As the roles of physicians and hospitals in providing patient care become increasingly integrated, a move has begun to consolidate the traditionally disparate elements of clinical information into single, unified patient records—which until recently were relatively non-existent. Innovative applications of information technology make the creation of integrated patient records possible. Network communication is predicted to become the standard method for health care providers to share clinical information from many locations. Networking is giving rise to regional health care information systems. One regional network—Health Data Network, based in Louisville, Ky.—is described in detail.

Physicians and hospitals have traditionally shared as independent partners in the care of the patient. Their separate roles have been mutually accepted as fairly well defined, even if this definition was informal and by silent consent. The physician and the hospital have traditionally acted together as a somewhat integrated team to serve the patient. Yet, the information about that patient has been totally separated: the hospital medical records was one depository, and the physician's office was the other. Moreover, the information about any one patient typically has resided in the hospital where he has been treated. In the case of a patient who has been in several hospitals, his records are separate and distinct and remain in the medical records of each hospital. It is amazing to recognize that the information about any one patient has never been integrated into "the patient's record" when his records are scattered among several hospitals and physicians offices—even when these are within the same city.

Dramatic changes are now occurring in the way information is recorded, retained, and retrieved. For the first time in the history of writing, today's technology makes it possible to integrate patient information into an integrated record of that patient, and then to have that information shared by hospitals, physicians, and potentially other health care providers. This technology makes such sharing possible without the undesirable "big brother" overtones of a state-run information repository. "Networking" is the term used to describe the developing application of technology in such information storage and retrieval.

Networking has typically been associated with the radio and television industries as a means of communicating the same information from a central source to widespread audiences. As technology continues to blend communications and data processing, however, the concept of networking is taking on new dimensions in the area of health care information resource management.

Regional medical networks might well be a viable means for integrating all clinical information for a patient, who, because of mobility, need or preference, might in a lifetime use the services of several hospitals and physicians within a region.

Unlike some commodities, information management resources are most valuable when shared among the same users. In the context of the health care environment, significant benefits can be derived from a shared arrangement: improved communications; distributed, and hence, reduced costs; increased productivity, and more efficient management of other resources, which all add up to better patient care.

Consequently, prototypes of interactive networks of health care providers have been developed, linking hospitals, physicians, clinics and peripheral supporters of health care services, such as insurance companies, governmental agencies and financial institutions, to central computer facilities. Information flows freely throughout a geographically-distributed arrangement of these users, and is available wherever and whenever it is needed.

As common-sense as a network approach to information management would seem, there are relatively few fully-integrated health care information networks in existence today. There are still fewer networks built around clinical information management systems that manage financial functions as a by-product of their operation. However, these networks are developing just as surely as did their...
predecessors in the broadcasting industries.

One example is Health Data Network, with central computer facilities in Louisville, Ky. Established in 1970, Health Data Network services are extended across 500 miles of telephone lines to five hospitals and nearly 30 physicians.

HDN provides a completely self-developed, on-line, real-time, integrated health care information management system used by hospital administrative staffs, by nursing personnel, by virtually every hospital ancillary department, and by physicians from their offices and within the hospitals.

In addition, Health Data Network communicates by computer with an automated bank clearinghouse to make direct payroll deposit for hospital employees, physicians and their office staffs, and with Blue Cross/Blue Shield of Kentucky for filing insurance claims.

Health Data Network has taken advantage of all high technology best suited to its particular needs. The network uses both central and distributed data processing in the form of:

- central data base and large volume disks
- Intelligent minicomputers running on self-developed and self-maintained software at optimum cost effectiveness
- High speed communications, made possible by privately-owned modems
- Computer terminals with soft logic and functions that can be changed as needed by software modifications.

Since its inception, HDN has evolved along a carefully planned course, based on three deceptively simple sounding design criteria.

1. Information must be available to health care personnel wherever and whenever it is needed.
2. Health care personnel must have control of (and bear responsibility for) information.
3. The information management system must approximate what happens when it happens.

Taken together, these criteria form the very infrastructure of Health Data Network as an on-line, real-time integrated total health care information system operating 24 hours per day, seven days per week.

**NETWORK INTEGRATES CLINICAL INFORMATION**

Integration of information is a prerequisite for effective networking because medical professionals must have a complete picture of the patient's health. Piecemeal information from multiple computer systems is not only inefficient; it can prove dangerous if it has to serve as the basis of medical decision-making.

Health Data Network has developed an interactive network that is generic enough to be used by multiple independent hospitals and physicians via remote communications through minicomputers. In this system, much of the same information can be repeatedly accessed at any time by physicians and hospital departments, including the patient registration and business offices, nursing service, the clinical laboratory, medical records, pharmacy, respiratory therapy, dietary, human resources, financial managers, materials management and administrative personnel.

This information is available immediately and around-the-clock. As information is processed, file records are updated immediately and automatically, totally eliminating key punching and batch processing.

Serving physician management needs has been a primary objective of the network, and is accomplished through the PRIMA system.

The PRIMA system operates on two levels of information management functions. Level One of PRIMA is used by both office-based and hospital-based physician practices. At Level One, PRIMA:

- allows immediate inquiry into any patient account;
- maintains patient records with immediate updates of financial information;
- provides up-to-the-minute account balancing;
- controls daily cash for a steady cash flow;
- and prepares patient billing, collection letters and third-party payor billing.

In addition to these functions, PRIMA generates detailed monthly reports to keep physicians aware of the financial trends of their practice. Each month, PRIMA generates an aged trial balance report which shows total accounts receivable figures. Each patient account is aged by item according to the date of service (i.e. current to 30 days, 31-60 days, 61-90 days, etc.)

Bad debt and immaterial write-offs are compiled in a separate report. PRIMA also provides trend analysis of services and charges by patient financial class, physician or practice, showing the total number of procedures performed and the dollar amount billed by patient financial class for these services.

Level Two of PRIMA provides physicians on the staff of a hospital served by Health Data Network the capability to accomplish the following from their office via a cathode-ray tube (CRT) terminal hooked-up to the hospital's computer system: order laboratory tests and obtain lab test results; place orders for their hospital patients; and see medical information on their inpatients.

For an office-based physician practice, office personnel type pertinent patient information on the keyboard of a CRT terminal, which can be operated by any typist. Information entered at the terminal is first displayed visually for verification on a small, television-like screen and then processed by the system.

For hospital-based practices whose patients are treated at the hospital, all patient charges are captured at the time they are entered by hospital personnel. There is no duplicate posting of charges by the business office staff. This feature is both time and cost effective.
A new PRIMA clinical note screen is being developed for the network, based on the problem-oriented medical record concept pioneered by Lawrence L. Weed, M.D.

The new PRIMA screen will function as an electronic medical record for each patient. The physician can use this free-form screen to note problems, medications, treatments and results.

In addition, a physician can inquire into all problems, treatments, results and medications for a patient over any desired time period by entering "from" and "to" dates. By having quick and easy access to this information, physicians will be in a better position to exercise medical judgment.

**ENGINEERING ASSURES NETWORK RELIABILITY**

In a network of multiple hospitals and physician offices, reliability becomes a critical concern for a system operating around the clock. Because health care demands a high uptime computer operation, HDN has taken a number of steps to insure and enhance reliability:

- The network was designed to be redundant throughout. In the hospital and at Health Data Network, twin computers are wired together to act as one. If one computer fails, the other can serve as back-up with no interruption of service. Also two computers offer twice the capacity and split the workload volume. Work functions can be traded off between computers.
- An uninterruptible power system--a diesel generator and battery pack--is in place to maintain operations should outside sources of electrical power fail.
- An in-house electronic engineering department performs all equipment evaluation, maintenance and troubleshooting, and is on call at all times.
- Reliability is also enhanced by the company's choice of equipment. HDN "shops around" and purchases from many different vendors to get the equipment that is most reliable and that offers the most capability for the dollar.
- HDN maintains control over the communications function with privately-owned modems, and over every other link in the communications chain except the telephone lines.

Human engineering--designing the system to be logical first to the person at the computer terminal and then in terms of the computer and its files--has been an objective since the first day of operation.

Health Data Network has experienced tremendous growth since its inception, but growth is not intended as an end in itself. HDN is evolving toward a network of hospitals and physician practices for any region which shares a homogeneity of needs. In a group of this size, change would remain manageable, and sufficient resources would be provided to keep pace with technology.

Health Data Network is proof positive that an effective health care information management network can be designed and implemented. All of the components for building regional clinical data bases are available today--network communications, data base technology, technical expertise and hospital skills. It may be the 21st century before the health care providers are willing to utilize such functions, but if current networking activities are any indication, regional medical information networks are well on the way.