Successful Implementation of a Comprehensive Computer-Based Patient Record System in Kaiser Permanente Northwest: Strategy and Experience

Kaiser Permanente Northwest (KPNW) has implemented a computer-based patient record (CPR) system for outpatients. Clinicians at KPNW use this comprehensive CPR to electronically document patient encounters; code diagnoses and procedures; maintain problem lists; order laboratory tests, radiology tests, and prescriptions; and send patient-specific messages and referrals to other medical providers. More than 700 clinicians, representing more than 20 medical and surgical specialties, and 2600 support staff in 31 geographically separate sites use this system as the information foundation of delivery and documentation of health care for KPNW's membership of 430,000. As of May 1998, more than four million visits and two million telephone calls had been processed and documented into the system. More than 5000 outpatient visits are processed and documented each weekday. From an integrated clinical workstation, clinicians also access e-mail, an extensive results-reporting system, and sites on both the Internet and KPNW's intranet. This article describes a strategy for and experience with the implementation of a large-scale, comprehensive CPR in an integrated HMO. This information may be useful for persons attempting to implement CPRs in their own institutions.

The computer-based patient record (CPR) system at Kaiser Permanente Northwest (KPNW) has two key components: an extensive results-reporting system (RRS) and a comprehensive outpatient CPR called EpicCare (Epic Systems, Madison, Wisconsin). Introduced in the first of two stages of implementation, the read-only RRS provided full leverage for the existing computerized data from other departmental systems, giving caregivers quick, intuitive access to patient-specific information. At the same time that the RRS was introduced, we gave each clinician an organizational e-mail account and adopted e-mail as the standard for organizational communication. The RRS and e-mail systems clearly demonstrated that computer technology could improve a clinician's ability to provide medical care, and the success of this technology helped pave the way for clinician acceptance of EpicCare, the more comprehensive component of the system. EpicCare essentially automates all outpatient documentation, ordering, and messaging processes.

Phase I: The Results-Reporting System

Figure 1 is a schematic diagram of the RRS. Data from departmental systems are regularly downloaded into the RRS. The use of batch downloading, rather than a real-time interface, enabled us to develop and implement this system quickly and easily. At first, the RRS database was updated once daily, but the updates have gradually become more frequent and now occur on an hourly basis for most data. The RRS database contains basic demographic and benefit data for all members; pharmacy data; transcribed reports, including radiology reports, discharge summaries, history

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CLINICAL INFORMATION SYSTEMS

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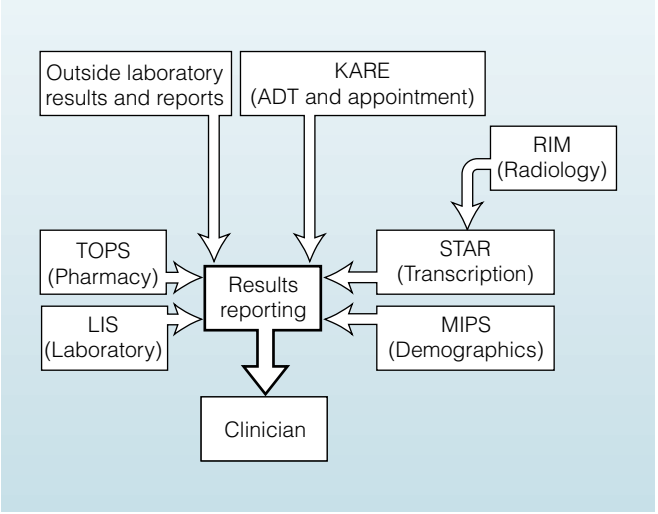

FIGURE 1. Schematic diagram of the results-reporting clinical data repository. ADT = Admission-Discharge-Transfer; KARE = Kaiser Ambulatory Resource; LIS = Laboratory Information System; MIPS = Member Information Processing; RIM = Radiology Information Management; STAR = Medical Transcription; TOPS = The Outpatient Pharmacy System.

and physical examination data, operative reports, consultation reports, surgical pathology and cytology reports; and outpatient laboratory results.

This read-only clinical data repository provides substantial benefit to clinicians while requiring little effort from them. The system has a consistent user interface with a quick, straightforward, single-keystroke navigation scheme. The system allows for both summary and detailed views of the data, making it easy for a clinician to scan the "chart" and view detailed information quickly, if necessary, by selecting a particular event from a displayed summary index of events. "All Events" (Figure 2), for example, is a summary index that lists, in reverse chronologic order, all of the interactions that a patient has had with our health care organization. Laboratory tests, dictations, medications, appointments, and admissions are integrated into a single view and displayed in reverse chronologic order; this allows the clinician to quickly scan the electronic chart for relevant events. A medication list (Figure 3) or a summary list of dictated reports (Figure 4) can also be displayed. Any dictated report can easily be selected from the summary list of dictated reports and viewed on-line (Figure 5). The data can also be displayed in other ways; for example, a clinician might ask to view a trend in outpatient laboratory results (Figure 6).

As of May 1998, more than four million visits and two million telephone calls had been processed and documented into the system.

With the RRS, the power of the computer to improve the ability of clinicians to deliver care to patients—not only by retrieving information instantly but also by providing different views and summary indexing of the data—was easily demonstrated.

The RRS was made available to all clinicians in our region in 1993. Because of the intuitive nature of the user interface, adaptation to this system was accomplished with little training. Clinicians received a three-page brochure that described how to use the system, and they were required to sign a confidentiality statement to obtain an account and a password. By October 1997, more than 700,000 screen accesses had been made to this database—the equivalent of five screen displays for every patient seen in our health care system. This project has been described in detail elsewhere (1).

Phase II: EpicCare

In the second phase of development of our CPR, we implemented EpicCare, a vendor-supplied comprehensive outpatient clinical information system. EpicCare is a client-server system that uses Chronicles, Epic Systems' proprietary database management sys-

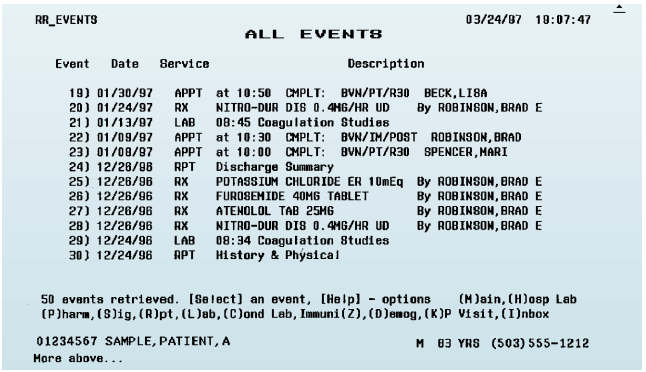

FIGURE 2. Sample "All Events" screen.

tem, which is based on ANSI-M. The front end is written in Visual Basic. In our initial rollout, this system ran with Microsoft Windows 3.1 (Redmond, Washington) as the operating system on Intel-based 486-66 MHz PCs. These workstations were installed in clinicians' offices, nursing stations, and ancillary departments; except for a small number being used on a pilot basis, workstations were not installed in examination rooms.

In addition to being an electronic version of the outpatient medical record, EpicCare automates all information transmission processes in the outpatient setting. Health care providers use it to document, to order, to refer, and to send messages to other health care providers. Guidelines and medication suggestions are provided "in-line" to clinicians as they use the system to provide care.

Figure 7 shows an example of a clinician's schedule for the day. Most clinicians work from this initial screen as they see patients in their clinic. From this screen, a clinician can quickly select a scheduled patient. Alternatively, by using the "Patient" button in the upper left corner, the clinician can enter a medical record number or a name to select any patient in the system. Buttons along the top and bottom of the screen let the clinician access the system's various functions, such as reviewing a chart, entering a note, ordering, or prescribing. The "In Basket" button allows the clinician to access such information as messages, forwarded charts, and phone messages.

The clinician uses the order summary screen (Figure 8) to enter and code diagnoses, update problem lists, order laboratory and radiology tests, and send referrals.

User- and departmental-specific selection lists make ordering tasks more efficient. For instance, the ordering of medications is streamlined by the provision of default directions, package sizes, and numbers of refills for commonly prescribed medications. By showing whether a medication is on or off the formulary and by suggesting alternatives for expensive drugs, the system supports cost-effective prescribing habits. By entering a disease name into the prescription field, a clinician can see a list of organizationally recommended medications for that disease. We have implemented medication guidelines for such conditions as *Helicobacter pylori* infection and gastroesophageal reflux disease. These and similar aids improve clinician efficiency and quality of care.

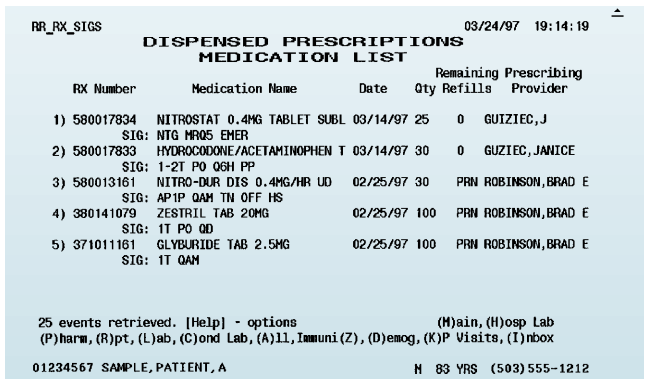

FIGURE 3. Sample medication list.

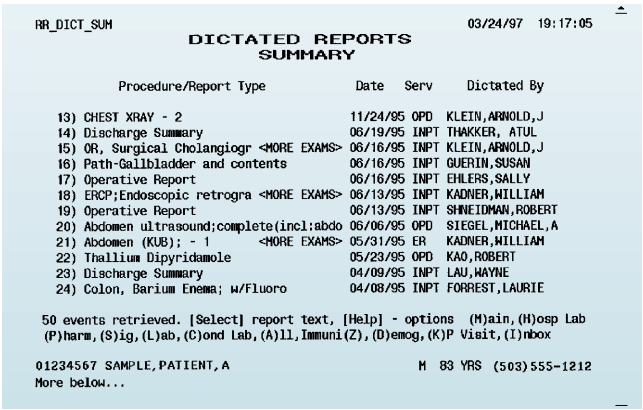

FIGURE 4. Sample summary list of dictated reports.

Figure 9 shows the screen through which the physician enters information for an "after-visit summary." This summary lists vital signs, orders, prescriptions, recommended or scheduled follow-up appointments, and patient-specific instructions and is printed out for the patient at the end of the visit.

Pilot Sites and Experience

The project team decided to test the system at two separate outpatient medical offices rather than just one. The rationale for this was twofold. First, the team recognized that a successful test at one office did not guarantee success at another. Second, the team wanted to ensure that EpicCare could be "scaled up" to support more than one geographic site without difficulty.

Between June and November 1994, EpicCare was tested with 46 primary care clinicians in two outpatient medical offices. User surveys conducted 2 and 4 months after implementation showed that clinician attitudes became increasingly positive as they became proficient with the system. At 2 months, only 38% of clinicians agreed with the statement, "EpicCare is worth the time and effort required to use it," but 86% agreed at 4 months. Another item on the survey was the statement, "If given the choice, I would return to the old (paper-based) system." At 4 months, 89% of the clinicians disagreed with this statement, 4% were neutral, and only 7% agreed.

System response time was considered adequate. The central server had unscheduled downtime of less than 1%. Minor problems encountered with workstations and printers were evaluated and resolved.

During the testing phase, the pilot clinicians and implementation team identified more than 100 potential enhancements to the system. These were discussed with the vendor, and many of the minor enhancements were made to the system as it evolved during the pilot implementation. Some of the more substantial enhancements were included in a subsequent release of the system. The vendor was responsive to our requests to modify the system, and the system itself was thought to

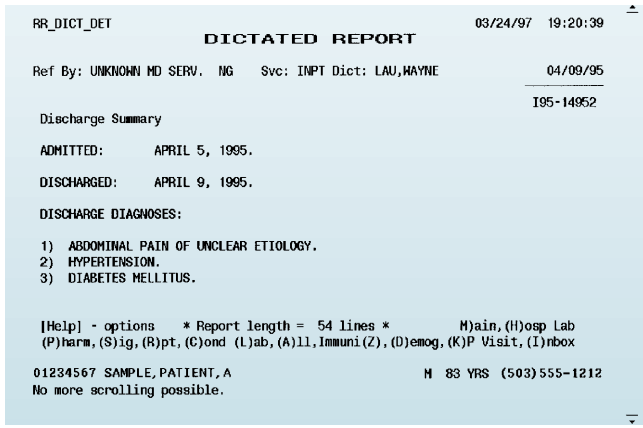

FIGURE 5. Sample text of dictated report.

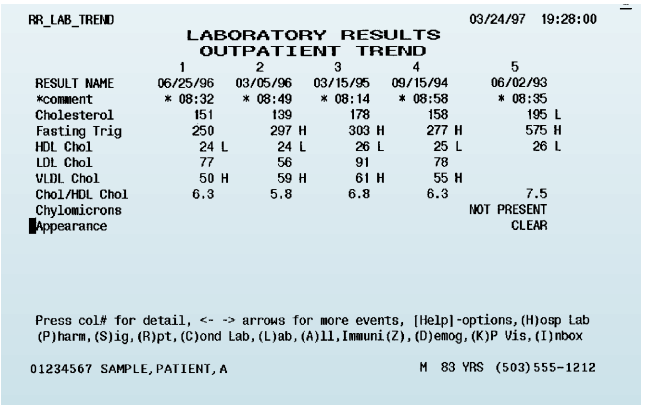

FIGURE 6. Sample display of a trend in outpatient laboratory results.

be flexible and easily modifiable in response to newly identified needs.

On the basis of our evaluation of the pilot implementation, we decided to regionalize the system. The approach to and results of the pilot site evaluation are discussed in detail elsewhere (2–4).

Full Implementation of EpicCare

After the requested enhancements were incorporated into a new release of the system early in 1995, the project team began full deployment. By the year's end, all KPNW primary care clinicians—internists, family practitioners, and pediatricians—were regular users. Rollout for KPNW specialists (at the rate of 50 per month) began toward the end of 1996 and continued in 1997. After issues related to the protection of patient confidentiality were resolved, mental health and chemical dependency clinicians were added as full EpicCare users. At the end of 1997, all permanently employed KPNW clinicians (totaling more than 700, along with more than 3000 support staff) in more than 20 medical and surgical specialties and 31 geographically separate locations were using EpicCare as a foundation on which to deliver and document medical care. Approximately 30,000 outpatient visits per week are now processed and documented through EpicCare.

During rollout, we continued to print a paper copy of the record of each outpatient visit to file in the paper chart. Now that implementation is complete, we are evaluating when we can stop filing these copies. We have been able to substantially decrease the movement of the paper chart; however, rather than unilaterally stop this movement, we polled clinicians to determine whether they desired the paper chart for particular appointment types. Each clinician's preference was then entered into our chart tracking system, and charts are pulled or not pulled according to the

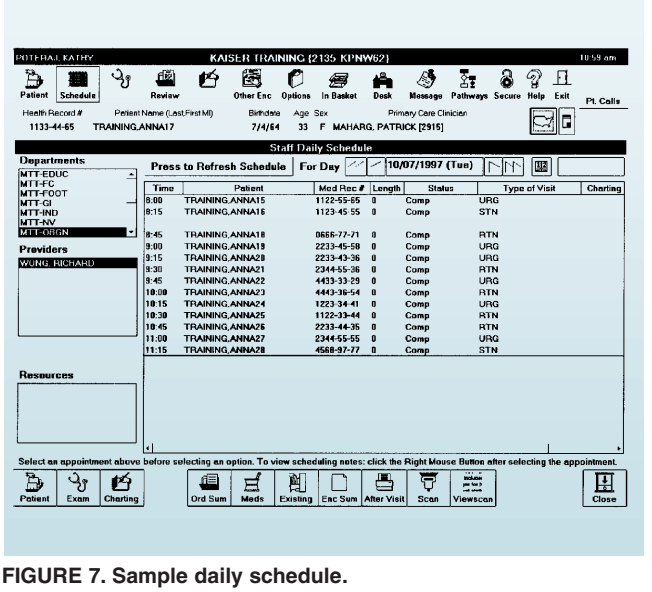

FIGURE 7. Sample daily schedule.

clinician's preference. Overall, we continue to pull the paper chart for approximately 40% of outpatient visits. Reasons for continuing to pull the chart include the need to access information that was entered into the chart before the implementation of EpicCare, review information that was placed in the paper chart from an outside source, and review electrocardiograms. We are evaluating technologies that will allow us to scan paper documents into EpicCare, and we are working with Hewlett-Packard, the vendor of our electrocardiography system, to allow direct electronic access to electrocardiograms from clinician workstations. As the amount of information entered into EpicCare increases, the need for the paper chart continues to decrease.

Throughout the course of implementation, both Epic Systems and KPNW have continued to keep pace with new hardware and software technologies. New EpicCare releases also reflect enhancements suggested by its users. The latest version, EpicCare V5.3, uses Visual Basic 5, a faster compiled version of Visual Basic. Both client and server hardware and the network infrastructure at KPNW have been updated. The operating system has been upgraded to Microsoft Windows '95, and workstations have been upgraded to Intel 200-MHz Pentium platforms with 48 MB of memory. Now, through a single workstation, clinicians can access EpicCare, the RRS, the appointment system, e-mail, and a World Wide Web browser. An extensive intranet site provides extensive information, including evidence-based clinical guidelines, clinical practice resources, advice-nurse protocols, clinician availability information (such as beeper numbers and consultant-of-the-day assignments), continuing medical education offerings, policy manuals, and drug-alert information. All clinicians also have access to MEDLINE and the Internet.

Major Issues and Challenges

Full implementation of a comprehensive CPR throughout KPNW is now complete. With the foundation of the CPR system securely in place, we are now turning our attention to analyzing data, incorporating additional guidelines into the process of care, improving system efficiency, and emphasizing processes to improve population-based patient care. We are also starting to install EpicCare workstations in examination rooms and on radio frequency–connected laptop devices.

Issues that KPNW has resolved, as well as those it continues to face, are these:

- Improving clinician attitudes and "priming" clinicians for acceptance of a CPR. The introduction of the RRS and e-mail demonstrated the power of computer technology and encouraged a positive attitude toward a comprehensive CPR.

- Maintaining enthusiasm despite initial "start-up difficulties" experienced by clinicians. Implementing a comprehensive CPR—especially when doing so requires major changes in clinician behavior—is not an easy task. The initial response by clinicians to this entirely new way of interacting with the patient record was less than enthusiastic. Having

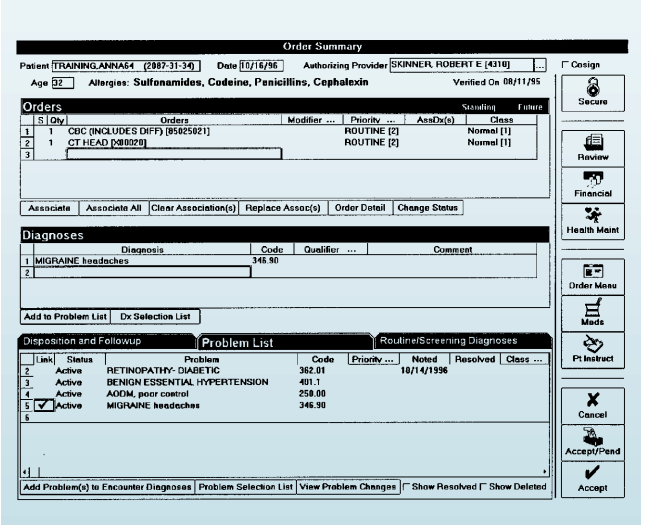

FIGURE 8. Sample order summary screen.

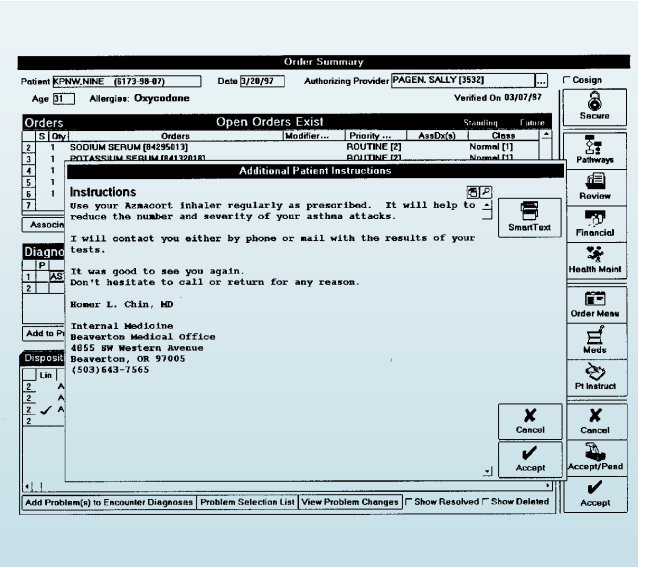

FIGURE 9. Screen through which the "after-visit summary" is created.

learned from the pilot experience (in which clinician reaction was initially mixed but predominantly positive after 4 months), the project team was able to provide convincing data indicating that start-up difficulties would lessen over time. Equally (if not more) important, the team provided effective training and support when the system became operational. Finally, the team listened and responded quickly to user concerns.

- Managing politics. A few clinicians were negative, and even hostile, toward the idea of an electronic record. Vocal detractors may try to influence leaders to halt a project before it has been fairly tested. Project team leaders anticipated the importance of good two-way communication and devoted a sizable portion of project time to communicating with stakeholders, users, and decision makers during the critical planning, training, and start-up phases of the project.

- Preparing clinicians for major change and managing variable proficiency. Many clinicians can adapt easily to electronic processes; others cannot. To help the timid and the reluctant, the project team ensured that a carefully crafted training program and scheduled support were in place during the first weeks of implementation at each site. Informal training programs led by local clinicians who championed the system allowed slower adapters to continue to improve their skills long after implementation had been completed.

- Improving coding. Substantial problems, especially those that arouse anxiety and frustration, must be addressed swiftly and effectively. One such hurdle that we overcame was improving the diagnosis coding process. Although this was a major area of complaint for our initial users, we developed a more responsive process that would successfully balance the needs of the organization with those of the clinician–users (5, 6). Because EpicCare requires the clinician to enter clinical diagnoses and then codes them automatically, coding accuracy is high (5). We believe that accuracy is much higher than that obtained solely through a billing system because entry of the clinical diagnosis and the coding task are part of the same process (that is, the code is also the diagnosis used by the

As the amount of information entered into EpicCare increases, the need for the paper chart continues to decrease.

clinician in the care of the patient) and the diagnosis entered by the clinician is matched against a list of more than 4000 International Classification of Diseases, ninth revision (ICD-9) codes.

- Implementing prevention guidelines and providing information more efficiently. By developing prevention and summary views of patient information through the RRS, KPNW makes it easier for clinicians to review clinical patient data and organizational guidelines that can help them take appropriate action.

- Using diagnosis and treatment guidelines. When a clinician orders a diagnostic test, information specific to that test is displayed, prompting and educating the clinician on appropriate actions. This information includes the appropriate indications for a test, the workup needed before the test is ordered, and the necessary patient preparation. When prescribing a drug, a clinician can enter a diagnosis and have the system display the appropriate medications for that condition. In this way, we seamlessly embed organizational guidelines into the process of care.

When prescribing a drug, a clinician can enter a diagnosis and have the system display the appropriate medications for that condition.

- Managing security and confidentiality. We have developed security and confidentiality safeguards that balance the patient's need for confidentiality with the organization's need to make information easily accessible to medical care providers. Extensive, detailed audit logs of every action taken with the CPR are the means by which the organization can investigate real or suspected breaches of confidentiality and thus enforce confidentiality policies.

- Collaborating with a responsive vendor. This is a key facet of a system implementation, especially if the product is not completely mature. In addition, every organization has different issues with respect to such things as ancillary system interfaces and information process flows, and the vendor and product must be flexible enough to support the different workflow processes that are encountered. We were fortunate to find an effective vendor and a product that was able to support our workflow processes.

Discussion

Despite much activity and interest, few attempts to implement a comprehensive CPR that includes clinician progress-note entry, diagnosis and problem list maintenance, and direct prescription and order entry, on a large scale, have met with success (7–9). Some successful implementations of electronic records do not include direct progress-note charting or order entry but rather use a paper interface and have data entered into the computer later by clerical personnel (10, 11). Few systems involve the direct entry of orders into a clinical information system (12). There are several reasons, in addition to our responses to the challenges enumerated above, why we have succeeded where many others have failed.

Each Kaiser Permanente Division consists of two separate but closely cooperating organizations: 1) Kaiser Foundation Hospitals and Health Plan and 2) a local Permanente medical group. These two organizations have a mutually exclusive agreement to work together as Kaiser Permanente. Their collaboration is a cooperative endeavor among representatives of medicine and management, and the responsibility for organizing, financing, and delivering quality prepaid health-care services to capitated health plan members is shared. This organizational structure and relatively closed capitated delivery system give KPNW many advantages in the deployment of clinical information systems.

First, we are a vertically integrated health care delivery system, providing the vast majority of health care services—including laboratory and radiology tests, primary and specialty care, and pharmacy services—under one umbrella. Each ancillary service is therefore supported by a single information system. Because only one interface is needed between the CPR and each ancillary system, the job of building interfaces is much easier than it is for most organizations. It is not necessary for us to take on the difficult tasks of constructing a single reference vocabulary and maintaining appropriate mapping between the terms used by multiple evolving ancillary systems and the reference vocabulary.

Second, because we have a capitated prepaid membership, members receive most of their care

through KPNW. Therefore, information about members in the organization's systems is, for the most part, complete.

Third, physicians and other clinicians are employees of KPNW, so it is easier for us to mandate their use of the CPR.

Fourth, because of an exclusive contract between the medical group and Health Plan, all patients seen by KPNW clinicians subscribe to a single insurance plan. The CPR, therefore, does not need to support the various processes of different insurance plans.

Fifth, a strong partnership between physicians and operational staff allows participation and leadership by physicians in developing and implementing a CPR. This strong physician involvement improves the likelihood of acceptance of a CPR by other physicians in the organization.

Implementation of a comprehensive CPR requires substantial training and effort on the part of clinicians. By initially implementing a read-only clinical data repository, we were able to facilitate later clinician acceptance of the comprehensive CPR. The first phase of implementation—making all computerized clinical data available to the clinician quickly and easily—clearly showed clinicians that computer technology could improve patient care. This phase, we believe, was instrumental in improving clinician attitudes toward automation and setting the stage for eventual acceptance of the comprehensive CPR.

Strong and unwavering support from senior managers and the hiring of a senior manager–physician director who had direct oversight of CPR activities were critical factors in allowing the organization to make the quick decisions that were necessary in the implementation of something as complex as a comprehensive CPR.

Finally, we were fortunate to have a good team of strong project managers and clinician leaders that were able to take effective action in the direction necessary for successful deployment of a CPR. We believe that our implementation of a comprehensive CPR is the first vendor-supplied system that has been fully deployed in a large, integrated HMO.

Health care organizations in the United States are on the cusp of a revolution in the computerization of health care delivery. After years of false starts and failed expectations, a comprehensive CPR can now be implemented and used by clinicians. The many barriers to successful deployment of the CPR are slowly eroding as health care organizations and CPR vendors incorporate their experience and the latest technical advances into their products. With a firm electronic foundation in place, KPNW is now poised to continue to leverage this technology in the areas of integrated decision support, improved practice efficiency, and data collection for outcomes analysis and research.

Health care organizations in the United States are on the cusp of a revolution in the computerization of health care delivery.

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The HMO Group Announces New Name

An alliance of the nation's leading not-for-profit and provider-based health plans has announced that it has adopted a new name: Alliance of Community Health Plans. Established in 1984 as "The HMO Group," the Alliance of Community Health Plans (ACHP) comprises 26 leading health plans that serve more than six million Americans in 26 states. Together, these plans work with approximately 100,000 physicians in thousands of communities nationwide. The new name better reflects the group's mission to improve the health of individuals and local communities.

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