), are calculated during this part of the editing process. The edit/error module also maps ICD-10-AM and ICD-9-CM-A diagnosis codes.

HL7 standards are managed by the New Zealand HL7 User Group (NZHUG/HL7). Data generated by real-time transactions are streamed on a continuous basis using these HL7 message standards.

In the NZHI system, clinical data are sent with NHI numbers to ensure that individual records are captured. These include:

- Hepatitis B screening; through the New Zealand Hepatitis B Pilot Project;
- Laboratory claims: from laboratory tests processed by Health PAC;
- Maternity and newborn data: all pregnancies and newborn registrations are collected from NMDS;
- MWS: The Medical Warnings System; containing known risk factors that may be important when making clinical decisions about patient care including; medical warnings incorporating adverse medical reactions and significant medical conditions, event summaries incorporating identification of the facility where the patient's medical record is located and donor information incorporating donor

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summaries and healthcare user contact details using the ICD-9-CM-A range E930-E949 and drugs involved and medical conditions; ICD-9-CM-A range 001-999;
- Mental health information: NHI numbers, demographics and legal status of patients with mental health conditions;
- Mortality data: using ICD-10-AM 2nd Edition and WHO mortality coding guidelines;
- National booking reporting system: information on numbers of patients waiting for publicly funded treatment, length of wait before receiving treatment, priority and booking status;
- National immunization records: all immunizations including childhood and adult immunizations, Tuberculosis vaccine (BCG) and Meningococcal vaccination;
- National minimum dataset: statistical information, including clinical coding data, for inpatient and day patients at time of discharge;
- National non-admitted patient collection: outpatient and emergency department activity including date, facility and type of service provided; and
- Cancer registry: http://www.nzhis.govt.nz/collections/collections-guide.

Personal Health Record

New Zealand has not yet adopted a national PHR strategy that would allow patients direct access to their electronic records. There are, however, some local health facilities that provide patient Internet access to their records. Use of this service is still minimal and, in New Zealand, patients are not considered to be the legal owner of their records.

EHR Governance

Legal/Regulatory

The New Zealand Ministry of Health, Manatu Hauora, is the government's principal agent and advisor on health and disability. NZHIS is a division of this ministry which ensures that information is secure and protected from unauthorized access. The New Zealand Health and Disability Registration Authority ensures that anyone accessing the health data complies with all regulatory processes. NZHIS leads the development and implementation of IM and IT standards for the New Zealand health sector. Its role is to guarantee that relevant standards are identified for development and that, once defined, are implemented effectively.

The New Zealand Health and Disability Registration Authority also controls access to the NHI number, a unique identifier that is assigned to every person who uses health and disability support services in New Zealand. In its use of the NHI, NZHIS must meet the requirements of the Privacy Act of 1993 and the Health Information Privacy Code of 1994. The NHI is also associated with the MWS, designed to warn healthcare providers of any known risk factors that may be important when making clinical decisions about individual patient care.

Access to the NHI number is restricted to health workers authorized by NZHIS and DHBs. These include family doctors, nurses, midwives and hospital specialists. Creation or change of NHI details is further restricted to individuals who are authorized under the Health Information Privacy Code.

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All hospitals are required by the Ministry of Health to provide clinical information electronically under the auspices of Section 22 of the Health Act 1956, section 139A of the Hospitals Act 1957 and the Cancer Registry Act 1993.

Healthcare Policy

The NZHIS mandates that:

- Information must be available across all levels of the national system with the most clinical detail being stored within the local systems.
- EHRs must be distributed, linked and referenced from local to regional to national entities. No central or single EHR exists in New Zealand.
- Shared clinical information to support safe and integrated delivery of healthcare must emanate from key health event summaries.
- Interoperability must be achieved. Common standards and information anchors that allow disparate systems to share information are essential for a successful EHR initiative.

As indicated above, access to the NHI is regulated by the Health Information Privacy Code 1994 released under the Privacy Act 1993. Interoperability standards are developed under the initiatives of NZ GOSIP, IEEE, EDIFACT working group 9 and TC 251, and online transactions are supported by the HL7 Interface Standard. (http://www.moh.govt.nz)

Information that is held within the NZHIS database systems is accessed and maintained by authorized users logged on to host systems. Those host systems are operated by RHAs (regional health authorities) and CHEs (Crown Health Enterprises), both of which are responsible for healthcare provision within the DHBs.

The Ministry of Health is currently completing a Privacy Authentication and Security (PAS) project. This will set the standards on how the upgraded NHI interfacing will work, and how the various external and internal organizations will use it. Once these PAS standards are published, the Ministry plans to make the public interface widely available. Private sector practice management system developers will also be able to incorporate application program interfaces (APIs) into the PMS software. (http://www.moh.govt.nz)

Technology

As indicated above, the New Zealand EHR architecture consists of a distributed EHR system linked by a nationwide, secure broadband network. By design, there is no single, centralized system. The national system is driven by standards that have been developed through the collaborative efforts of NZ GOSIP, IEEE, EDIFACT working group 9 and TC 251, and HL7 Interface Standard is deployed for encoding transactions between systems.

HISO provides standards for ethnicity, Health Practitioner Index (HPI), referrals and discharges, e-labs, primary care clinical performance indicators, referral services management, chronic disease management and ambulatory care (outpatients) data sets. The clinical areas that are exchange services with the NHI include GPs, ambulatory and inpatient facilities (private and public), practice management modules and e-Pharmacies that are deployed for subsidized claims, constituting most of the public care arena.

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Adoption

The NHI has been in operation for 14 years. New Zealand's first national register, replaced by the NHI in 1993, was the National Master Patient Index. Newborns have been registered on the national system since 1992 and it is estimated that 98 percent of the population of New Zealand now have patient records in the NHI.

Outcomes

The 81 Primary Health Organizations across New Zealand and approximately 3,000 GPs now utilize the NHI for patient record access and update of the national registry.

Benefits

Regional initiatives such as well child and diabetes registries have delivered a system that monitors conditions, reviews treatment progress and relays its advice to the GP. Although the GP retains full clinical freedom and control, the additional information supplied by these registries has improved compliance and reduced adverse events. The EHR provides useful tools that assist DHB in addressing gaps in the system. Through the sharing of information and the use of queries, authorized users can deliver the right care at the right place and at the right time.

New Zealand's EHR implementation has created:

- Seamless delivery of care
- Reduction in error rate
- Sharing of information from multiple sources
- An accurate and portable patient health record

Implementation Experiences

Although most GPs in New Zealand have been using electronic systems since 1985, consumer interaction with their own medical records is non-existent. New Zealand, with a primary care EHR penetration of 52 percent, is second only to the U.K.'s 59 percent. Australia has a 25 percent penetration, higher than the U.S.'s 17 percent. (Kerr K. The electronic health record in New Zealand. Healthcare and Informatics Online 2004)

The strategy for EHR in New Zealand continues to focus on regional CDRs that integrate patient records and clinical images. Systems are being implemented in stages and include chronic care management, mental health, community, ambulatory and disability systems.

Along with the NHI which stores minimum data set information and patient visit summaries, regional repositories are being established to provide clinical health event summaries. One example is the patient discharge summary which can be shared across primary, community, outpatient and inpatient care facilities. (Health Informatics New Zealand - Phil Brimacombe, CIO, Health Alliance from the EHR Seminar, December 2006.)

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Next Steps

As the delivery of healthcare shifts from disease treatment to disease prevention and from inpatient admissions to outpatient visits, the current system will need to be expanded to better align with these changes. This will require additional national data collections (e.g., primary, community and disability support services).

In the national collections, there is little information on GP visits. However, there is extensive information on the 1,700 annual admissions to hospitals, as captured in NMDS. Adoption, therefore, is limited in the scope of the data collected, but is always at a national level and driven through Ministry of Health policy.

Moreover, New Zealand health consumers are not featured significantly in the current system. The Ministry of Health recognizes the importance of involving consumers and has also identified the security concerns associated with the development of a complete PHR. (Healthcare and Informatics Review Online)

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MALAYSIA

Overview of Country Healthcare System

As of 2006, the population of Malaysia is approximately 27 million. Approximately 5 million Malaysians live in East Malaysia and 21 million live in the Malaysian Peninsula. The annual growth rate is 2.4 percent and approximately one third of the population is under the age of 15. Sixty-three percent of the population is between the ages of 15 – 64, while only five percent are over the age of 65. Malays comprise over half of the population; Chinese account for approximately 24 percent; Indians, seven percent; indigenous peoples, 11 percent; and all others, eight percent. (http://en.wikipedia.org/wiki/Peninsular_Malaysia)

The unemployment rate in Malaysia is three percent of its labor force and the literacy rate is almost 90 percent.

Malaysia enjoys a comparatively high standard of health, the result of long-established healthcare and medical services. There are only three large hospitals in Malaysia that are capable of supporting a HIE system. They are all located in the capital of Kuala Lumpur: Subang Jaya Hospital, General Hospital and Penang Adventist Hospital.

National EHR Program

National IT/ICT Status & Strategy

The following vendors have agreed to participate in Malaysia's HIT implementation:

- **Malaysian Medical Association (MMA):** MMA is the national association of physicians. Its mission is to represent medical doctors and to promote the profession of medicine.

- **Association of Private Hospitals in Malaysia (APHM):** APHM is the national association of private hospitals. Its mission is to represent private hospitals and to promote their place in the Malaysian healthcare system.

- **OpenMenu Plus SDN BHD (OMP):** OMP is a joint venture consortium of companies and partners who have expertise in IT and software solutions for the healthcare industry.

- **Mimos Berhad (MIMOS):** MIMOS is a government-owned company that researches and develops information and communication technology specializing in microelectronics.

- **Microsoft (Malaysia) SDN BHD:** Microsoft develops, manufactures, licenses and supports a wide range of software products in Malaysia, including operating systems, server applications, productivity applications and software development tools.

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National/Regional EHR Approach

The current state-funded plan is called the OpenMenu Plus Initiative and is designed to provide an entry-level set of HIT services and functions. OMP will implement a secure infrastructure that will enable the private medical sector – hospitals, clinics and laboratories - to interact with their patients, clients and partners. It will also provide general resources for doctors, including continuing medical education, directories of medical facilities and physicians, and drug information.

The OPM model appears to be evenly distributed, supporting both rural and city medical practices. Clinicians will be able to access the system through PCs, hand held devices, smart cards or telephones.

The use of smart card technology will enable transactions to be performed throughout the healthcare provider and payor sectors, including government, corporate and insurance entities. It will provide a legally binding, secure and auditable communications infrastructure designed to engender trust among its users.

Although the infrastructure used for EHR data storage is highly secure, patients neither retain ownership of their medical records nor have specific rights related to their information.

EHR Governance

Legal/Regulatory

The National Information Technology Agenda (NITA) was established in 1996 to provide a framework for coordinating and integrating three strategic elements: human resources, infostructure and IT-based applications. Malaysia may be hampered in this attempt by the fact that there are no kickback or self-referral laws. In a society where business corruption in not uncommon, any attempt to stem the self-interest of healthcare professionals may create a barrier to sharing information on a uniform basis.

Healthcare Policy

A Health Technology Assessment (HTA) Unit was established by the Ministry of Health in August 1995. This purpose of this unit is to provide input into healthcare policy making, provide a sound scientific basis for technology adoption and deployment, and promote the continued use of existing technology. The Ministry has created a three-tiered organizational structure in which expert groups first carry out technology assessments with the help of the HTA, a technology committee then vets these reports, and the HTA Council rules on their recommendations.

Technology

The Malaysian HIT initiative will rely on HL7 as the primary standard for the exchange and storage of data. The three main Malaysian hospitals are linked by a national HIE network that uses this standard.

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Adoption

All patients who have received care in one of Malaysia's three hospitals are automatically enrolled in the system.

Outcomes

It is unclear how the Malaysian government plans to measure patient outcomes and healthcare improvements related to the implementation of HIT.

Benefits

Information to study the benefits of HIT implementation is in the early stage of collection by the Malaysian Ministry of Health. The Ministry is slated to report on cost savings and improved outcomes as early as 2008.

Implementation Experiences

Information was not available on this topic.

Next Steps

Information was not available on this topic.

References

Information was not available on this topic.

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About the Contributors

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HONG KONG

Introduction

Hong Kong has 43 public hospitals and 12 private hospitals that serve a population of 6.83 million people with 25 million visitors to the country per year. It boasts one of the world's lowest infant mortality rates and longest life expectancies.

Hong Kong spends five and a half percent of its GDP on healthcare; 57 percent in the public sector and 43 percent in the private sector.[1] Public funding is governed by the Food and Health Bureau (FHB), one of 11 public bureaus responsible for public policies. Within the FHB, the Department of Health oversees public health measures and the Hospital Authority (HA) manages all public hospitals and government outpatient clinics.

The HA was formed in 1990 to manage all public healthcare services including 43 public hospitals/institutions, 47 specialty outpatient clinics and 74 general outpatient clinics. The public sector has a total of 27,742 hospital beds and 29,000 clinical staff delivering over one million inpatient visits, two million emergency visits and 13 million outpatient visits annually. One hundred percent of long-term care, 93 percent of inpatient and tertiary care and 24 percent of primary care are provided by the HA with the balance provided by the private sector.

Computerized Patient Records Systems

HA first developed its IT infrastructure in 1991, including financial, human resources, patient administrative and departmental systems. In 1994, it began developing its Clinical Management System (CMS), an integrated computerized patient record system that gives clinicians access to all available electronic clinical information on their patients. HA adopted a centralized approach in developing its CMS for clinical care, greatly reducing IT cost per hospital. Inter-operability between different hospitals was one of the key aims in developing the clinical management system. Thus, in Hong Kong, 160 facilities in the public sector use the same CMS. The system has a familiar user interface to enhance the efficiency in a busy clinic setting. The HA CMS has very high user acceptance and is in use in everyday care delivery.[2]

The electronic patient record, (ePR) was first developed in 2000 using a unified information model.[3] It provides a standardized repository of all clinical data collected throughout the HA and offers a clinician-friendly view into the comprehensive longitudinal lifelong record of the patient. In addition, the ePR acts as a data source for clinical decision support, and a rich resource for audits, research and reporting. The ePR is comprehensive in scope and includes details of patient episodes and visits, diagnoses, procedures, discharge summaries, allergies and alerts, all medications, laboratory and radiology results, nursing and allied health information, documents and letters and specialist clinical data. In recent years, radiological images have also been available throughout the HA as part of the ePR and patients can also elect to share their health record with clinicians outside the HA. As of 2007, eight million patient records are held in the EPR.

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Hospitals and clinics	164	CMS transactions	3 million daily
Visits	15 million	ePR transactions	590,000 daily
In patient admissions	over 1 million	X-ray images	32 million
No of patient records	8 million	Laboratory items	800 million
		Prescription items	340 million

The CMS and EPR are integrated across all settings throughout HA facilities including emergency, inpatient, outpatient and outreach services. CMS and EPR are essential clinical and management tools for Hong Kong and, together, handle over three million clinical transactions per day.

Computerization in the private healthcare sectors is less developed. Although most of the 12 private hospitals have financial and administrative systems, CPOE and clinical documentation are still in their infancy. In the ambulatory sector, only 20 percent of the 5,000 private practitioners use computerized patient records systems.

Overview of EHR Program

Governance

In recent years, several government papers and reports have highlighted the need for patient records (with patient consent) to flow freely between different care settings in both the public and private sectors. To accomplish this goal, the Food and Health Bureau has established a steering committee on E-Health Record Sharing. Stakeholders from both the private and public healthcare sectors form this committee and their mutual goal is to build consensus and gather expertise for the development of a territory-wide information system. In turn, this will enable sharing of all patient records throughout the healthcare system. Until this happens, governance in the public sector is driven by the HA.

The HA has instituted formal clinical IT governance structures and processes[4] in which the public hospitals and more than 120 clinicians from all specialties are engaged in the design, development and implementation of the clinical systems. This emphasis on clinician engagement and ownership has achieved high utilization rates and produced real clinical and business benefits. In addition, strong portfolio management with control of scoping and prioritization has led to a very cost effective program. To date, the HA has spent $200 million U.S. on the development and implementation of this clinical informatics portfolio. For future development, the HA has established “Clinical Systems Strategy 2007-2012,” a Phase III program of the CMS that will extend the benefits of e-health to the private sector.

Policy and Legal Requirements

Patient Privacy

Hong Kong is addressing the privacy rights of patients through its Personal Data Ordinance. This regulation applies to any person (data user) who controls the collection,

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holding, processing or use of patient data. In addition to the Personal Data Ordinance, the Medical Council of Hong Kong regulates clinicians through the Professional Code of Conduct that includes the handling of patient information.

Data Sharing

Six guiding principles have been proposed for sharing information through the EHR:

1. Record sharing should compelling but not compulsory.
2. Corporation institutional structures should be developed that facilitate sharing of information.
3. A self-sustaining business operation model should be developed to continue this process.
4. Privacy and security should be maintained at all times.
5. Open technical standards should be employed.
6. A "building block" approach should be employed to promote the system's adoption and ease its implementation over time.

Technology, Adoption and Outcomes: PPI-ePR Sharing

The PPI-ePR sharing project was established in 2006 as the first large-scale feasibility test for sharing patient records between public and private healthcare sectors. After receiving patient consent, clinical records are shared with participating clinicians through an Internet portal. The patient is assigned a PIN (personal identification number) and his ePR record is then extracted and encrypted into the secure PPI-ePR database.

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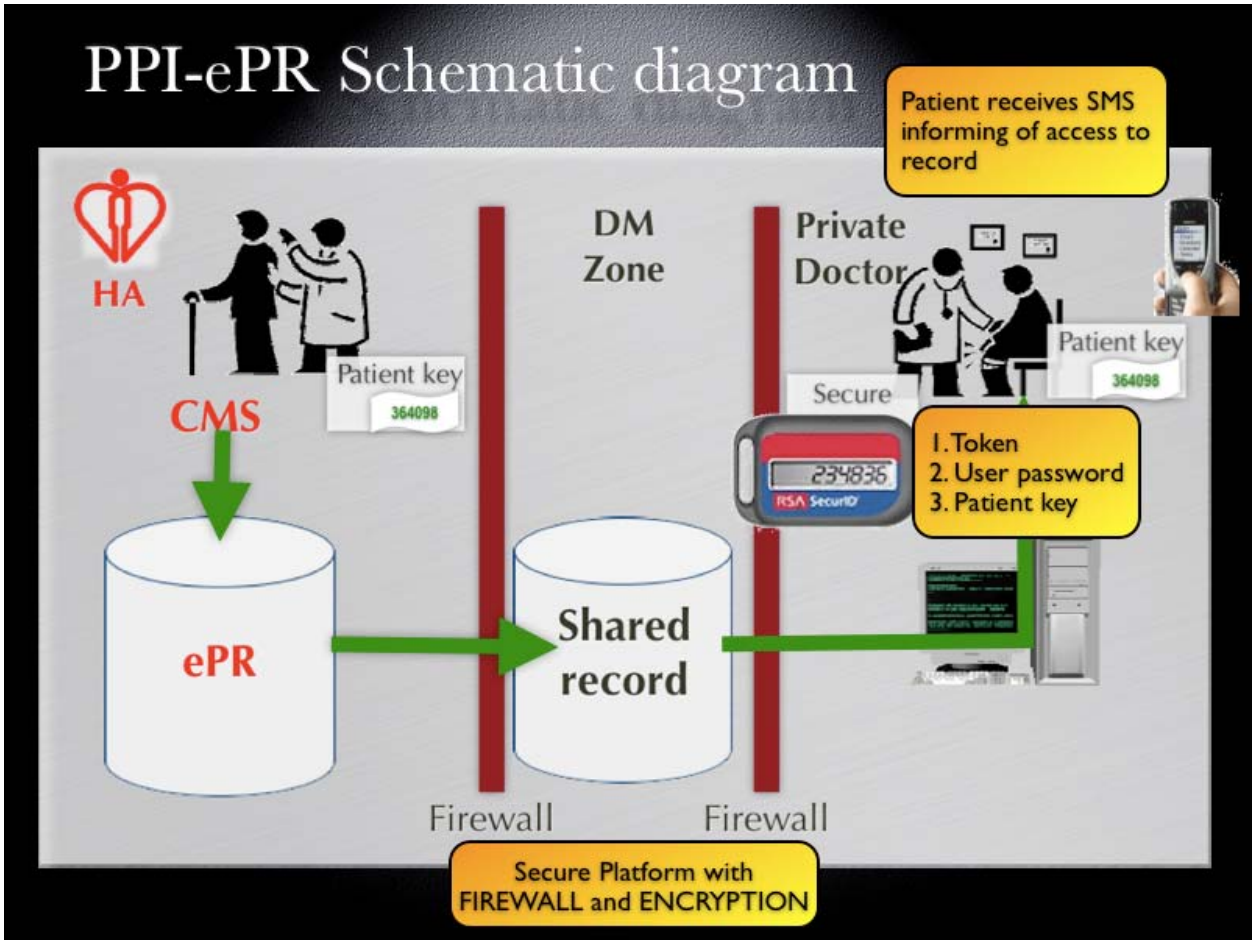

Physicians in the private sector who participate in this project are also given a PIN and a security token in which a six-digit number is refreshed each minute. The physician uses his PIN and token number, combined with the patient's Hong Kong identity number and PIN, to access the patient's record. Upon successful authentication the PPI-ePR will display the patient's record on the Web browser, protected by SSL-VPN. As an additional security measure, an SMS message will be sent to the patient's mobile phone, alerting him of the physician's access to his record.[5]

As of October, 2007, over 15,000 patients, 800 private physicians and private hospitals totaling 600 beds have enrolled in the project.

EHR Next Steps

Three work groups have been created to manage the key issues involved in setting up a national EHR system in Hong Kong. These are the:

1. Work group on institutional arrangements;
2. Work group on legal, privacy and security issues; and
3. Work group on e-health record and information standards.

Recommendations from all three groups will form the consensual basis for all future EHR development for Hong Kong. In the meantime, the PPI-EPR project will continue to extend its scope to more private healthcare settings and to pilot two-way sharing with selected physician groups.

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SINGAPORE

Overview of Country Healthcare System

Singapore is the smallest country in Southeast Asia with a population of 4.48 million as of 2005. Singapore is the fourth most densely populated country in the world. The annual growth rate in year 2000 was 2.8 percent. The majority of the population is Chinese with a substantial minority population of Malay and Indians. Mahayana Buddhism is considered the first religion in Singapore, but is not followed by the majority of the population; significant numbers of Singaporeans follow Islam. Although Singapore has four official languages, its national language is Malay with English widely spoken.

Since achieving independence in 1965, Singapore has developed into one of the wealthiest countries in Asia. This is an impressive accomplishment for such a small country with very limited natural resources other than its people. What is equally impressive is that Singapore is generally acknowledged as having one of the most successful healthcare systems in the world, both in terms of cost efficiency and community health outcomes. This is especially remarkable in light of the fact that the country is only just beginning to use HIT.

National EHR Program

National IT/ICT Status & Strategy

The key to Singapore's efficient healthcare system is that individuals are financially responsible for their own healthcare. As a result, the healthcare system is funded predominantly by private means.

Singapore is just beginning to experiment with the use of patient IS to further increase positive patient outcomes. Although its adoption is limited, IT is expected to increase as the Ministry of Health initiates new programs for healthcare technology. Moreover, since Singapore already has a strong interconnected society with easy access to wireless and broadband services, healthcare IT adoption is expected to accelerate into a consistent set of patient IS.

National/Regional EHR Approach

In the public sector, Singapore provides authentication services to patients directly through smart card technology and uses HL7 standards. Patient clinical data is owned by the Singapore Health Sciences Authority (HSA), but patients do have some control over its use.

Since most healthcare technology emanates from the private sector, companies such as Health Online, a for-profit health resource organization, provide the most advanced design and delivery of health services. Health Online provides video conferencing between patients and care providers, patient and physician access to medical records hosted by the company, and a professional education forum.

Healthcare providers are just beginning to adopt EMRs. The slow diffusion is due to the prohibitive costs of EMR systems; the difficulty in linking to, or drawing information

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from, legacy systems; and the limited availability of data input devices that meet physician requirements.

EHR Governance

Legal/Regulatory

Both the public and private sectors deliver healthcare services in Singapore. In 1999, public healthcare was reorganized into two vertically integrated networks in order to promote integration, cooperation and collaboration among all public sector healthcare providers. These networks are known as the National Healthcare Group (NHG) and Singapore Health Services (SingHealth).

In the private arena, the Parkway Group and Raffles Medical Group are Singapore's two major private healthcare providers.

Healthcare Policy

The HSA is the governmental/legal/regulatory body for EHR and has absolute control over both public and private healthcare ventures. It is responsible for the quality, safety and efficacy of medications, biomedical technologies, medical devices, radiation equipment, blood and blood products, and all other health-related products in the country. In addition, it is the government authority that runs the national blood banking service, provides consultative services to healthcare institutions and conducts scientific, investigative and analytical support for vital government functions such as forensics, food safety, industrial health and environmental regulation.

Adoption

NHG has undertaken a huge initiative to integrate its financial, material and patient management processes into a national electronic patient care system codenamed Project Nauticus. Nauticus will provide interoperability through a seamlessly integrated patient care system among all healthcare institutions within the group.

In 2003, NUH became the first hospital in Singapore to install wireless access in every ward. Today, both NHG and SingHealth emphasize wireless sharing of EMR information between all of their member hospitals.

NHG currently uses radio-frequency identification (RFID) tags to track movement of patients, staff and physicians in its NUH and Alexandra hospitals. It is also implementing a next-generation healthcare IT solution called Soarian (Siemens Medical Solutions) into all member hospitals. This system will seamlessly integrate financial, clinical, administrative and diagnostic processes into patient care. SingHealth has implemented a consolidated IT system that supports a single, integrated view of patient information across all member institutions within the group.

The Parkway Healthcare Group is planning to electronically link its clinics with its three hospitals – Gleneagles, Mount Elizabeth and East Shore.

Outcomes

Compared with the rest of Southeast Asia, Singapore has achieved significantly high patient satisfaction and is now collecting information on healthcare outcomes.

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Benefits

Use of IT in healthcare has contributed significantly to the country's success in disease management, especially when dealing with the recent SARS outbreak.

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About the Contributors

Erik Pupo is the senior enterprise architect for Vangent.

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MIDDLE EAST

ISRAEL

Overview of Israel's Healthcare System

Israel is located in the Middle East, along the eastern coastline of the Mediterranean Sea and bordered by Lebanon, Syria, Jordan and Egypt. It lies at the junction of three continents: Europe, Asia and Africa and is about 290 miles (470 km.) in length and 85 miles (135 km.) in width at its widest point.

Israel is a country of immigrants. Since its emergence as an independent country in 1948, Israel's population has grown five-fold and currently stands at approximately 7.1 million inhabitants. Its key cities include its capital Jerusalem with a population of 729,100; Tel Aviv-Yafo with a population of 382,500; Haifa with a population of 267,000; and Be'er Sheva with a population of 185,300.

A National Health Insurance law has been in effect in Israel since January 1995 and covers a standardized group of medical services. This coverage includes inpatient hospitalization for all residents of Israel. All medical services are provided by the country's four healthcare organizations.

Life expectancy is 82.2 years for women and 78.5 years for men and the infant mortality rate is four per 1,000 live births. The ratio of physicians to patients and the number of specialists compare favorably with those in most developed countries.

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Figure 1. Map of Israel

Healthcare Demographics

In addition to private practice, Israel's 32,000 physicians, 9,000 dentists and 6,000 pharmacists pursue their professions as members of hospital staffs and neighborhood clinics. About 68 percent of the country's 51,000 nurses are registered nurses (RNs), while the rest are practical nurses.

There are 356 hospitals in Israel. Most provide general medical care, but there are also psychiatric facilities, skilled facilities that provide geriatric care, and rehabilitation services. The Clalit Health Services Fund has 14 hospitals.

Average length of stay for inpatient admissions are 4.1 days for all acute care hospitals and 10.8 days for all hospitals combined.

National EHR Program

National IT/ICT Status and Strategy:

The Israeli National HIT is an evolving, innovative, state-of-the-art implementation of clinical data exchange. It is based on the unique concept of “virtual temporary sharing” where a logical connection of multiple caregivers and medical organizations creates a patient-centric virtual repository of information. Data is not kept centrally; instead, all information remains in its original format, location, system and ownership. On demand, relevant information from anywhere in the system is instantly integrated and delivered to the point-of-care. This system, successfully covering more than half of Israel's population, is currently evolving from a voluntary private-public partnership (dbMOTION and CLALIT HMO) to a formal national reality. Now that the central government is taking over the process, its leadership is essential to achieving the full potential of the HIT. All partners and stakeholders in the Israeli health system are coordinated with each other, all driven by a shared vision; the emergence of a secure, private and confidential HIE network.

National/Regional EHR Approach

Hospitals

Most general hospital services are provided by the government and Kupat Holim Clalit (General Health Fund). The Ministry runs nine government hospitals and two municipal-government hospitals and Kupat Holim Clalit owns eight. There are also ten other public hospitals and nine smaller private hospitals. Excluding day beds, there are 2.69 general-care beds per 1,000 people in the population.

The majority of Israel's hospitals use EMR systems. There are many different systems in use and most hospitals use more than one. Although hospital adoption rate is high, the systems are not interoperable. The lack of data exchange between hospitals and within hospital departments, therefore, diminishes the value of the electronic records. It prevents the formation of a single hospital network where systems can provide data, such as laboratory and radiology results, to each other.

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Home Care

Home care services fall into two categories: long-term medical and rehabilitative care, and personal nursing care. In April 1988, the Nursing Insurance Law mandated that those patients entitled to home care receive a nursing allowance through the National Insurance Institute with two exceptions: 1) the Health Ministry continues to finance the care of handicapped individuals who were receiving care prior to April 1988 and who do not qualify under the Nursing Insurance Law; and 2) children below the age at which they become entitled pursuant to the Nursing Insurance Law.

Preventive Health

The public health services that are mandated to prevent disease and promote individual health include:

- The Food Service
- Environmental Health Administration
- Epidemiology and Laboratories
- Mother and Child Care
- Dental Care
- Health Education
-

District and regional health offices of this public health system provide active oversight and services at the district and regional levels.

Pharmacies

The Clalit Health Services fund runs 400 pharmacies. The Pharmaceutical Division of the Israeli Ministry of Health licenses and regulates pharmacists and pharmacies and controls the country's supply of medications. Under Israeli law, drug labels must be in Hebrew and English.

Israel's system for pharmaceutical regulation is strongly based on those from both the U.S. and EU. Israeli regulations require that drugs approved for sale must be manufactured using U.S. or EU standards for Good Manufacturing Practices (GMP) and USFDA or its equivalent European Standards. Drugs that are approved for use in Israel are generally already approved in the U.S. or EU.

Laboratory

The public health laboratory system includes free-standing central and regional facilities as well as national institutions and centers. In addition to performing routine and specialized blood tests on individual patients, Israel's laboratory system carries out surveillance for infectious disease and monitors toxicological, chemical and microbiological tests on samples of water, food and wastes. Checking the efficacy and safety of medication and cosmetics is also the responsibility of the public laboratory system.

EHR Governance

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Israel is a democratic state in which the government is the executive authority. The government consists of a prime minister, other ministers and the Knesset (Israel's Legislature). Responsibility for all health services lies with the Ministry of Health, which prepares legislation and oversees its implementation, controls medical standards nationwide, maintains food and drug quality standards, licenses medical personnel and facilities, promotes medical research, evaluates health services, and supervises the planning and construction of hospitals. The Ministry also acts as a public health agency for environmental and preventive medicine. The Health Ministry employs over 19,000 workers engaged in 60 medical, paramedical, engineering and technical, administrative and housekeeping professions.

The Ministry of Health is responsible for the four health funds: Clalit (57 percent), Maccabi (24 percent), Meuhedit (10 percent) and Leumit (12 percent) as well as the hospitals. Clalit dominates the arena and has set much of the HIT agenda, but the smaller health funds try to use technology as a competitive asset.

There is a 99.9 percent penetration of ambulatory EMR in the public sector. Despite a high degree of computerization, there is still a low penetration of a full EHR system in hospitals. One of the barriers to adoption in the private sector is a low incentive for providers to invest in IT.

Technology

All Israeli hospitals use a LAN network environment to connect to and run their EMR systems. These systems are interconnected to other IT systems and departments within the hospital—90.5 percent of the EMR systems are connected to the central demographic repository, 85.7 percent are connected to laboratories, 52 percent to the surgical units, blood banks and radiology departments and 50 percent are connected to pathology.

Security

One hundred percent of the systems are password-protected and additional data security procedures are in place in 80 percent of the hospitals. More than a third of all hospitals control user access through role/class authorizations and electronic signatures. Data encryption is present in five percent of the hospitals.

Firewalls are functional in 65 percent of hospitals; backup and recovery procedures are used by 80 percent. One of the biggest concerns on the part of the hospitals is inappropriate access to patient records, violation of data security policies and access to patient's information by unauthorized users outside the organization.

Adoption

There are 299 clinical departments that actively use the installed EMR systems in Israeli hospitals. Hospital-based physicians use the EMR in over 98 percent of the departments and more than 90 percent of the departments use the EMR for recording patient admissions and discharges.

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About 40 percent of hospitals utilize EMRs for daily medical follow-up (e.g., progress notes) and nurses use them to record their admissions and discharges. Twenty percent of hospitals also use the system for daily nursing progress notes. Finally, almost half of all hospital surgery departments document their procedures into the EMR.

The main applications for EMRs in Israeli hospitals include: laboratory testing and documentation, imaging studies, clinical data repositories, CPT and ICD9 coding for billing, warehousing of data to support research and report outcomes, decision support, PACS and voice recognition. Many of the EMRs are now Web-based. Voice recognition does not appear to have garnered physician support and most Israeli physicians are comfortable typing directly into the system. Finally, decision support systems are present in only a few hospitals.

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CANADA

Overview of Country Healthcare System

Canada has a predominantly publicly financed and administered healthcare system with 13 interlocking provincial and territorial health insurance plans. The system is designed to ensure that all eligible residents have universal access to medically necessary hospital and physician services, regardless of age or income and without direct charges at the point of service. Adopted in 1984, the Canada Health Act (CHA) defines the national principles, symbolic of the underlying values of equality and solidarity that govern the healthcare system. These principles call for a system that is:

- Publicly administered
- Comprehensive
- Universal
- Portable
- Accessible

While the CHA sets out the criteria and conditions that the 13 jurisdictions must satisfy in order to qualify for their full share of available funding, the provincial and territorial governments have primary jurisdiction over healthcare services. They set their own priorities, administer their budgets and manage their own resources. One exception is the responsibility for Aboriginal (First Nations people and Inuit) health services, which is shared by federal, provincial and territorial governments as well as Aboriginal organizations. The federal government also provides direct delivery of healthcare to other specific groups, including serving members of the Canadian Forces, the Royal Canadian Mounted Police and eligible veterans.[1] Many other organizations and groups, including health professional associations and accreditation, education, research and voluntary organizations, contribute to healthcare in Canada.

Few Canadian industries compare in size and complexity to Canada's public healthcare sector. More than 100 health regions, 900 hospitals, thousands of clinics and physician offices and a healthcare workforce of approximately 400,000 coordinate care delivery for a population of just over 33 million. Healthcare is also one of the country's most information-intensive industries with approximately 2,000 healthcare transactions per minute, all requiring documentation and information sharing. Each year, the system generates:

- 440 million laboratory tests
- 382 million prescriptions
- 322 million office-based physician visits
- 35 million diagnostic images
- 2.8 million inpatient hospitalizations

While healthcare is often defined as a core value of Canadian society, the system has come under stress in recent years due to various factors, including:[2,3]

- Aging population: one Canadian in five will be 65 years old by 2026;

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- Shortage of general practitioners: creating a sporadic pattern of care across channels;
- Care settings: continue to shift from acute to home care and other alternatives; and
- Rising costs: healthcare costs were expected to exceed $160 billion CAD in 2007.

National EHR Program

National IT/ICT Status & Strategy

Despite the challenges listed above, Canadians have high expectations from their healthcare system. They want accurate, portable information; communication between their various healthcare providers; privacy protection; input into decisions; elimination of risk; access to test/lab results; and timely access to appropriate care. An EHR can fulfill these expectations.

Recognizing the importance of an EHR, the federal government established Canada Health *Infoway* Inc. (*Infoway*) in 2001 to support and accelerate the development and adoption of interoperable EHR solutions across Canada. *Infoway* is an independent, not-for-profit organization whose members are Canada's federal, provincial and territorial deputy ministers of health. Its goal is that by 2010, each province and territory will benefit from new health information systems (HIS) that will modernize healthcare. Furthermore, 50 percent of Canadians will have their EHRs readily available to the authorized professionals who provide their healthcare services.

Initially, funding for *Infoway* was $500 million CAD. In 2003, another $600 million CAD was allocated towards the core EHR. In 2004, the federal government added $100 million CAD for the development of a pan-Canadian public health surveillance system and *Infoway* received $400 million CAD in 2007 to support its programs and develop patient wait time strategies.

National/Regional EHR Approach

As shown on the chart below, Canada's approach to a national system fits primarily the "Service Oriented" #3 category. Services are defined within a common framework, the EHRS Solution (EHRS) Blueprint. The Blueprint has the following characteristics:

- It is a flexible business and technical design framework that allows solutions, components and business rules to be reused by multiple applications in the health IT enterprise.
- It ensures that all EHR solutions can seamlessly and securely exchange patient health information between point of service across the continuum of care across healthcare delivery organizations, and across healthcare delivery jurisdictions.
- It addresses the business, conceptual and logical architecture, deployment models and potential applications in a health ecosystem.

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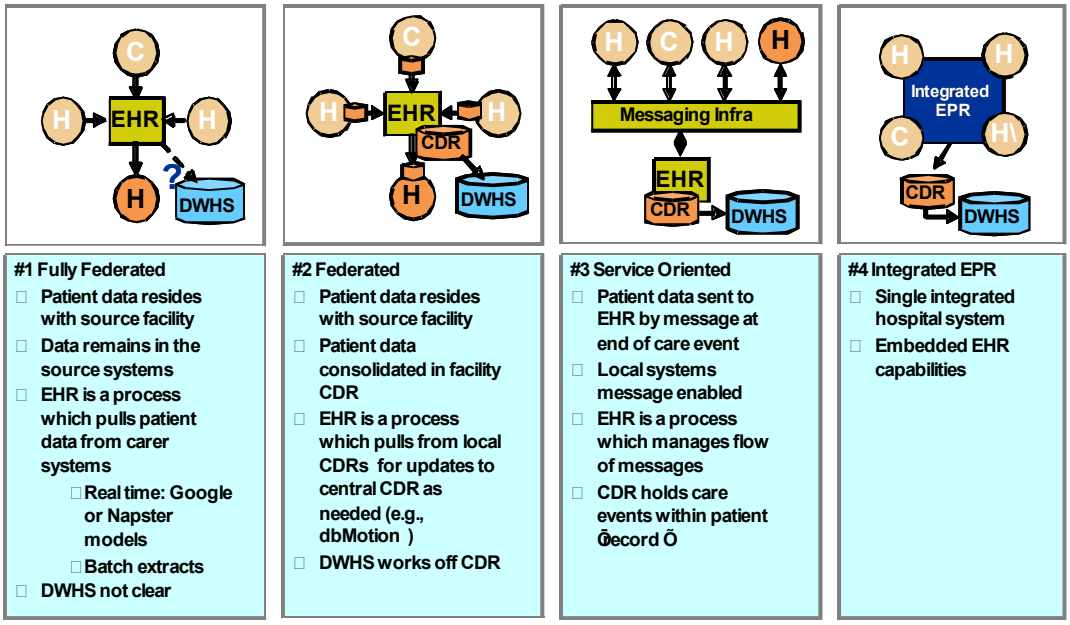

There are three elements to the national EHR approach led by *Infoway*:

1. **Strategic investor***: Infoway* works in collaboration with the federal/provincial/territorial jurisdictions, regional healthcare authorities, other healthcare organizations and IT vendors and suppliers to identify investment opportunities. Once investment decisions are made, its public sector partners lead the development, implementation and use of EHR solutions. *Infoway* provides leadership by establishing a strategic direction for EHR.

2. **Gated funding:** *Infoway* co-invests an average of 75 percent of eligible planning and implementation costs for approved projects, with the provinces and territories funding the balance. To manage risk, it uses a "gated" funding model that ties reimbursement to the achievement of specific implementation milestones, including end-user adoption by clinicians.

3. **Interoperability**: *Infoway* promotes the use of common architecture and standards to ensure that systems can interoperate so that data can not only be shared over distance, but also read and understood. A comprehensive EHR can bring together all elements of personal health information to provide a complete profile to facilitate diagnosis, quality outcomes, patient safety, health system deliver efficiency and speed access to care. This has led to the development of *Infoway's* EHRS Blueprint and a portfolio of interoperability standards (e.g., HL7 v3, SNOMED CT), which has been adopted by all of Canada's health jurisdictions.

   In addition, *Infoway* has established a national function called the *Infoway* Standards Collaborative (SC), a coordination function created to develop, support and sustain health information standards. It is responsible for implementation support, education, conformance and maintenance of EHR standards currently being developed by *Infoway*. The SC is also responsible for several standards initiatives including the Partnership (semi-annual plenary and meetings on standards and architecture) , HL7 Canada, Canada's participation in DICOM, LOINC® (Logical Observation Identifiers Names and Codes), SNOMED CT, and, in conjunction with the Canadian Standards

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Association (CSA), the secretariat to the Canadian Advisory Committee to the International Organization for Standardization (ISO)/TC 215.

EHR Governance

Legal/Regulatory

Security and privacy are essential elements of EHRS. They are addressed together in the EHRi Privacy and Security Conceptual Architecture, Version 1.1, June 2005, and in Version 2 of the Blueprint released in 2006. In Canada, privacy is addressed in many federal/provincial/territorial general privacy and healthcare specific privacy laws. The features included in the architecture are based on requirements set out in legislation. Moreover, *Infoway* requires that privacy impact assessments be undertaken on all projects that receive funding and involve personal health information. This provides assurance that the project sponsor considers privacy and security throughout all stages of the project.

Currently, patient consent (express, implied, deemed or no consent) varies by jurisdiction. Generally, health information may be collected, used and disclosed on the basis of implied consent. Legislation sets out a list of secondary uses that are permitted without consent. These include activities such as healthcare administration and management. Information for research purposes will often require express consent unless certain conditions, set out in legislation, are met. These conditions typically require that research be reviewed by an ethics board.

Healthcare Policy in Canada

The concept of an interoperable pan-Canadian EHR is in accordance with the four patient-oriented principles in the Canada Health Act:

1. Universality: Public healthcare insurance must be provided to all Canadians.
2. Comprehensiveness: Guarantees that all medically necessary hospital and doctor services are covered by public healthcare insurance.
3. Accessibility: Financial barriers to the provision of publicly funded health services, such as user charges, are discouraged, so that care is available to all Canadians regardless of income.
4. Portability: All Canadians are covered under public healthcare insurance when they travel within Canada or move from one province to another.[4]

When fully functional, the EHR will be in alignment with this policy. It will also support the government's commitment to its two overarching objectives for healthcare in Canada:

- To ensure that all Canadians have timely access to medically necessary health services regardless of their ability to pay for these services; and
- To ensure that no Canadian suffers undue financial hardship as a result of having to pay healthcare bills.

Implicit in these two objectives, particularly in the former, is the requirement that the medically necessary services provided under Canada's healthcare system be of high quality. The EHR will serve to enhance healthcare providers' contribution towards diagnosis and speed access to quality care.

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Technology

Infoway's EHRS Blueprint is the framework for the Canadian EHR solution; it provides the enterprise system architecture that guides overall development of the whole and the individual parts. The building blocks include: registries that uniquely identify individual patients/clients as well as health service providers; shared repositories of patient-centric health information; software applications used at the points where health services are provided (point of service applications); health information management services that coordinate the placement and retrieval of data in the shared repositories; and a standards-based communications layer that uniformly authenticates software applications and systems users who interoperate with the EHR.

The Blueprint is the conceptual architecture for the interoperable EHR that puts the right information about the right person in the hands of the right people at the right time and place. It is achieved by creating a robust and extensible framework and standards for sharing health information. This supports a broad range of current healthcare processes and is flexible enough to accommodate improvements and developments in best practices.

The architecture is also technology-neutral. It does not mandate the use of a particular technology, product or vendor service but simply describes how the system should work. In a best-of-breed approach, however, any application selected by the jurisdictions for their projects must be compliant with the Blueprint and with the interoperability standards. This principle, and the use of standards-based commercial solutions that reduce cost and risk, is part of *Infoway*'s business strategy.

Adoption

Clinician adoption is a key to EHR implementation. It often requires change management in the clinical setting in conjunction with a number of initiatives to promote adoption. For example, following the implementation of the Drug Profile Viewer in 175 emergency departments in Ontario, a follow-up survey showed barriers to adoption included multiple passwords, workflow and training. By addressing these issues through best practices, follow-up training and support, adoption momentum was restored and targets met prior to the deadline.

Lessons learned to date point to the following key issues to be addressed for successful adoption:

- Involve clinicians in all aspects of the project, from requirements definition to implementation.
- Demonstrate active response to clinician input and concerns.
- Understand what motivates clinicians to adopt EHR technology including patient safety, innovation and efficiency
- Provide evidence of EHR solutions efficiencies.
- Define the desired impact on workflow and ensure that technical implementation supports workflow enhancements.
- Engage and encourage clinician "champions" and clearly define their roles to facilitate successful adoption of EHR solutions.

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- Provide a flexible offering of pre- and post-implementation support (such as 1:1 training) to best meet physician needs and ensure rapid solution uptake.
- Set targets for adoption and monitor them on a regular basis, refocusing change management tactics as required.
- Measure benefits and impacts as benefits realized in early implementation will motivate latent adopters.
- Manage expectations through effective communication via multiple channels and forums as well as by providing effective, transparent messages targeted to the clinician audience.

Results

Since its inception, *Infoway* has approved more than 241 projects in the following targeted program areas: Diagnostic Imaging Systems, Drug Information Systems, Infostructure, Innovation and Adoption, Interoperable EHR, Laboratory Information Systems, Public Health Surveillance, Registries and Telehealth. The investment strategy for a new program area — Patient Access to Quality Care — is currently under development. Of the 241 projects approved as of the end of the second quarter of *Infoway's* 2007-2008 fiscal year, 157 were active and 84 complete. The majority of the projects, 148, were undertaken jointly with the provinces and territories, while 93 active or complete projects were pan-Canadian.

Benefits

According to Booz Allen Hamilton's report,[5] completion of the pan-Canadian EHR will result in a capital cost of $10 to $12 billion CAN over 10 years with expected annual savings of $6 to $7 million CAN upon full implementation.

Cumulative benefits to Canadians are expected to be the following:

- Increased patient participation in care;
- Well-managed chronic illness (Disease Management);
- Improved access to care in remote and rural communities;
- Fewer adverse drug events;
- Better prescribing practices;
- Reduction in duplicate or unnecessary tests;
- Reduced wait times; and
- Saved lives.

One area in which benefits are now clearly definable is Diagnostic Imaging (DI). By creating a shared Picture Archiving and Communications System (PACS), groups of hospitals can share the cost of building a repository for digital diagnostic images. A recent study of sites where PACS was operating showed the following results:

- 87.2 percent of radiologists and 73 percent of referring physicians indicated that PACS increased their reporting and consultation efficiency
- 86 percent of radiologists and 65 percent of referring physicians indicated that report turnaround time improved since the implementation of PACS
- Almost two-thirds of referring physicians stated that PACS improved their ability to make decisions regarding patient care

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Implementation Experiences

Infoway's approach to creating a pan-Canadian EHR has been to build "toolkits" based on knowledge gleaned from individual projects. For example, early diagnostic imaging projects in British Columbia and Ontario provided essential feedback upon which a DI toolkit was created for replication of similar projects. In turn, each replicated project produces information that benefits the replication of future projects. This reduces ramp-up time on a project by providing a "blueprint" to follow. Reuse and replications have been key strategies for *Infoway*, with many of its projects in 2007 progressing to the implementation phase.

Examples of successes from across Canada:

- **Prince Edward Island and Ontario**: Seniors arriving at a hospital emergency room can have their prescription medication profile retrieved instantly.

- **Manitoba and New Brunswick**: Expanded telehealth services connect patients and specialists through high-speed networks, reducing delays, costs and stress.

- **Saskatchewan:** A pharmacy information network will soon give healthcare providers their patients' complete pharmacy dispensing history – electronically.

- **Alberta:** Chronically ill diabetic patients receive collaborative care from a diverse team of specialists who monitor, communicate and make decisions based on a complete and readily available EHR.

- **British Columbia, Quebec, Nova Scotia and Newfoundland**: A patient's MRI can be digitally captured and electronically downloaded for interpretation by an available radiologist almost anywhere in the province. In fact, a similar system has helped a B.C. health authority cut turnaround time for radiologists' reports by 41 percent.

- **Northwest Territories, Yukon and Nunavut**: Telehealth services are overcoming the problems associated with distance and accessibility to healthcare services by electronically linking patients with clinicians a long distance away.

Next Steps – Vision

Despite the fact that implementation is already underway across the country and all jurisdictions have some components of the infostructure in place, Canada's journey to establish a fully interoperable EHR is far from complete. There are still hurdles to overcome, including clinician adoption/patient engagement, jurisdictional capacity to implement the required project and systems, achieving total interoperability, vendor adoption of common standards and architecture and, most importantly, recapitalization of *Infoway* to assist in funding the full EHR.

Recently, more than 100 healthcare stakeholders across Canada, including deputy ministers and health region executives, hospital CEOs and CIOs, clinicians, patients, health associations and government agencies were asked for their input as part of a vision development exercise undertaken by *Infoway*. What emerged was a comprehensive vision

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to guide the next 10 years of investments in HIS, including the pursuit of four key initiatives:[6]

1. Complete the baseline EHR for all Canadians and extend its functionality and reach.
2. Articulate a strong business case for ongoing support and secure funding.
3. Bring key stakeholders (particularly public and front-line practitioners) on board.
4. Invest selectively in IT to enable the next level of "business needs."

Although *Infoway's* current goal is centered on the year 2010, it is looking to 2015 as the potential date for achieving an interoperable, pan-Canadian EHR. It has developed "2015 Vision", a plan for Canada's health infostructure. "2015 Vision" balances priorities, ensuring that systems are integrated and can achieve lasting improvement in patient care, safety, access and healthcare productivity. The Vision is based on five priorities:

1. Finish what has been started in EHR and public health surveillance.
2. Implement EMRs in physician offices and physician order entry systems in hospitals.
3. Enable public visibility into wait times and access.
4. Facilitate patient self-care and empowerment through consumer health solutions.
5. Invest in advanced IT solutions to reduce wait times and for chronic disease management.

These priorities will drive the efforts of *Infoway* as it works toward full EHR implementation.

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UNITED STATES

Overview of Country Healthcare System

The U.S. has a population of more than 300 million people distributed over a land mass so large that the country ranks 179th in the world for population density. As a result of migration into large cities, the population has grown considerably in the 10 largest metropolitan cities including New York City, Los Angeles, Chicago, Houston, Philadelphia, Phoenix, San Antonio, San Diego, Dallas and San Jose.

The U.S. spends a higher portion of its gross domestic product on healthcare than any other country in the world, but ranks only 37th in its performance according to the World Health Organization. In contrast, the U.K. spends just six percent of gross domestic product (GDP) on health services yet ranks 18th in its performance. Several small countries, including San Marino, Andorra, Malta and Singapore, are ranked close behind second- placed Italy.

The U.S. healthcare system is comprised predominantly up of private for-profit insurance companies, non-profit and for-profit hospitals and other health provider delivery centers. The largest payor of healthcare costs, however, is the U.S. government with programs such as Veteran's Health Affairs, the Center for Medicare and Medicaid Services (CMS), TRICARE for the military, SCHIPS and other government backed programs.

This distributed model consisting of multiple payors has created a very complex and diverse mechanism for funding and delivering healthcare services. There are also approximately 47 million uninsured patients in the U.S. who use services on an as-needed basis and generally receive their care at emergency rooms, urgent care centers or "walk-in" clinics. Not all of these individuals, however, are poor or unemployed. They include children, those employed by small businesses that cannot afford to provide health insurance and those who have opted out of their insurance programs due to inability to pay for increasing premium cost.

The employer-based private insurance in the U.S. has failed to provide adequate and consistent coverage for the entire population. Employers can negotiate insurance premiums with multiple "tiers" of coverage, based on risk, past history of medical expenses, utilization and population mix. This system is flawed, however, because of the inconsistency in how employees provide coverage choices to their employees.

The U.S. system of healthcare financing and delivery may be the most complicated among all developed nations. It is the only country, for example, that has not adopted a universal healthcare system.

The drive, so far, towards adoption of EHRs in the U.S. has been the result of fear of reported medical errors, legislation without mandates, quality and transparency in pricing and employers' inability to afford the increasingly higher costs of healthcare. Many experts agree that the best way to improve healthcare quality and to reduce medical errors is to fully deploy EHRs. Unfortunately the U.S. lags far behind other countries documented in this paper.

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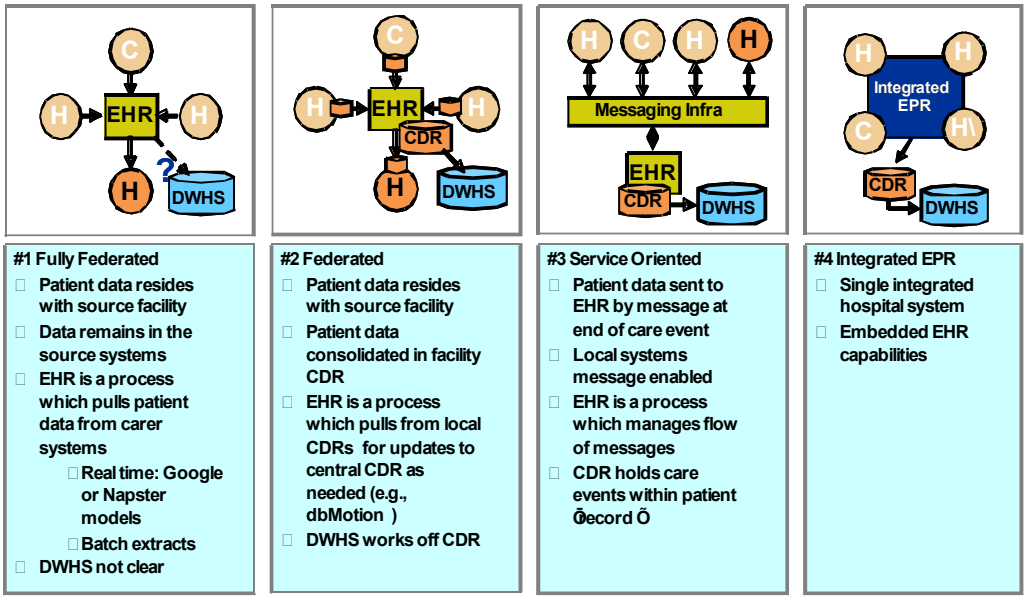
National/Regional EHR Approach



The goal for the U.S. is to have an integrated, national EHR system that fits the first category above, the "Fully Federated" Model. This is demonstrated by the federal government's attempt to help facilitate local, regional and state-sponsored programs for EHR adoption.

EHR Governance

Legal/Regulatory

In most cases in the U.S., there are no financial or other incentives to physicians or to health systems to implement healthcare IT. Although there is general agreement that EHRs would improve the quality and coordination of healthcare, the government has relied on a "bottom-up" approach to its adoption. Although the federal government has issued grants through the Office of the National Coordinator for Health Information Technology (ONC) to organizations to develop a nationwide IT infrastructure, little money is directed toward paying for those systems. As the largest single payor of health benefits in the U.S., the federal government has issued little in the way of punitive mandates for lack of adoption. In addition, paltry offerings of financial incentives, such as through Medicare, has made little difference in physician adoption rates. Research has shown that many U.S. physicians see no benefit to themselves or their practices by moving from paper to electronic systems and the costs involved are too exorbitant for most small practices.

Many state and local governments have issued grants for the development of RHIOs in an attempt to promote exchange of health data. Most of these efforts have either not advanced beyond their formative stages or have failed. A recent Harvard study reported by Healthaffairs.org (http://www.healthaffairs.org/press/novdec0708.html) found that, of the 145 RHIOs reviewed in 2007, almost 25 percent were already defunct and only 20 modest-sized organizations were successfully exchanging data. Five of them only

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exchanged data in a targeted arena such as Medicaid enrollees or patients with a specific disease such as diabetes. The other 15 were exchanging clinical data across a broader range of patient populations.

Most RHIOs rely on small start-up grants and hope that stakeholders will pay for the exchange of health information. They often find that not all stakeholders are on board with the project from its inception. They struggle with interoperability issues when attempting to get different systems to communicate with each other; privacy and security concerns regarding where the data is stored and how it is exchanged; a lack of provider trust due to peer competition; and the high cost for a physician's office to implement a system. Without data to exchange, the system cannot thrive; without physician adoption, there cannot be a complete set of data entered. Therefore, physician acceptance is critical to the success of any RHIO. RHIOs that focus on the technology and its integration alone cannot expect to succeed. If most of the grant money is spent on hardware and infrastructure and little on lowering the cost barriers to small hospitals and physicians, the result will be a regional system devoid of data.

The limitation under Stark II Law is another barrier to EHR adoption, even though there was a "relaxation" of the law in December of 2007. In an attempt by HHS to give federally qualified community health centers and others a financial incentive, it loosened its anti-kickback rules. The "safe harbor" now permits hospitals and payors to provide EHR systems with e-prescribing to physicians as long as the benefits are made available to all patients and the physicians purchase their own hardware and contribute 15 percent to the retail value of the software system.

Despite the implementation of the Stark II safe harbor, many U.S. physicians are still not willing to pay for the high cost of hardware, the direct and indirect costs of moving from paper to paperless offices, or the 15 percent of the cost of high-priced software. An unanticipated result is that it may actually delay adoption. Physicians who were considering the purchase of an EHR system are now waiting for one to be offered to them by a third party. In a system where most U.S. hospitals are community based, have fewer than 300 beds and are financially constrained, this is not likely to happen without government incentives.

Healthcare Policy

As indicated earlier, the U.S. has taken an indirect approach to the development of a national EHR system. Legislation is focused on facilitating the development of EHR systems within the private sector but federal funding sources have been limited and the government has not enforced its own legislation.

For example, in 2005 U.S. Department of Health and Human Services (HHS) issued legislation known as the Patient Safety and Quality Improvement Act. The purpose of this legislation is to create patient-safety organizations that would collect and analyze healthcare facility data. To date, despite the combined efforts of U.S. senators, The Joint Commission and the American Medical Association (AMA), HHS has failed to enforce this legislation.

Technology

The infrastructure for a national EHR system in the U.S. has yet to be determined. However, attempts to define such an infrastructure through certification of accepted

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functionalities, standardizations of data exchange and collaboration between stakeholders are sponsored by the federal government. Organizations such as the CCHIT, HITSP and the American Health Information Community (AHIC) have been funded by ONC to provide consensus for a national IT system.

At the local level, the capitalist-driven healthcare market combined with a lack of federal funding for EHRs and few federal mandates for its adoption have allowed an explosion of clinical electronic ambulatory records systems. The large number of disparate systems in the ambulatory sector has hampered interoperability and exchange of data. Although other countries suffer from the same problems with standards and interoperability, there are fewer vendors involved.

Adoption Rates and Challenges

Although a recent study suggested that 75 percent of medical students strongly support the use of EHR in clinical medicine, the U.S. lags behind most other developed countries of the world in its adoption.

Many countries, including Canada, England, New Zealand, Australia, Denmark and the Netherlands, had "top-down" government mandates for implementation of healthcare IT a decade before the U.S. began to introduce EHR-adoption bills into Congress. Others countries, including India and Israel, have developed a "grass roots" approach that has been driven by competition in the private sector, but fueled at local and national government levels. Canada's approach has been a collaborative effort between the government and private sectors but has been financed extensively through public funds.

In the U.S., the federal government has more recently become involved in HIT adoption with the establishment of ONC. This office reports directly to the HHS Secretary and it has taken an indirect approach to the development of a national EHR system. ONC has chosen to encourage, rather than to fund or to mandate, a nationwide, interoperable, IT program for the healthcare industry.

Despite attempts by the federal government through CMS to foster HIT adoption, incentives have been slow in coming and of little substance. Medicare's Pay-for-Performance program has not yet been finalized and its early attempts at promoting electronic data exchange is less of a boat and more of a life raft, trying to stay afloat in an ever-deepening ocean.

Through the Department of Defense and the Veterans Affairs Administration, the military branch of the government has been more successful in adopting IT into healthcare. Early attempts such as the VA's "VISTA" software was widely used at VA hospitals and clinics across the country.

Local, state and national governments have encouraged the growth of RHIOs to promote a network of interconnected EHRs. Of the 145 RHIOs established, 25 percent have failed and only 20 have successfully exchanged data.

Despite wider acceptance and adoption of healthcare IT systems outside of the U.S., there is still a world-wide lag in adoption of fully integrated EHR systems. Defined as an end-to-end system consisting of clinical patient records, personal health records, e-

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prescribing, interoperability with lab and radiology systems and others, EHR adoption rates among hospitals and physicians in most countries is not that far ahead of the U.S.

EMR and e-prescribing systems, as subsets of EHRs, are sometimes used by varying numbers of PCPs around the world. The U.S. rate for "sometimes use" of EMR is reported to be 17 percent compared to 14 percent in Canada, 25 percent in Australia, 52 percent in New Zealand and 59 percent in the U.K. The numbers of PCPs who are using e-prescribing "often" is reported to be nine percent in the U.S., eight percent in Canada, 44 percent in Australia, 52 percent in New Zealand and 87 percent in the U.K.

In the U.K., PCPs have received many years of policy mandates and financial incentives from the NHS Greece. This has resulted in the majority of hospital-based physicians using EMRs.

Common barriers to EHR adoption in the U.S. include:

- Funding
- Employer/member participation
- Provider buy-in
- Access to meaningful data sources
- Complexities of market competition

The end result is a patchwork of different vendor systems at different stages of maturity in the healthcare marketplace. This hampers the attempts by the NHIN and ONC to create a unified promotion of data standards, interoperability and national best practices.

Pricing as a Driver of EHR

Driven by the growth of consumer-driven healthcare plans, U.S. consumers have begun to demand detailed data from healthcare providers. Unfortunately, many providers do not have the adequate systems in place to provide such data. According to a survey conducted by the PNC Financial Services Group, 85 percent of consumers said that they believed hospitals and doctors should be required to disclose their charges. More than half of respondents said that their selection of doctors and hospitals would be influenced by such information. The same survey found that consumers struggle with claims payment issues. Sixty percent of respondents did not know that there was a limit on how long they have to dispute claims denials.

Consumer-Directed Health Plan (CDHP) demand for transparency in pricing is expected to lead to greater competition and the need for greater cost-efficiency on the provider side. One way to achieve this is through the adoption of EHRs.

National EHR Programs in the U.S.

The U.S. healthcare IT strategy has been reinforced by the president's goal of every American having an EHR by the year 2014, but the burden of implementing this strategy has largely been left up to the private sector, including providers, payors and community-based organizations. RHIOs or HIEs have been growing across the nation, but with the poor success rate as indicated above.

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The same challenges to EHR adoption exist regardless of population size, geography, member mix and funding sources. These include:

- Acquiring clean data from vendors and providers, payors and other sources;
- Availability and access to data;
- Infrastructure and other financial costs;
- Funding;
- Technical resources to manage and sustain systems once they are implemented;
- Security and privacy concerns;
- Ownership of the data once it is collected;
- Data standards and methodology for collection, aggregation and normalization; and
- Developing quality measures that are meaningful and consistent across the U.S.

Similar to most other counties, regional and local EHR development is considered to be the first step in building a national system. Despite their high failure rate, RHIOs are still considered to be the building blocks of ONC's proposed NHIN initiative. To build a national network of interoperable health records, an attempt has been made to first develop local and state level systems. To be successful, the NHIN concept requires collaboration by stakeholders including insurance companies, hospitals, employers, physicians and pharmacies. Information and interoperable data exchange are critical to the delivery of quality, cost-efficient healthcare.

Data Standards

Like most other nations, the U.S. has a multitude of standards that are still being heavily debated and used across multiple IS. These include HL7, SNOMED and DICOM. Newer versions of XML have world-wide acceptance and are slowly phasing out older programming languages. Like other countries, the U.S. has concentrated on standards within its own borders although it is involved in an international collaboration effort through such organizations as the ISO and the International Electrotechnical Commission (IEC). ISO is a network of the national standards institutes of 157 countries with one member per country and a Central Secretariat in Geneva, Switzerland, that coordinates the system.

ISO is a non-governmental organization; its members, therefore, are not delegates of national governments. ISO does, however, bridge an important gap between the public and private sectors. Many of its member institutes are part of the governmental structure of their countries or are regulated by their government. Other members are from the private sector and have been set up by national partnerships of industry associations.

IEC is also a member network that was founded in 1905 and attempts to bridge the gap between government and private industry. ANSI is the U.S. representative organization to the IEC.

Many U.S. organizations have been involved in trying to set unified "standards" in the healthcare arena. They include the American National Standards Institute (ANSI), HL7, HITSP, and the U.S. National Committee (USNC). ISO and IEC have some input from the U.S. on an international level. Thousands of individuals, companies, government

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agencies and other organizations such as labor, industrial and consumer groups have been involved in the development for standardization of EHRs. This has been going on for years and yet we do not have a unified nation standard for healthcare IS in this country. In 2008, however, the ONC-supported HITSP will present its consensus recommendations to the U.S. government.

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SUMMARY, CONCLUSIONS and FUTURE DELIVERABLES

Overviews of Countries' Healthcare Systems

One of the barriers to global collection of data is that local and countrywide efforts to implement EHR systems have been intermittently reported. Early in its work, the HIMSS Global Enterprise Task Force (GETF) recognized common threads that linked EHR efforts within and between countries, but that these common activities had not been adequately identified. Therefore, the GETF investigated a battery of EHR components including security, quality, financing sources and barriers. Common sections for each county or territory were then incorporated into this white paper including an overview of the healthcare system, national EHR status, strategy and approach, governance, technology and expected next steps.

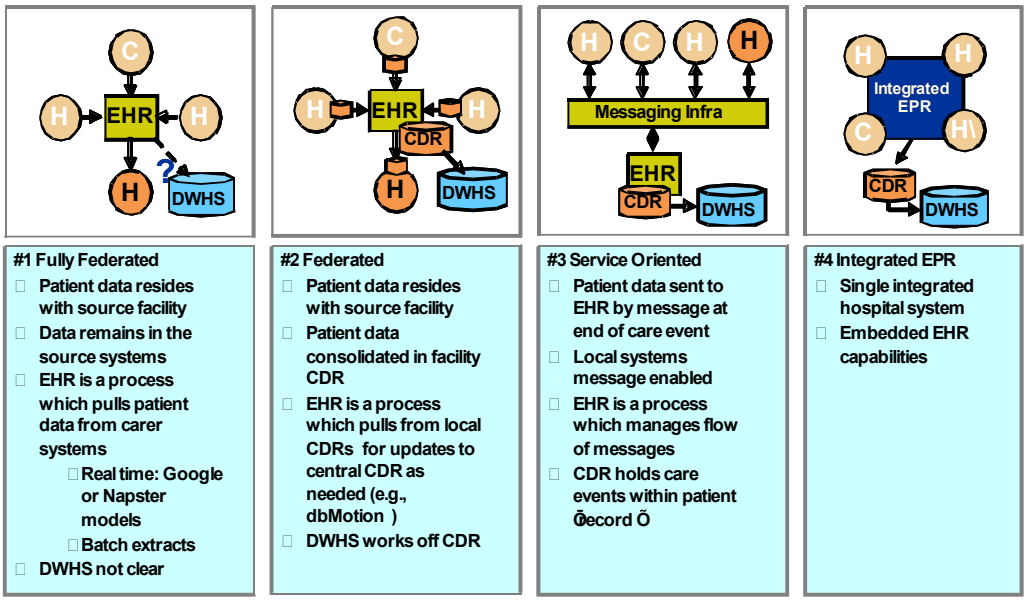
The need to harness and deploy this information is readily apparent. It can be used to predict the future success of efforts to imbed IT into the world of healthcare whether those efforts are parochial, countrywide or global.

National Status, Strategy and Approach

The GETF observed the widest possible variation among countries in the duration of EHR planning efforts. We followed each country's progress towards setting key foundations by enacting new laws and regulations, the creation of strategies within the context of different forms of government and the practical steps take to drive the programs forward. The GETF then implemented guidelines to facilitate global comparisons.

Each section of this white paper describes the country's approach to the development, acceptance, deployment, adoption and implementation of a national EHR system and HIE. Each approached was categorized according to the following diagram:

Figure 1: Database Approach



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Source: Capgemini Government Solutions.

GETF members also addressed each country's information, services and messaging models and its process for user authentication and access control. To the extent the EHR strategy included a patient view or Personal Health Record (PHR), the GETF described how patients interacted with the EHR.

Governance and Funding

Although healthcare budgets contribute to the bulk of worldwide-industrialized government spending, HIT lags far behind other global IT businesses including banking, telecommunications and the media.

Both governance and funding for healthcare IT can occur through national or local governments, the private sector or combinations of both. Canada Health Infoway, for example, an independent not-for-profit corporation, leads the national effort with all 14 federal, provincial and territorial governments as shareholders. By 2007, the Government of Canada had invested $1.6 billion CAN in *Infoway* and *Infoway* will have committed nearly $1.5 billion CAN in co-investment within the jurisdictions by March 2008.

Australia built on their experience from Health*Connect*, when the Council of Australian Governments created the National E-Health Transition Authority (NEHTA), a not-for-profit company limited by guarantee and jointly funded by all state, territorial and national governments.

The governments of South Africa, Sweden, Germany and the Netherlands fund committees that are developing EHR strategies for a national system. Sweden, France and South Africa have already moved towards a government-funded national system, while Germany and the Netherlands have not yet formally committed to this model.

Other countries are at an earlier stage of EHR development, but are making progress despite not having a formal national program. Wales, for example, is running pathfinder projects using a combination of local and national funding. Norway is conducting research that is expected to lead to a national EHR program. The Research Council of Norway awarded Norwegian University of Science and Technology (NTNU) a contract to establish Norwegian Electronic Health Record Research Centre (NSEP). The Center receives annual funding of 5 million NOK to strengthen and develop an interdisciplinary research group with competence in health research and ICT.

A national program also does not exist in Israel. EHR implementations, however, are wide spread in both the public and private sectors. In a survey conducted to evaluate the status of EHR systems in 26 major general hospitals, 21 (representing 91.3 percent) were found to have implemented at least some aspects of an EHR system.

Technology

All countries suffer from similar issues related to the lack of healthcare IT standards and barriers to interoperability.

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Germany, the Netherlands and France are attempting to overcome this barrier by adopting a variation of the HL7 standard. Germany employs a distributed strategy model. However, since its hospitals compete against each other for patients and services, they have resisted the implementation of a shared solution.

South Africa is in the process of selecting an EHR vendor through an RFI process. Selection of a mainstream vendor could lead to interoperability and utilization of industry standards such as Health Level Seven (HL7) and Digital Imaging and Communications in Medicine (DICOM).

The current EHR project in England is the National Care Record Service Program. Implementation started with a nationwide procurement process that resulted in one NASP and five LSPs. England's EHR information model is based on HL7 v3 RIM and is updated and queried through HL7 v3 messaging.

Canada created a national framework to guide the development of an interoperable EHR across all jurisdictions. Each jurisdiction determines its own implementation strategy**.** Like Germany, Canada has national agreement to use a distributed model approach with health data emanating from different operational applications within a given jurisdiction. The data is then replicated into the interoperable EHR via the EHR infostructure. Thus, Canada's EHR is comprised of many EHRs integrated through a peer-to-peer network of message-based (specifically HL7 v3 with nomenclatures such as LOINC and SNOMED CT), interoperable systems across the country.

Israelis have implemented at least twenty-seven different types of EHR hospital systems, with more than one type used in any given hospital. Physicians work with EMR systems in over 98 percent of the hospital departments. The EMR systems are used for clinical admissions and discharges in more than 90 percent of the departments and for daily medical follow-up in about 45 percent of the cases.

Future Task Force Deliverables

HIMSS, as the worlds' leading organization in healthcare IT, can be the catalyst for promoting EHR efforts within and between all countries of the world. To that end, the GETF will continue to disseminate its research findings through national and international sources including HIMSS AsiaPac and HIMSS EMEA, World of Health IT Conference and additional conferences.

GETF deliverables include the reporting of case studies of EHR implementation from around the globe, updating the Global Comparison Matrix and expanding the White Paper to include lessons learned from each country.

This white paper is a "living document." Updates from each country submitted and from additional countries not yet researched will be incorporated into updates to the Paper.

Other Resources

Learning from Abroad: Lessons and Questions on Personal Health Records for National Policy. Don Detmer, MD, MA, Chief Executive Officer, AMIA, 2006.

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Additional resources for each country are included at the end of each section.

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