Chapter 3

COMMUNITY HEALTH INFORMATION NETWORKS (CHINS) AND THEIR RELATIONSHIP TO TELEMEDICINE

BRUCE A. FRIEDMAN AND WILL MITCHELL

Introduction

This chapter will describe the relationship between telemedicine and community health information networks (CHINs). Hence, the first task is to define a CHIN.

A community health information network is an organizational and technical entity designed and operated to facilitate the electronic data interchange and integration of various types of health care information for the benefit of those organizations and health care professionals that participate in the network.

The term "electronic data interchange (EDI)" refers to electronic exchange of information among organizations. The term was coined outside the health care system. For example, a clothing manufacturer might create electronic links with its upstream cloth suppliers and its downstream retailers. If inventory of a clothing item falls below a specified level on the shelves of the retailer, an electronic message would be sent to the clothing manufacturer who, in turn, would automatically initiate an order to an upstream cloth supplier to ship more cloth to the clothing manufacturer. Electronic data interchange in health care can be taken to mean the creation of electronic links between payers and providers of services to enhance the quality and efficiency of health care services. EDI has been described as potentially one of the most significant cost-saving measures in health care, particularly relevant to health care transactions, such as: (1) materials management, (2) coordination of benefits, (3) referrals and authorizations, (4) prescription ordering, (5) test ordering/result communication, and (6) appointment scheduling (Schaich, 1993). Participants in a CHIN may include health care providers such as hospitals and private physicians, suppliers such as pharma-
cies and reference laboratories, payers, employers, regulators, inspection and accreditation bodies, and other health care entities.

CHINs are recent developments, and there is thus little literature about them so far. In fact, the primary discussions about CHINs are taking place in the business press (Zinn, 1994). A valuable source of current information about CHINs is the *Journal of the Community Medical Network Society* (ComNet), based in Atlanta, Georgia. The most up-to-date profile about the current status of CHIN development was recently published in this journal (Furukawa and Peake, 1995). Included was a list of what are described as “CHINs in progress,” 224 CHINs either operating or being formed in nine geographic regions as of August, 1995. The Community Medical Network Society also publishes the “CHIN 100 Market Directory,” which profiles over 500 “CHIN-Ready” health information networks that might form the basis of future CHINs. The number of CHINs will undoubtedly grow every month for some time to come.

The notion of a CHIN as both an organizational and technical entity can be confusing. The distinction between the two will be discussed in greater detail in ensuing sections. Confusion and ambiguity also arise when one attempts to list the existing CHINs in the U.S., such as in the article just cited. Generally speaking, the CHINs recognized in such lists are groups that publicize themselves as CHINs, even though their ability to share information on a regional basis is often only partly developed. Conversely, a for-profit hospital chain may have deployed highly sophisticated systems for sharing information across hospitals or routing financial information to a centralized operations center for the hospital chain, but may make no claim to having achieved the status of a CHIN. Most CHINs are in embryonic stages of development at present, and the CHIN mantle is largely self-bestowed.

Two of the most extensive existing CHINs are based in Wisconsin and Colorado. The Wisconsin Health Information Network (WHIN) was established by the Ameritech Corporation and Aurora Health Care of Milwaukee during 1992 and operates in metropolitan Milwaukee. In mid-1995, WHIN connected about 13 hospitals, 1,700 doctors, 5 payers, 8 clinics, and 12 ancillary service providers. The WHIN system processes patient claims and insurance eligibility information and also provides some access to clinical information such as laboratory results, drug prescriptions, and patient records. Integrated Medical Systems, Inc. (IMS), Golden, Colorado, has operated the Colorado Medical Informa-
Community Health Information Networks

ion Network (MEDACOM Colorado) since about 1990. In 1993, the Colorado CHIN included 27 hospitals, 800 physicians, five pharmacies, a laboratory, an insurance company, a diagnostic center, and an imaging center. Physicians can use the network to access laboratory reports, send prescription refill orders to pharmacies on the network, and communicate with other physicians through electronic mail. About 45 IMS MEDACOM physician networks are in operation in the U.S. Although other CHINs plan to achieve similar or greater levels of functionality, most networks now emphasize transfer of current information between hospitals and physicians with little or no central storage and retrieval of integrated patient records.

Few CHINs offer extensive functionality as yet. The first simple CHINs were organized in the United States during the mid-1980s. Although several hundred CHINs existed or were being formed by mid-1995, many were in planning stages and most others offered rather limited functionality in the information that they allowed participants to exchange. The term functionality is computer system jargon for which there is no adequate substitute, and refers to the capabilities of an information system to perform various tasks or applications adequately. The reader should also be aware that "vaporware" abounds in the CHIN sector as it does in all information-system development fields. Vaporware refers to a computer software product that is announced and developed in a prototype form, but is not yet available in the commercial market with all the features cited in brochures or advertisements.

The rapid and fluid development of CHINs should create several opportunities for health care organizations that offer telemedicine services or are contemplating doing so. Telemedicine is health care delivery at a distance, while information technology overcomes time and distance barriers between health care providers and clients. Telemedicine and CHINs complement each other because a CHIN provides the basic information technology and network infrastructure to permit telemedicine initiatives. As discussed later, managed care and capitated payment also provide potent economic incentives for health care CEOs to invest in telemedicine. Therefore, synergies between CHINs and telemedicine should be made more explicit in health care organizations engaged in CHIN planning. Such organizations should explicitly identify deployment of telemedicine services as one of the primary goals for CHIN development projects. Stated another way, CHINs now provide useful platforms for providing health services at a distance, but the telemedicine
opportunity may not be obvious, or a high priority, for CHIN planners at the highest level. It is helpful, therefore, for those most knowledgeable about telemedicine to highlight the clinical, as opposed to financial and administrative, potential of electronic exchange of information.

Types of Information Exchanged by CHINs

Typically, the delivery of health care services requires the generation, storage, and communication of three types of information: clinical, patient management, and financial. A better understanding of CHIN requires further description of these three types of information. Clinical information consists of diagnostic and therapeutic data concerning patients. In telemedicine, much of the diagnostic information is available in digital form. The chances for success of telemedicine initiatives under the organizational umbrella depend on the extent to which a CHIN facilitates the exchange of all digitized information throughout an enterprise or region. Patient management information refers to demographic information, admission-transfer-discharge information for hospital inpatients, and scheduling information for ambulatory care patients. Financial information consists of billing and other financial data. Under the previous fee-for-service system, the major goal of financial information has been to generate charges for services delivered to patients. Financial management has been changed under managed care. Patients no longer receive a bill for the services delivered to them. Consequently, financial systems for generating bills are now rapidly evolving into systems for tracking and monitoring the allocation of resources.

CHINs as Organizational Entities

As described earlier, a CHIN is both an organizational and technical entity. Typically, discussions about CHINs focus on their hardware, software, and architectural elements. The architectural aspect refers to the information-technology infrastructure of the health care network. This primary focus on CHIN technology is unfortunate, because the organizational underpinnings greatly affect the goals and objectives of the network. The type of organization that owns and operates such a network will control the degree to which it emphasizes the exchange of clinical information. For example, a network owned or heavily influenced by one or more health care provider organizations is more likely
to have an interest in the exchange of clinical information than one owned by a health insurer. The physician acting as an advocate for the integration of telemedicine objectives into the strategic plans of a CHIN therefore needs to take into account the goals and interests of the CHIN organization with which he or she is interacting.

No single organizational model dominates this early stage of CHIN development. Indeed, organizational variety is likely to continue in the future because the goals and objectives of any particular CHIN need to be shaped to the strategies of its organizers and to suit heterogeneous health care environments. CHINs will also undoubtedly change as the structure of the health care environment itself changes. Emerging federal and state health care legislation may shape future evolution. For example, legislation might require electronic data interchange between health care providers and the federal and state governments when they act as third-party payers. If so, public agencies might become important technical and organizational participants in CHINs.

**CHINs as Technical Entities**

Three key technical aspects of a CHIN are connectivity, interoperability, and the data repository. Connectivity refers to the physical linkage (e.g., telephone lines) between host systems. Interoperability refers to the ability of two host systems to exchange information in a meaningful way. A data repository, simply stated, is an information storage depot. Information can be copied to the repository from multiple host systems, thus integrating common information such as historical and clinical data for a single patient in a manner not possible on any one of the host systems that copy information to the data repository.

Given the extant technology, connectivity as it relates to CHINs is relatively simple. Systems consist of a local area network or wide area network that links the various host computers comprising the CHIN. Connectivity to physicians' offices in the community is usually achieved with modems and standard telephone lines. To emphasize the previous point, the various host computers may provide patient management, financial or clinical information. Authorized users with PCs can access the CHIN network via direct network connections or via a modem connection. Connectivity is sometimes referred to as "bandwidth," referring to the ability to transfer information from one place to another.
Because of improvements in network technology, bandwidth will soon cease to be a constraining factor in CHIN development.

Unlike connectivity, interoperability raises many technical problems for the near future. Interoperability refers to the ability of distributed host computers with different hardware platforms and running under different operating systems to communicate with each other. The presence of so-called legacy systems within nearly all health care organizations complicates interoperability. Legacy systems consist of older installed dedicated systems that usually perform specialized tasks adequately. Hospital personnel are often reluctant to eliminate legacy systems because of the previous investment in them and also because the systems frequently are meeting the perceived current needs of the organization. The basic problem with legacy systems is that they are often highly customized and inflexible. It is thus often technically challenging to create interface links between customized proprietary systems installed in a single hospital facility. Before the advent of so-called "open computing," hardware and software vendors, often the same companies, purposefully designed systems that could not easily communicate with a system supplied by another vendor. In fact, interoperability was often difficult to achieve even across product lines from the same vendor. This strategy was pursued to achieve "client control" and ensure a continuing income for the vendor. Some firms achieved remarkable success with such closed system approaches until networked architecture began to supplant mainframe-centric architecture and hospital clients began to balk at the purchase of highly proprietary systems. Achieving interoperability with a CHIN across multiple hospitals and connecting multiple legacy systems poses a substantial challenge.

The data repository of a CHIN, sometimes referred to as the data warehouse, is the most technically and strategically challenging aspect of CHIN deployment. It is at the level of the data repository for a CHIN that much of the information copied to it from various production systems is to be integrated. Queries supporting outcomes research will also be directed primarily to data warehouses. Such integration provides the patient-view of information that clinicians find highly desirable, as opposed to the departmental view of information provided by specialized departmental systems such as the laboratory information system. Most data repositories being developed today use relational database technology that allows sophisticated queries and ad hoc report develop-
ment that cross individual patient records and individual patient encounters.

Relational database technology presents a tradeoff between the ability to retrieve data in a structured way across patients and the rapidity with which the system can respond to a request for such support. Clinicians appropriately demand sub-second system response time when retrieving clinical information necessary to treat an individual patient. System response time is the time required by a computer to respond to a user's command. Although response time depends on the complexity of the task that the computer is being asked to perform, response time is generally understood to refer to the "speed" of the computer.

Strategic issues concerning data sharing present what may be even a greater challenge than technical issues concerning data repositories. Creating a data warehouse to which multiple CHIN partners have unlimited access raises vexing issues for organizations that compete in a particular health care market. We expect an inverse relationship between the breadth of participation in a CHIN within a city or region and the level of detail in the information stored in the CHIN's data repository. CHINs that provide the most open access to health care-organizations and professionals will tend to emphasize short-term information exchange between pairs of organizations rather than long-term data storage and retrieval available to most participants in a city or region. CHINs that provide relatively open access to information can thus be distinguished from those that offer more restricted access. The tensions that exist between open versus restricted access to information are likely to have a major impact on the technical capabilities developed by particular CHINs.

Open Versus Restricted Access to Information

Some CHINs function as open systems, where most or all health care-related organizations and professionals in a region are eligible to join and are encouraged to do so. For instance, a network established in a city or region might accept as clients all hospitals, pharmacies, private practitioners, and payers willing to accept its fee structure. The Wisconsin Health Information Network exemplifies such an open CHIN. As an incentive for participation in the network, the CHIN fees for physicians are often underwritten by hospital sponsors.

Open systems provide opportunities for maximum exchange and integration of health care information. Open systems also allow smaller
health care organizations to gain access to more sophisticated systems than they themselves are able to develop in-house. However, a CHIN pursuing an open system approach to development will need to address several major issues: maintaining system compatibility, establishing price schedules that allow less affluent health care organizations to participate yet also provide sufficient revenues to maintain and improve the system, and coping with conflicting strategic demands of competing participants in that CHIN. Many open systems will probably maintain a relatively simple level of technical sophistication to be compatible with other systems, keep costs low, and avoid strategic information conflicts. In addition, the difficulty of achieving a technical consensus among multiple participants will inherently limit the sophistication of such open systems.

Operating as a network hub, services offered by open CHINs are likely to include payment processing and relatively simple access to clinical data such as clinical test results. Such a system is analogous to a telephone system that provides basic communication connections among many people and organizations. To the extent that a CHIN maintains patient management, financial, or clinical databases; however, issues of breaches of security, patient confidentiality, and loss of control of proprietary information inevitably will arise. A hospital or other provider in a community might join an open system initially in order not to be excluded and perhaps achieve some of the basic benefits of information transfer. However, such a client might then oppose the creation of a more sophisticated network to protect patient confidentiality or to keep information away from its competitors. A hospital that does not achieve a high level of expertise as a participant in such an open coalition may also have an incentive to withdraw from the coalition and create its own restricted-access CHIN to develop more sophisticated information management capabilities.

In contrast to open systems, some CHINs will operate as proprietary systems in which the CHIN operator explicitly or implicitly restricts access to only some of the health care organizations in a city or region. The terms "restricted" and "proprietary" CHINs are synonyms here. Restrictions might take the form of interconnection requirements that effectively exclude smaller organizations or competitors. Proprietary networks are likely to be more sophisticated than open systems because of the possibility of enforcing stricter interconnectivity standards on all clients. Moreover, the ability to screen out competitors within a proprie-
tary network will increase the use of the system to exchange strategic information. For instance, hospitals increasingly will need to compete to provide contract-based services for payers, employers, or lower-tier hospitals and managed care facilities. In this situation, knowledge of a hospital's cost structure and clinical volume become critical strategic issues. A hospital will be willing to share such information with other CHIN clients only if hospitals with which it is competing for contracts cannot gain access to the information. Similarly, pharmacies increasingly are viewing on-line patient records of prescription history as a strategic advantage and will be reluctant to share their records with competing pharmacies.

In the near term, it is likely that substantial tensions will arise within many regions concerning the extent to which CHINs will take an open versus restricted approach. Vendors that operate CHINs as open systems are likely to face conflicting pressures to maintain broad-based open systems and also to protect the strategic interests of individual organizations. Such vendors will also face issues concerning breaches of security and patient confidentiality, especially when the CHIN maintains extensive patient management, financial, or clinical databases. Some health care providers and payers undoubtedly will feel locked out from proprietary systems and will use whatever financial and political pressure they can to gain access to the CHIN organization and to the information and services provided by that organization. Some attempts to organize proprietary systems are likely to falter due to political pressure or the refusal of key organizations to join. In open access to CHINs, meanwhile, some central players are likely to attempt to limit their competitors' access to the system. Some open systems are likely to fail due to controversies that arise as a result of such attempts.

Because of the tension between open versus restricted access, we expect that CHINs evolving within hospitals or integrated delivery systems (IDSs) will become increasingly important. We also expect that more CHINs will form around a dominant health care provider than around multilateral coalitions of equal-status providers because it is easier to negotiate and develop a network in a less fractious organizational and political setting. Nonetheless, relatively small coalitions of providers are likely to continue to play important roles as organizers of hospital-based networks in some regions. Hospital coalitions that create CHINs will tend to offer access to those organizations and professionals whose interests complement those of the coalition. The complementarity of interests
should increase the incentives to provide detailed access to current information and to data repositories. In addition, the presence of a CHIN established by a local provider or small hospital coalition will create a concentrated enough set of interests to undertake long-term financial and managerial commitment necessary for long-term survival and success.

Organizational Models

Table 3-1 presents four basic organizational models for CHINs: (1) the for-profit vendor model; (2) the health care insurer/payer model; (3) the hospital or integrated health care delivery system (i.e., provider) model; and (4) the community-foundation model. The second column of the table summarizes several organizational features of current information networks representing each model, including ownership and management, expertise, information emphasis, and access.

Table 3-1. Four Basic Organizational Models for CHINs

<table>
<thead>
<tr>
<th>BASIC MODEL</th>
<th>OWNERSHIP &amp; MANAGEMENT</th>
<th>EXPERTISE</th>
<th>INFORMATION EMPHASIS</th>
<th>ACCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) For-profit vendor model</td>
<td>Vendor, often in partnership with local health care providers and payers</td>
<td>Varies with vendor background</td>
<td>Financial and patient management, with some clinical information (e.g., test results, medical records, prescription ordering, image transmission)</td>
<td>Sometimes operates as a common-access regional provider, but will often offer primary access to partners</td>
</tr>
<tr>
<td>(2) Health care insurer/payer model</td>
<td>Health care insurer, payer, preferred provider organization, sometimes in partnership with local providers</td>
<td>Claims processing</td>
<td>Financial</td>
<td>Relatively open access to providers, but might have limited access to other payers</td>
</tr>
<tr>
<td>(3) Hospital or integrated delivery system model</td>
<td>Local hospital or local hospital coalition owns the CHIN, vendors frequently provide capital, develop systems, and manage networks</td>
<td>Clinical and administrative</td>
<td>Financial and patient management, with some attention to clinical information</td>
<td>Primary access to local provider or coalition partners</td>
</tr>
<tr>
<td>(4) Community-foundation model</td>
<td>Regionally based community coalitions, often with employer organizations as key members</td>
<td>Varied</td>
<td>Financial and patient management</td>
<td>Open</td>
</tr>
</tbody>
</table>
The For-Profit Vendor Model

The for-profit vendor model includes systems developed by startup firms as well as by companies with other established business lines. Several startup firms, most notably Integrated Medical Systems (IMS), have created community health-information networks in various regions and cities throughout the United States. IMS, which currently operates the largest number of CHINs in the U.S., is active in about 45 markets. However, most CHINs that are established by new firms offer relatively simple functionality to users because of the technical and financial constraints that new companies face. Startup firms will likely continue to play roles in creating new CHINs but will often face limits on new opportunities for expansion. IMS, for instance, recently was acquired by pharmaceutical manufacturer Eli Lilly and Company. Eli Lilly also owns PCS Health Systems, Inc., which manages most of the real-time retail pharmacy prescription transactions in the U.S. for managed care organizations.

Established companies in various industries are also keenly aware of the growth potential of health care and have started information networks. These are often developed in partnership with local health care providers and payers. Examples of for-profit network developers involved in CHINs throughout the U.S. include telecommunications companies such as Ameritech, hospital information-system software vendors such as Shared Medical Systems Corporation (SMS), and computer companies such as the International Business Machines Corporation (IBM).

Most of the CHINs initiated by established companies are in early stages. In addition to the Wisconsin Healthcare Information Network in Milwaukee, Ameritech launched the Regional Health Information Network of Northern Ohio (RHINNO) in Cleveland in late 1994 and is involved in projects in Tennessee and Illinois (1995). SMS, which is based in Malvern, Pennsylvania, is the prime contractor for the Metropolitan Chicago Community Health Information Network. The Chicago CHIN, which awarded its vendor contract in late 1994, is developing a network that eventually will link providers, physicians, payers, employers and others for the electronic exchange of clinical, financial and administrative data. The initial demonstration phase of the project, in fall 1995, allowed 500 physicians within six hospitals to receive laboratory results electronically. In 1995, IBM initiated two pilot-stage CHIN projects in Dayton and Cincinnati, Ohio.
The growth potential of the CHIN market will probably continue to attract many vendors of health care and EDI software as a new market for their products. Such vendors may position themselves as purveyors of CHIN software or they may sell turnkey CHINs (hardware plus software) to hospitals and health care insurers. Several factors underlie the appeal of the evolving CHIN market for software and hardware vendors. First, the health care vertical market is attractive owing to its size. Second, the hospital-based market for information systems is fairly mature, so new sales will be difficult to generate unless they are compatible with a CHIN strategy pursued by a hospital or integrated delivery system. Third, a health care software vendor without CHIN software runs the risk that its installed hospital client base may be eroded by other vendors that are able (or perceived to be able) to offer products that allow information to be shared across heterogeneous organizations.

The relationship between such for-profit software or turnkey system vendors and payers and providers will be analogous to that which currently exists between hospitals and their vendors of hospital information system (HIS) or laboratory information system (LIS) software. That is to say, the vendor licenses the use of the software to the client and also charges monthly software support fees that cover the cost of new software releases as versions. Although the software and hardware supplied by such CHIN software vendors may be critical to the success of the CHIN, the vendor will not be a financial stakeholder in the CHIN organization and will be compensated on the basis of software and hardware purchase price and software licensing fees rather than on the basis of being an equity stakeholder in the CHIN venture.

The experience and expertise of the vendor developing a health network, as well as the demands of payers and providers participating in the organization, will affect the functionality of a vendor-operated network. Although this may seem intuitively obvious, it is important to state it to counteract some of the hyperbole that often accompanies CHIN announcements and press releases. Different vendors bring different expertise to bear on their development efforts. For instance, firms dealing with hospital information systems usually have prior experience with information-system development and deployment in the medical sector. On the other hand, telecommunications companies, especially large ones, have vast experience with data transmission, system connectivity, and interoperability among disparate systems. Computer companies have substantial computer network architecture and operating system experi-
ence. By contrast, many vendors, even HIS software vendors, tend to have limited experience in the day-to-day management of clinical databases. To date, the primary emphasis of most vendor-operated CHINs has been on financial and patient management information. Many systems also offer some management of clinical information such as laboratory test results but, for most, large-scale clinical data exchange remains in the future.

The Health Care Insurer/Payer Model

The second category of CHINs is the health care insurer/payer model. Preferred provider organizations (PPOs) are included in this category. Some health-insurance organizations such as the Blue Cross/Blue Shield in Virginia, Minnesota, and Illinois are establishing CHINs to provide two-way electronic financial links with health care providers. Similarly, some PPOs such as the ProviderLink subsidiary of United HealthCare, based in Minneapolis, Minnesota, have also set up such networks. A preferred provider organization is a network of designated providers that accepts discounted fees for services in exchange for an agreement to abide by certain guidelines regarding use of service. Typically, insurers and preferred provider organizations have experience in electronic data interchange of claims processing data. Therefore, most insurer/payer CHINs are heavily oriented toward financial transactions.

Hospital or Integrated Health Care Delivery System Model

The third category listed in Table 3-1 includes a local hospital, hospital coalition, or an integrated health delivery system (IDS). An integrated delivery system is a vertically and horizontally integrated health care provider organization. Nearly all large tertiary care medical centers or large networked hospital systems are now integrated delivery systems. Examples in Michigan would include the University of Michigan Medical Center in Ann Arbor and the Henry Ford Health System in Detroit. An integrated delivery system may also provide an insurer function, which spans the second and third categories in Table 3-1, and can be defined as an accountable health plan. Examples of CHIN ownership by providers include a coalition of hospitals in a single city (e.g., the Metropolitan Chicago Healthcare Coalition), a health system encompassing multiple hospitals under a single corporate umbrella (e.g., Inova Health Systems in Virginia), and a large tertiary care hospital that has purchased smaller hospitals and developed a series of free-standing clinics.
to create an integrated health care delivery network and a health-maintenance organization (e.g., Henry Ford Health System in Michigan and its Health Alliance Plan). We also refer to integrated delivery system CHINs as provider-based systems.

Provider-based CHINs are organized as organizational units within a hospital or a coalition of hospitals, and tend to offer the broadest range of financial, patient management, and clinical information to users. The scope of their functions reflects the need to increase the efficiency or productivity of physicians and nurses who are the employees of the enterprise. By way of contrast, a CHIN owned by a PPO would have less perceived need to improve the efficiency of physicians who contract to provide services to that organization, since they are contractors rather than employees.

In practice, many CHINs in the first three categories listed in Table 3-1 include joint participation among for-profit CHIN vendors, payers, and providers. MEDACOM Minnesota, for instance, is a joint venture of Minnesota Blue Cross Blue Shield and Integrated Medical Systems. IMS, which operates CHINs in multiple large metropolitan areas throughout the country, also licenses health information network software to payers or providers in smaller markets. Joint participation in CHIN development is often critical because of the complexity of the network design and installation, the technical challenges of creating data warehouses, and the political ramifications of sharing health information on a regional basis.

The political ramifications of making health care information widely available on a regional basis are beyond the scope of this discussion. Some of the political issues involve confidentiality and privacy, antitrust legislation, Food and Drug Administration (FDA) regulatory environment, professional accreditation, reluctance of provider organizations to share what they perceive to be proprietary information with competitors, and, finally, control of the storage of information. The latter issue concerns both CHIN vendors who try to position themselves as regional brokers of health care information, and the providers who may perceive this as a usurpation of their natural roles.

Provider-oriented CHINs frequently involve one or more CHIN vendors that serve as investors, developers, and managers. For instance, a vendor partnership known as ChinAlliance is developing the Metropolitan Chicago CHIN. Shared Medical Systems (SMS) acts as the prime contractor. AT&T Health Care Solutions provides networking and net-
work management, videoconferencing, telemedicine and teleradiology experience. Coopers & Lybrand's health care consulting practice provides systems integration experience. Healthcare Data Exchange offers broad access to payer eligibility files. IMS/Illinois Medical Information Network provides community health care products and services that allow the electronic communication of text, data, and voice messaging among providers. National Electronic Information Corporation (NEIC) provides electronic claims processing experience. PCS Health Systems, Inc., which is also the parent of IMS, offers prescription services. Synaptek provides all-payer claims processing for physicians. The partnership contracted in 1994 to develop and operate the CHIN for a consortium of Chicago-area hospitals. Thus, the same vendors that operate for-profit networks are also actively developing provider-oriented ones.

The Community-Foundation Model

The fourth organizational model for development listed in Table 3-1 is the community-foundation model. An example is the John A. Hartford Foundation of New York, which has provided funds and acted as a catalyst for the preliminary development of CHINs within several communities, including MidSouth Health Care Alliance in Memphis, Tennessee, and the Foundation for Health Care Quality in Seattle, Washington. Ownership of such a network resides in a not-for-profit organization that encompasses health care providers, employer groups, foundations, consumer groups, and public agencies within the community. Private foundations have been willing to provide seed money for the creation of CHINs because the exchange of health care information may provide positive benefits for the community, such as ready access to a patient's medical record, sharing of health records across different providers, and the presumed efficiency gains for the health care industry associated with enhanced EDI referred to earlier. The community foundation category is similar to the hospital or integrated health-system model. The foundation model is not likely to be a major force in CHIN development in most communities, however, owing to the difficulty of organizing broadly based groups with diffuse goals. Nonetheless, the model may succeed in particular locations where coalitions already exist or are easy to form.
Comparison of For-Profit and Other CHINs

The for-profit vendor CHIN variants share several distinct advantages in comparison to insurer-based, hospital-based, and community-based CHINs. Established companies in the telecommunications and computer sectors tend to have substantial capital to invest in CHIN ventures, as well as requisite technical expertise. Additionally, vendor-based networks are often able to respond to technical and market changes more quickly than CHINs controlled by health care organizations, especially when compared to CHINs that involve coalitions of health care providers and other organizations. Further, for-profit health information networks can sometimes act as "disinterested brokers" among health care organizations with competing interests, much as telephone companies and electric utilities provide basic services to competing businesses.

In spite of these advantages, both technical and political problems have slowed the diffusion of for-profit CHINs. On the technical side, some vendors have invested insufficient capital or lack expertise needed to develop sophisticated systems. Perhaps more importantly, vendors generally have underestimated the inherent political difficulties of bringing together disparate health care organizations to create a single information network. The political difficulties become particularly pronounced as the sophistication of systems and sensitivity of information increase. Health care professionals and delivery organizations have become increasingly wary about becoming too dependent on outside for-profit vendors for the day-to-day control of their proprietary information. Health care professionals understand that they run the risk of being unable to deliver effective health care if system problems disrupt information transfer in any way. System failure can also occur if information management is handled totally in-house, of course, but many health care organizations want to play a major role in managing information transactions. Moreover, hospital CEOs have become increasingly aware that information management plays a strategic role in health care delivery, and organizations risk losing competitive advantage if competitors gain access to sensitive information about them. The potential for security breaches exists when providers delegate information management to vendors.

Such issues are likely to have a strong impact on the success of CHINs. For instance, political concerns have slowed the expansion of the Regional Health Information Network of Northern Ohio (RHINNO), which Ameritech established in late 1994. The Health Action Council of North-
east Ohio, which is a business coalition of health care purchasers, contends that the network cannot “serve the complex and divergent needs” of the area health care community with Ameritech running the network (Schrimpf, 1995). The business group and the Cleveland Academy of Medicine have withheld their support from RHINNO, which had only one subscriber by fall, 1995. Similarly, more than half the respondents to a survey by Modern Healthcare magazine said that consortia of hospitals, physicians, payers, and business interests should own CHINs, compared with 6 percent who thought vendors should own the networks (Morrissey, 1995).

Revenue issues also may favor the development of provider-based CHINs relative to for-profit CHINs. Revenue sources among for-profit CHINs include combinations of initial connection charges, annual membership charges, and usage fees. One company charges a client $75,000 to $150,000 to connect to its system, plus a monthly charge ranging from about $80 for doctors to as high as $24,000 for high-volume payer organizations. Some for-profit networks assess fees on local hospitals who then provide free or inexpensive connections for local physicians. Some companies operate by charging an initial licensing fee for the software, yearly software support fees, and consulting fees for their roles as a systems integrator, while others charge a small fee per transaction.

No matter what revenue format is selected, however, many for-profit CHINs are likely to reach quickly the limits of what health care organizations and professionals are willing and able to pay for their services. These financial constraints may in turn limit the growth of for-profit CHINs. By contrast, many hospital-based networks will be able to include capital and operating costs within their broader information-systems budgets. To the extent that it contributes to the strategic position of a hospital, the direct financial self-sufficiency of the CHIN will be perceived as less important than it would be in the case of a for-profit CHIN. In the near term, therefore, health care providers, payers, and other health care organizations are likely to play substantial roles in most successful CHINs. Many for-profit vendors will play larger roles as subcontractors for system development and management of provider and insurer-based CHINs than as operators of stand-alone for-profit health networks.
A CHIN Evolution Trajectory

As noted earlier, most existing CHINs offer relatively simple information exchange and relatively limited access within a region. Over time, however, CHINs will probably become more technically sophisticated and serve a broader base of health care professionals and patient populations. Table 3-2 provides a simple taxonomy for a CHIN trajectory of the evolution of CHINs.

Table 3.2. The CHIN development trajectory from an enterprise health network to an integrated health system network to community health information network (CHIN). Under each of the three categories are two bullets listing its major distinguishing features.

<table>
<thead>
<tr>
<th>Enterprise Health Network</th>
<th>Integrated Health System Network</th>
<th>Community Health Information Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Confined to enterprise</td>
<td>• Links affiliated and contracted entities</td>
<td>• Community-based separate organization</td>
</tr>
<tr>
<td>• Minimal integration of information</td>
<td>• Early development of data repository or data warehouse</td>
<td>• Full regionalization of health information</td>
</tr>
</tbody>
</table>

The simplest form of a CHIN in Table 3-2 is an enterprise health network that establishes access via a local area network among various host computers within a single enterprise. We also refer to this model as an enterprise CHIN. Such enterprise networks usually develop within large tertiary care medical centers that include multiple hospitals and geographically distributed free-standing clinics or surgicenters. Users access the various host computers and databases within the enterprise using workstations and PCs. The users of an enterprise network can connect sequentially with the mainframe computer for patient accounting and patient management information, the laboratory information system for laboratory test results, and the pharmacy system to order medications. An enterprise health network provides relatively high volume and highly functional linkages between the main hospital and geographically distributed clinics, surgicenters, and purchased physician practices. Enterprise CHINs serve many needs of complex health care organizations. A large medical center has a compelling need to establish two-way electronic communication with its own medical staff and also with its cadre of referring physicians. In essence, such a complex tertiary care center creates a new goal in its strategic planning when
it decides to create a CHIN, that is, regional integration and communication beyond that offered through smaller-scale, facility-wide computer links.

Many CHINs organized to serve a single integrated health care delivery system will be enterprise CHINs, with a complex tertiary care hospital system as the central organizer. An enterprise CHIN encompasses a single provider organization (e.g., the Henry Ford Health System). An enterprise health network will often be easier to plan and deploy than a health network that facilitates communication between independent organizations because competing hospitals are not part of the process. Nonetheless, legacy systems pose the same interconnectivity problems for enterprise CHINs that they do for health networks spanning different organizations. In addition, an enterprise health network is as much a moving target as an interenterprise network because large medical centers are in constant negotiation with other providers and payers and frequently establish new strategic alliances and merged organizations. The new enterprises that emerge from such negotiations will have new and enlarged appetites for information exchange.

The integrated health system network in Table 3-2 is the second stage in the evolution. An integrated health system network is broader than an enterprise health network, providing wider ranging communication links to the various entities that have contractual relationships with the managed care organization that controls the integrated network. Such a network might involve the creation of communication links between a tertiary care hospital that has organized itself as an HMO and an outside group of primary care physicians with which the health maintenance organization has a contract to provide care and gatekeeping functions. Clearly, brief telemedicine consultations between the primary care physicians and the specialists in the tertiary care hospital about the need for patient referrals would be valuable. Similarly, the hospital might create links with specific insurers, employer organizations, pharmacies, reference laboratories, and other organizations with which it has close relationships. Many vendor-operated CHINs that offer open participation also will provide at least part of the functionality associated with an integrated health system network.

The last category in Table 3-2 is the fully formed CHIN. Criteria for such an entity include the seamless transmission of clinical, patient management, and financial information among participants. A fully-formed health network would be a separate business organization and
would have open participation to a broad range of health care organizations and participants. A fully-formed CHIN would help achieve regionalization of health information, by which we mean nearly total portability of information across various providers and payers. This would be achieved by the creation of a regional data repository that stores data generated by multiple providers in the region. These criteria for a fully formed health information network are far beyond the technical and organizational reach of any current CHIN. Nevertheless, there are compelling reasons for such a goal. Even partial realization will be a major step forward.

**CHINs and Managed Care**

The phenomenal growth of managed care organizations has been the major impetus for the growth in interest in CHINs, especially for the increasing interest in creating them as an integral part of integrated health care delivery systems. Several reasons underlie the tight coupling between health network development and managed care. First, the movement toward managed care has stimulated the consolidation of smaller hospitals into larger geographically dispersed organizations. Such consolidated health care corporations require integrated financial and patient management information systems, if for no other reason than to manage the organizations from a business point of view. In this context, hospital CHINs can provide system integration on a regional basis. The pursuit of interoperability and the integration of multiple host systems within a hospital chain present substantial difficulties, given that many or most of the consolidating hospitals will often wish to retain, or cannot afford to eliminate, their legacy financial and patient management systems.

Second, the movement toward managed care stems from the need to reduce costs while simultaneously maintaining quality. The cost of HMO and PPO contracts is now declining after an extended period of yearly increases for health care coverage that substantially exceeded increases in the yearly cost of living. Because health care is information-intensive, many of the anticipated cost reductions under managed care will flow from enhancements in automated information management (Davidson, 1992; Johnson, 1994; Grandia, 1994; Wyatt, 1994). Robert Kennedy, the Chief Information Officer at the Metropolitan Chicago CHIN, estimated at the “Second Annual CHIN Summit” held in June, 1995, that approximately 2–4 percent of total health care dollars could be saved through
administrative cost savings related to CHINs, without taking clinical cost savings into consideration. With a $1 trillion health care economy, this would translate into about $20–$40 billion in savings.

CHINs have thus become largely synonymous with the notion of efficient data management and data sharing across regions and complex organizations, providing a kind of mantra for efficient and automated information management in health care organizations. This enthusiasm for integrating systems and information across disparate organizations and across geographic distances may be premature, given the relative lack of success of system integration within many individual hospitals. Nonetheless, while some of the goals and assumptions about CHIN functionality may be overstated, CHINs are likely to continue to evolve as organizational and technical entities.

The movement toward managed care and the need for health care reform have also provided opportunities for health care consultants. Many of the consulting system integrators of former times are now being engaged as CHIN consultants and much of the impetus for projects may be coming from such consultants. Although there is support for the notion of top-down, long-range, strategic CHIN planning, there is also a fear that such plans may be unrealistic and might never be acted upon, in the same way that many prior system integration plans were never implemented at the facility level. Strategic network planning that considers the needs of an organization for data communication and exchange, including the provision of health care delivery at a distance, is likely to be more successful.

**Managed Care as a Driver for Telemedicine Within CHINS**

Current developments concerning CHINs in managed care systems will affect the potential relationship between CHINs and telemedicine. Some CHINs undoubtedly will evolve as networks that link many independent health care facilities. In the near future, however, most CHINs and similar systems will be controlled by single managed care systems or, at most, by small groups of health care organizations. Managed care systems have the incentives to use more complex forms of information exchange, both to provide health care and to gain competitive advantages, and the resources to develop the information networks. Therefore, many of the opportunities for linking telemedicine initiatives to CHIN development will arise within the managed care systems now emerging, rather than within multiparty networks of traditional health care organizations.
The evolution of CHINs within managed care systems has implications for the development of telemedicine.

Historically, telemedicine programs have been designed primarily to deliver health care services to isolated and underserved patient populations, such as rural populations, military personnel, nursing home residents, and prison populations. The funding for such programs often came from federal and state governments or from foundations with a special interest in the health care needs of such populations. Under managed care, financial incentives are now rapidly evolving that can serve as a stimulus for hospital and health maintenance organization CEOs to invest in telemedicine programs that span shorter distances. Such incentives have been weak in the past.

It is useful to consider how such telemedicine initiatives might arise in a large tertiary care teaching hospital. Under fee-for-service, physician specialists and the hospital itself derived financial benefits when geographically removed primary care clinics referred patients to the specialty care ambulatory clinics or referred patients for inpatient admission to the hospital. Under managed care and capitated systems, by contrast, there are strong disincentives for such referrals to specialists. There is undoubtedly a high percentage of cases in which a primary care physician in a free-standing clinic could manage effectively, if that physician could have a brief real-time consultation with a specialist to buttress his or her proposed treatment plan for the patient.

Of course, such a consultation could and does take place today with little capital investment, via the telephone. This opportunity notwithstanding, real-time spontaneous teleconsultations will be more acceptable to physicians and patients alike with both audio and video connections and with both the referring and consulting physicians simultaneously viewing identical laboratory test results, diagnostic images, and a patient's current list of medications on their PC screens. Such teleconsultations will be common and well accepted in the near future, particularly as patients begin to realize that they are also direct beneficiaries of the efficiencies of the system. The nature of such intra-organizational teleconsultations, in summary, is that they will be brief, the distance spanned will be relatively minor, and the goal of such a consultation will be to avoid a patient referral to the very specialist who may be providing the telereferral. The major driver in the growing incidence of teleconsultations will be that CEOs will invest in and promote such systems
because their emergence will have a substantial effect on the cost and efficiency of medical services. In other words, the telemedicine investment "goes right to the bottom line," especially when it can be combined with investment in a CHIN that also provides other clinical, patient management, and financial functionality.

This discussion has significant implications for the future geographic span of telemedicine. Telemedicine is generally thought of as spanning long distances in order to reach remote locations. In addition, though, telemedicine that develops in a CHIN environment and contributes to CHIN development will also commonly span much shorter geographic distances. Distances to be spanned in the delivery of health care will include a few miles between suburban outpatient facilities and central hospitals, or even contact of a few city blocks between adjacent buildings that are part of the same medical center. This variant of telemedicine is referred to here as "enterprise telemedicine" and is likely to become the most common variant of "health care delivery at a distance" in a short time.

REFERENCES


Health Information Networks: Creating the Health Care Data Network. Chicago: American Hospital Publishing.