Topic Series: HIE Technical Models

From the
HIMSS Guide to Participating in HIE

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Health Information Exchange (HIE) Technical Models

There are various conceptual models of HIEs; each presents issues of interoperability, development and sustainability, and privacy and security concerns for health environments, clinical providers and patients. HIMSS outlines three clinical data exchange models: centralized, federated and hybrid. In addition there are other models, variations on a theme such as the health record banking model. This section introduces several of the HIE models and briefly presents various business models that they may operate under in general terms.

For healthcare organizations considering joining an HIE, there are many hurdles to overcome as well as benefits to consider. These hurdles include cooperation with potential competitors, development and agreement on technical standards and system functions, infrastructure development, and financing and sharing the ongoing costs to sustain the activity. Consumers and their providers may also have issues in the area of control and privacy and security.

To date there have been many publications indicating the benefits of an EHR and computerized provider order entry. Since the technology is early in its adoption curve, many of its benefits are just being realized. These benefits include a reduction in medication errors and eliminating redundant tests. Many studies confirm the cost savings of an EHR and the value of the completeness of the medical record for ensuring quality patient care and lives saved. Given the potential of connecting and sharing data across enterprises, the value that HIE provides could be enormous based on current literature.

The development of a common framework and standard data model has been in process for some time. There are several common frameworks evolving, including CCHIT criteria for EHR system functionality and the HL7 Reference Information Model (RIM) for data modeling. Many examples of the use of these frameworks exist across the nation. Widespread adoption of these frameworks and standards by vendors has been slowed by the expense of applying them to the established product base developed using earlier technology. Many groups and organizations are driving toward a common framework. Partnerships and a reasonable business model are critical to the viability and sustainability of any HIE. Also paramount is the readiness of a community to support the structure of an HIE and all it entails.

The models described below ultimately provide for sharing clinical information, medication lists, lab results, imaging studies and demographic data across multi-stakeholder enterprises and geographical regions for the benefit of improving patient safety and quality, and decreasing health-related costs.

The Centralized Model

In a centralized model or warehouse, patient health or medical-related data is collected from local sources, but stored in a central repository. If an entity requests patient data, the transaction

1 Just BH, Durkin S. Clinical data exchange models: matching HIE goals with IT foundations. JAHIMA; February 2008:(79)2.
is routed through the central repository. Such architecture permits local entities to maintain autonomy while cooperating to provide data at a local or regional level.3,4

HIE Centralized Repository Model

A typical centralized architecture is implemented as a logical, single, large database that aggregates similar data from numerous sources in one location. Because all data exists in a single warehouse, it is very easy and fast to perform queries against it.

In the centralized model, all providers send their data to a central repository, usually on a daily basis.

There are many benefits to a centralized model:

- The querying system’s response to a data request is quicker than other models because the data is centrally maintained and consolidated.

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• Less real-time dependence on other participating systems for the same reason.
• Facilitates community-wide data analysis since data is available centrally.
• Economies of scale are introduced through the use of large-scale central resources as long as appropriate investments are made.
• Better expertise in managing central resources due to their scale and class of products used.
• Able to support existing systems well as data needs only to be extracted and sent to the central repository.6

This model also has a number of limitations:

• Strong central coordination is required. The central database cluster needs to be carefully managed and maintained for this system to work.
• Dependence on large central database for inter-system queries.
• Timeliness. Data submissions from participating systems may lag, resulting in inaccurate consolidated records at query time.
• May require a large effort to keep demographic and clinical records free from duplication since these records will be collected from numerous disparate sources.
• Harder to implement incrementally. A large, up-front investment in central resources is required.
• Likely fairly expensive option to implement, not only technically but organizationally.23

One of the fundamental challenges of all models is data matching. It is required that there be accurate matching of patient data between the local system and the central repository or other systems. In the absence of shared identifiers, other algorithms or strategies must be employed. If the patient is new to the centralized system there is a significant burden to match records on the repository side. There is risk that data may be linked to the wrong person. If sensitive clinical data is present this may present privacy issues when errors occur.

Finally there is the challenge of database congruency issues from providers where data collection standards, messaging formats and field naming conventions are inconsistent.

The centralized model requires the most planning, coordination and development to be successful. From a technology perspective the centralized model requires a heavy investment in a single vendor and system integrator to build a logical central repository that makes it functional for all stakeholder organizations.7

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The Decentralized or Federated Model

The decentralized or federated model provides organizational control of the healthcare record and provides the framework for data-sharing capability to enterprises, perhaps widely distributed across regions or even nationally. The local entity owns their data and the Record Locator Services manages the pointers to the information.

In the decentralized or federated model, updates and access to healthcare records are only provided when needed. The decentralized or federated model allows the initiator of a health record, such as a provider, to maintain ownership and control over the record while providing access to the record to authorized personnel. In this model, providers form a single administrative entity or governing body at the regional level, with each retaining control of its own internal business activity.

As with other HIE models—similar to a large healthcare system of multiple entities—providers, medical groups, labs, imaging services organizations and other healthcare groups form a cohesive group organized in a framework to support the exchange of health information. This information may include medical history, medical exams and lab results, diagnostic images and demographic information about the patient.

The setup of decentralized or federated model systems is complex, expensive and costly to maintain. The consumer may also have concerns with data distributed far and wide in an interconnected set of frameworks. There are also many potential points of failure both in data maintenance, confidentiality and security.
Some advantages of the decentralized or federated model include:

- Data is stored locally at the point of service and accessed only when needed for exchange. There is no conflict of who owns the data except for the ownership rights of the consumer.
- Data is always current.
- Failure of a single system doesn’t cripple the whole model or others in the exchange, but it may make some patient data unavailable at the time of a query.
- Any EHR system can be connected to any other, but assumes common interface standards.
- More repositories or compartmentalization means a smaller amount of data is available to potential hackers with single-system penetration, though this is arguable as penetration of an RLS could provide access to the same quantity of patient data. The data would just have to be retrieved to collect it in a central file—the function of an RLS.\(^2\)

Disadvantages of a federated model:

- Need to ensure authorized and legitimate access to third-party systems.
- Need to capture consumer consent to opt in and opt out of the decentralized network thus ensuring legitimacy for data usage.
- Data control and availability is not guaranteed, thereby limiting the value that can be achieved by providers.
- Standards and profiles are still being defined.\(^8\)

The Hybrid Model

The hybrid model is a cross between centralized and decentralized architecture. A hybrid model provides the interface engine for which organizational entities in the HIE communicate.

The hybrid model stores key record identifiers and requests for the information that is distributed across the network. The record locator key is used to gather and transfer medical information to the requesting healthcare provider. Algorithms exist within the applications in the network to ensure positive probability of gathering candidate patient records.

In hybrid architecture only some of the actual data is replicated to the central data repository. The hybrid model may also include elements where data is produced locally and the original is stored centrally, but the centralized repository and locator registry are dependent on federated EHR adapters for production of links to the original patient information. In addition to the required data to identify the patient, the central database may store a minimum of clinical data. This is commonly referred to as a “minimum clinical data set” and may include such information as current medications, current diagnoses and allergies. In addition to these few elements, there are also pointers to where additional data is housed.
**The Health Record Banking Model**

The health record banking model endeavors to provide control to the consumer regarding who can access their record housed in a central system repository. There is a belief among proponents that by placing health records under the control of the consumer that many of the HIPAA/privacy issues disappear since the consumer can authorize access to personal medical information freely even under the most restrictive state law. Medical information would be transferred like a financial transaction to a requester given access by the consumer.

Health record banking (HRB) is a conceptual model where a system is designed and setup to maintain the lifetime healthcare record of the consumer who can direct, control and provide access to the electronic record stored in central repository, like a financial deposit into a bank. There is increasing interest in this type of model. Communities such as Louisville, KY, and the states of Washington, Kansas and Tennessee are each exploring the model. Vendors, like Cerner and ICW, are developing a systemic framework to support such a model.

The HRB is a secure, centralized information repository to house patient data records. Like a bank, consumers control their own data, can monitor it and grant access to it electronically. During a clinical encounter the consumer authorizes access to their health record via the Internet or a compatible electronic record from a connected system. Once authorized the information is transferred to the provider. After the encounter, data may be transferred back to the system repository to close the loop by adding to the electronic medical record. Transfer of information based on the financial services analogy provided could be a fee-based service or philanthropy driven service. With a fee-based service, a provider ensures there is payment for the effort, a potential method for offsetting their cost to participate.

**International Models**

Canada Health Infoway is a nationwide initiative to interconnect systems across every province and territory. Canada Health Infoway is an independent, federally-funded, not-for-profit organization that is accelerating the development of electronic health records across Canada. As a strategic investor, they work with Canadian provinces and territories with a goal to have an EHR for 50 percent of Canadians by 2010. Infoway’s members are Canada's 14 federal, provincial and territorial Deputy Ministers of Health.

Infoway was created in 2000 through consensus between Canada’s federal, provincial and territorial governments. Canada has invested in provincial EHR systems infrastructure and in doing so has made the Infoway initiative a catalyst for developing a consistent EHR vision and collaborative vehicle for standards across Canada. The mission of the Canada Health Infoway is

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to foster and accelerate the development and adoption of electronic health information systems with compatible standards and communications technologies on a pan-Canadian basis.

In building this international model concept, Canada set standards of interoperability up front and set the expectation that all electronic health systems installed must comply with the interoperability standards. Canada promotes the idea that EHRs are a significant opportunity for ongoing international collaboration. Canada has developed liaisons with most of the major standards development organizations, to ensure that at some point in the future data sharing could ostensibly be accomplished across borders. 12

In Finland, The Hospital District of Helsinki and Uusimaa (HUS) is composed of 24 hospitals in the province of Uusimaa, which includes the capital of Helsinki. As a joint authority it was founded in 2000 to provide health services for over a million residents in its 31 member municipalities. Named Navitas, this federated model HIE is at its core a record locator service. It is a service which maintains a regional directory of links pointing to patient and treatment information located in any of the connected healthcare information repository systems in the region. Each participating organization has its own patient information system in addition to stand-alone patient information systems in HUS.

Provider access is by Web browsers and includes both inpatient and outpatient clinical and demographic information. All data is sorted according to Social Security coding, which is standard procedure in Finland. The data transfer is encrypted and data is transferred via private dedicated networks. Viewing of the patient data through the links requires the patient’s informed consent.

The Navitas locator service is available today for all healthcare professionals in the Hospital District. The directory contains information from 1.4 million citizens. Currently there are more than 40 million links in the database. The number of links has been minimized to make it easier for the professional to get a holistic view on the patient’s medical history. 13

The 2009 HIMSS International HIE white paper provides additional information on health information exchange activities occurring in other countries.

State-Led vs. Community-Based Models

State-led HIE models promote information exchange for the common good and encourage, promote and facilitate the creation of regional information data exchange. Thus, they are in a better position to take on many of the tasks necessary for implementation. 14

14 Deloitte Center for Health Solutions. Health Information Exchange (HIE) Business Models: The Path to Sustainable Financial Success; 2006
Most important is the setting of standards of interoperability until national standards are defined. States share in the responsibility for ensuring the privacy and security of personal information. They may also be better sources of funding to develop the infrastructure necessary to support a regional network.

Are community-based models better suited to the specific needs of the community? Potential HIEs at the local level are not bound by standards unless mandated by state law. Requiring states to use nationally recognized standards, such as those selected by the Health Information Technology Standards Panel (HITSP), could facilitate rapid development of data sharing between entities.\textsuperscript{15}

The role of the state in HIEs is not yet clearly established. Each state is making its own decisions about the role it chooses to serve. Whether it is an “operator” of an HIE or a facilitator of many local HIEs directly or through a state-designated entity has yet to be determined.

**Industry Drivers**

One such facilitator is a collaborative called Integrating the Healthcare Enterprise (IHE). IHE is an initiative by healthcare professionals and industry to improve the way computer systems in healthcare share information. IHE promotes the coordinated use of established standards such as DICOM and HL7 to address specific clinical needs in support of optimal patient care. Systems developed in accordance with IHE communicate with one another better, are easier to implement and enable care providers to use information more effectively.\textsuperscript{16}

Connecting for Health is a public-private collaborative with representatives from more than 100 organizations across the spectrum of healthcare stakeholders. Its purpose is to catalyze the widespread changes necessary to realize the full benefits of health IT, while protecting patient privacy and the security of personal health information. Connecting for Health is continuing to tackle the key challenges to creating a networked health information environment that enables secure and private information sharing when and where it’s needed to improve health and healthcare.\textsuperscript{17}

The real industry driver is the need to transform healthcare to be affordable for everyone. We all must work together to insure the transformation is attained in our lifetime.

- Not-for-profit–Usually local, these HIE organization are driven by their nonprofit healthcare charter within the community for which they operate and provide services. Tax exempt status and potential tax credits or incentives may assist such organizations in mitigating their costs. An emerging variation to the not for profit model is the ability to

\textsuperscript{15} Health Information Technology Standards Panel Web site. Available at: \url{http://www.hitsp.org/}.

\textsuperscript{16} Integrating the Healthcare Enterprise Web site. Available at: \url{http://www.ihe.net/}.

\textsuperscript{17} Connecting for Health Web site. Available at: \url{http://www.connectingforhealth.org/aboutus/index.html}.
use philanthropy to drive the sustainability of an HIE. This model is similar to how many hospitals operate today as well as national public radio.

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