



The Comprehensive Computer-Based Patient Record (CPR)

Kaiser Permanente Northwest (KPNW) has implemented a comprehensive outpatient computer-based patient record (CPR). This CPR is not only an electronic version of the outpatient medical record, it also automates all information transmission processes in the outpatient setting. Clinicians use this system to electronically order laboratory tests, radiology tests, and prescriptions. Clinicians also use this CPR to document encounters, code diagnoses and procedures, maintain problem lists, and to send patient-specific messages and referrals to other medical providers. Many guidelines, reminders, and medication suggestions are provided to the clinician as they use the system to order, refer, and prescribe. All permanently employed KPNW clinicians, totaling more than 700, in over 20 medical and surgical specialties in 31 geographically separate locations, as well as 2600 support staff, used EpicCare as a foundation on which to deliver and document medical care. Healthcare for KPNW's entire membership of 440,000 is now provided through this system.

The impact of this CPR has been assessed by user surveys, process/outcome measures, utilization/cost measures, and impact on support functions; all show a pattern of significant improvement. Specific examples of improved care include outcomes data concerning breast and cervical cancer screening, and diabetic glucose monitoring and control. Cost benefits have included impact on outpatient visits, laboratory tests, pharmacy use, diagnostic testing, improved access to specialty care, and impact on support functions such as chart pulls and phone calls to the laboratory. The system has received national media recognition and demonstrates that implementing a CPR can profoundly influence delivery of an integrated care experience and improve the provision of cost-effective, evidence-based care.

KPNW's CPR system has two key components: An extensive Results Reporting System (RRS), which was implemented in 1993, and a comprehensive outpatient computer-based patient record, called EpicCare, which was implemented over the years 1994-1997. The Team Members for this project are shown in Table 1.

Background

In 1992, KPNW was struggling to maintain market share in the highly competitive Portland Local Market Area. Market share and customer satisfaction were dropping while rates were rising. Before this time, little incentive existed to collect data on diagnoses or procedures, but the advent of large purchasers in the health care market exerted pressure on KPNW to justify rate increases and demonstrate value. KPNW also recognized the need to improve its understanding of care processes and outcomes to more effectively manage the costs of providing care. KPNW thus adopted renewed emphasis on automation and data collection to improve ability to provide cost-effective, evidence-based care.

KPNW leaders believe the ability to deliver integrated care distinguishes KPNW from all other managed care organizations in the community. A key aspect of integrated care is having members' medical information available at any time and place they seek care. Not having members' medical information

at these encounters contributes to inconsistent, incomplete, redundant, and unnecessary care. Members state they "want to be known" and expect that Kaiser Permanente clinicians and staff will have quick access to comprehensive medical information at the time of an encounter. The availability of comprehensive clinical information is the basis for providing the integrated care experience that is necessary to meet quality, financial, and customer satisfaction goals and to respond to purchasers.

Prompted by the need to better integrate and provide cost-effective care, KPNW began implementing a comprehensive computer-based patient record (CPR)—beginning with an extensive Results Reporting System (RRS) and then followed by an electronic outpatient medical record, EpicCare.

Shared leadership by the Medical Group and the Health Plan, led by Allan Weiland, MD, and Michael Katcher, was the foundation for successful implementation of this comprehensive CPR. Senior leaders put in place a formal governance process for information services. A regional Information Services Steering Committee (ISSC), composed of senior managers from the Health Plan and the Medical Group, was formed to develop strategic plans and capital budgets for information services. In 1993, Northwest Permanente hired an assistant medical director trained in medical informatics, Homer Chin, MD, with responsibility for clinical systems. To accelerate CPR

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“The RRS merged all electronically accessible and clinically relevant data into a single patient-centered database.”

Table 1. Team members - Comprehensive Computer-based Patient Record (CPR) system		
Northwest Permanente Medical Group	Northwest Information Technology	KPNW Health Plan Operators
Homer Chin, MD (Contact Person) Internal Medicine Medical Director, Clinical Information Systems	Dan Azevedo, BS IT Director, KPNW Division	Dawn Hayami, MS Project Director, Healthcare Analytics, Kaiser/Group Health
Larry Dworkin, MD Pathology	Mariene Brannon, BA Project Leader	Peggy McClure, MS, MBA Manager, Health Systems and Call Center
Michael Krall, MD Family Practice Lead Physician, Clinical Information Systems Project	Marla Dearing, BA Manager, Customer Service and Training	Nan Robertson, RPh CIS Manager
Philip Marshall, MD Fellow, Center for Health Research	Brad Hochhalter, BA National Project Manager (Convergent Medical Terminology Project and Data Warehouse Planning)	Nick Socotch, RN CIS Implementation Specialist
John Pearson, MD Chief, Pediatrics	Gary Huscher, BS, MBA Application Group Manager	Jacquie Zehner, ART, BA Director of Medical Records Technical Services
Paul Wallace, MD Director, Clinical Practice Guideline Program Chairman, Clinical Strategies Integration Group Medical Oncology	Twila Mysinger, BS Assistant to IT Director, KPNW Division	
Richard Wong, MD Obstetrics & Gynecology	Debi Weiss, BS Application Manager	

development and implementation, a sponsor group of senior managers was formed—two from the Health Plan and two from the Medical Group—together with the Director of the Information Services Department. Although this sponsor group reported directly to the regional manager and medical director, most members were also on the ISSC. This overlapping membership ensured the alignment of CPR activities with the organization’s information services strategy. Project sponsors then selected a cross-disciplinary project team to develop and implement the CPR.

Phase one of the CPR development was implementation of the RRS as a single data repository to tie the data from 24 separate departmental systems together. Beta testing began in 1992, and full rollout was completed in 1994. The RRS merged all electronically

accessible and clinically relevant data into a single patient-centered database. This database included basic demographic and benefits data, outpatient pharmacy data, all dictated reports, laboratory data, Tumor Registry data, and appointment and inpatient admission-discharge-transfer (ADT) data. Transcribed data, from within KPNW and from affiliated hospitals, are available through the RRS. The success of RRS with clinicians helped pave the way for their acceptance of EpicCare, the more comprehensive component of the CPR.

Phase two of the CPR development was implementation of EpicCare that began in mid-1994 with pilots in two locations. EpicCare automates all outpatient documentation, ordering, and messaging processes. Concurrent with onsite implementation,



KPNW worked closely with the vendor to further develop the EpicCare product/application. After requested enhancements were incorporated in a new release of the system in early 1995, the project team began full deployment. By year-end 1996, all KPNW primary care clinicians—internists, family practitioners, and pediatricians—were regular users for essentially all outpatient primary care visits. Rollout for KPNW’s specialists—at the rate of 50 per month—began toward the end of 1996 and continued in 1997. When patient confidentiality issues were resolved, mental health and chemical dependency clinicians joined the ranks of EpicCare users. Since year-end 1997, all permanently employed staff of KPNW are using the CPR.

Objectives

KPNW leaders expected the clinical information system to meet these objectives:

- Provide data for external reporting (HEDIS, HCFA), billing, clinical quality improvement, population-based care, outcome analysis, and performance-based incentives.
- Increase efficiencies of care through timely access to patient information and automation of processes (ordering, prescriptions, specialty referrals).
- Create a foundation on which to build mechanisms to increase appropriateness of care and reduce variation in care processes.

Scope/Significance

By 1998, the CPR was being used by KPNW’s entire care delivery staff of over 700 primary and specialty care physicians and affiliated clinicians, representing more than 29 medical and surgical specialties, and by over 3000 support staff, including nurses, social workers, clinic assistants, clinical pharmacists, lab and radiology technicians, dietitians, physical therapists, and others. Available in every location where KPNW patients seek care at 25 KPNW sites and six affiliated community hospitals, the CPR is used for all outpatient encounters—with the exception of some emergency and urgency care visits and a portion of visits involving physicians-in-training or locum tenens physicians. The CPR contains detailed information on over four million office visits and over 2.5 million telephone encounters, some dating back to the EpicCare pilot implementation in 1994.

Implementing the CPR has yielded other clinical and operational changes as well. Clinicians now use EpicCare as their clinical documentation and communication tool. Clinicians document encounters, code diagnoses and procedures, enter progress notes, document telephone encounters, maintain problem lists, order laboratory and radiology tests, send prescriptions, and use the system to send and receive patient-specific messages, phone calls, and referrals. Clinicians have timely and comprehensive access to laboratory results, imaging findings, dictated reports (including all transcribed reports on KP members cared for in affiliated hospitals), dispensed medications, problem lists, progress notes, records of phone

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Figure 1. Data captured by EpicCare

Data contained in EpicCare include:

- Diagnoses (ICD-9-CM-coded with optional descriptor modification).
- Problem lists, generated from ICD-9-CM-coded diagnoses.
- Past history, generated from ICD-9-CM or CPT codes.
- Medication lists, active and inactive, and continuously updated as ordered.
- Orders: laboratory (cytology, clinical lab, pathology); imaging (x-ray, MRI, CT, nuclear medicine, mammography, ECG); prescriptions and injections; and internal referrals.
- Results: laboratory, imaging, and consult reports.
- Reason for visit, vitals, exam room procedures, assessment, treatment plan, and recommended return interval.
- Telephone encounters, reason for call, and letters.
- Annotated drawing images for clinic notes.
- Record of immunizations, allergy agents, smoking status.
- Narrative notes (may be transcribed from dictation or entered from keyboard) include progress, telephone advice, care-plan notes, and patient instructions.



Figure 2. CPR support of high-priority conditions

Conditions/Clinical Practice Guidelines	Results Report (Summary Screen)	Drug Ordering: Panels and "SmartRx"	Decision Support in Imaging Comments Field	"Smart Sets"	Member Instructions and Information	Alerts	Outreach
Acid peptic disorders		x	x		x		
Asthma		x		x	x		
Low back pain			x	x	x		
Dyslipidemia	x	x		x			
Breast cancer screening	x			x	x	x	x
Cervical cancer screening	x			x	x	x	x
Retinopathy screening	x						x
Diabetic glycemic control	x	x		x	x	x	
Hypertension		x		x	x		
Depression		x		x	x		
Headache		x	x	x	x		

contacts, and more (Figure 1). Clinicians and staff enjoy exceptional access to patient data—no matter when or where patients are seen; whether or not they have a scheduled appointment; and whether or not the contact is in person, by phone, through an advice nurse, or even via e-mail.

Clinicians take advantage of inherent system features as well as of KPNW-designed embedded decision supports to improve efficiency of and decrease variation in the ordering process.

Relevance to Patient Care

CPR implementation provided the infrastructure to improve processes that support the delivery of cost-effective, evidence-based care. The ready availability of patient data paired with embedded decision supports in the ordering process has increased efficiency and appropriateness of care.

The CPR supports the work of the Prevention Steering Committee in meeting Local Market Area performance targets for breast and cervical cancer screen-

ing. A comprehensive prevention summary report in RRS routinely printed for clinician review before an office visit gives dates of the patient's most recent mammogram, Pap smear, immunizations, and trended laboratory data along with appropriate testing intervals for the particular member. The After-Visit-Summary (AVS), printed and given to a patient at the end of a medical office visit, includes health promotion and prevention messages as appropriate. Data in the CPR are used to identify women who are overdue for mammography and Pap screening who are placed in the Prevention Safety Net. Tumor Registry staff then initiate outreach to these women and soon will be able to store exclusion data (eg, previous total hysterectomy, screening done through an outside health plan) in EpicCare. Since mid-1998, all clinicians who log on to EpicCare are presented with breast and cervical cancer Safety Net alerts if the particular member is overdue for screening.

The CPR supports disease-focused, population-based care. Reliable data from multiple databases are



used to develop patient registries and reports that track the status of members on these registries. For the diabetes population, the CPR has contributed to improve performance in meeting Local Market Area targets for glucose monitoring and control. Using hospital admission and outpatient visit diagnosis data along with laboratory and pharmacy data, KPNW has identified over 15,000 active members with diabetes for inclusion in the Diabetes Registry. A comprehensive Diabetes Summary Report in RRS, routinely printed for clinician review before an office visit, lists the most recent laboratory results (glucose, glycosylated hemoglobin, renal function) and date of most recent eye exam. Clinicians and diabetes care managers use quarterly aggregate reports of recent test results for diabetic members in their panel to guide outreach activities. The CPR supports many other high-priority clinical conditions (Figure 2).

EpicCare supports optimal, cost-effective prescribing of medications consistent with clinical practice guidelines. KPNW has developed over 50 "Smart Rx" that provide guidance on recommended medications for a given diagnosis. EpicCare also automatically prompts the clinician with the preferred medication when an order is being written for a medication either not on the KPNW formulary or not KP's preferred alternative. KPNW has developed over 400 of these alternative prompts.

Embedded guidelines displayed at the time the clinician orders an imaging test have influenced both the volume and appropriateness of upper gastrointestinal tract (UGI) and chest x-ray film orders. Clinicians can also easily connect to medical information resources from their EpicCare workstation. They can access over 200 KPNW-developed clinical practice guidelines and decision support references on the KPNW Intranet. External guidelines and other information resources are accessible via the Internet. Embedded guidelines help the referral process by informing the referring clinician of the appropriate indications for referral, who to call for urgent referrals, and what tests to order for the referring indication.

Figure 3 shows the decision support tools embedded in both RRS and EpicCare. Embedded within EpicCare are supports including default medication ordering, formulary information, smart Rx, smart sets, image ordering, internal referrals to specialty care, health maintenance alerts, and reminders. Within RRS, there is a V3 Summary Report with information and guidelines. In addition, with our integrated EpicCare

workstations, clinicians have immediate access to medical textbooks, Micromedex, Medline, CME offerings, drug information, and patient information handouts as well as to all medical resources generally available over the Internet. The CPR also enhances care through the production of after-visit summaries, support for a yellow/red-dot tumor registry altering system, and a diabetes registry of other population-based care initiatives.

The processes, tools, techniques, and practices used to design implementation, train and support clinicians and staff, and then implement and maintain the KPNW CPR are general learnings being shared with the National CIS functional teams to assist in implementation of a Program-wide CPR. For the most part, learnings are not dependent on the software selected. The improvements in implementing evidence-based medicine and clinical decision-making that KPNW has achieved and continues to advance can be generalized to other CPR implementations.

Innovation Leadership

The KPNW CPR Implementation Team has evaluated its CPR system often and has shared findings in many presentations and numerous published articles (see Publications). The Clinical Practice Guidelines Program presented the use and impact of embedded guidelines at the Institute for Healthcare Improvement Congress. Various local and national publications have featured the benefits KPNW has achieved through the CPR (see Publications). The KPNW CPR has also been used as the basis for two master's thesis projects.

KPNW's CPR has been recognized as a national best practice and was one of two recipients of the Computer-based Patient Record Institute's Davies Award in 1998. It is the largest installed comprehensive ambulatory CPR in the world.

Methodology and Results

Evaluation of RRS and EpicCare's impact on a complex and dynamic organization is a daunting task. KPNW chose a set of comprehensive and complementary approaches to measure CPR's impact from many different perspectives: user surveys, processes and outcomes of care for large populations, utilization/cost, and impact on support functions. Measurement of a wide range of processes and outcomes, which are integrated through and dependent on the CPR, demonstrates a consistent pattern of significant improvement.

"The CPR supports disease-focused, population-based care. Reliable data from multiple databases are used to develop patient registries and reports that track the status of members on these registries."



Figure 3. CPR features and patient care processes enhanced by the CPR

Defaults (medication ordering)	<ul style="list-style-type: none"> Includes default instructions, package sizes, and number of refills for commonly prescribed medications.
Formulary-based drug benefit (medication ordering)	<ul style="list-style-type: none"> Clinicians ordering prescriptions either not on formulary or not organizationally preferred medication receive message suggesting alternative preferred product. For example, when prescribing Zoloft for depression, EpicCare will suggest more cost-effective alternatives.
"SmartRx" (medication ordering)	<ul style="list-style-type: none"> Provide guidance on recommended medications for given diagnosis, for example, clinician who wants to order medication for sinusitis enters "sinusitis" in medication field to learn recommended drugs in priority order. Mouse click completes the order. Similarly, clinician can order multidrug therapy for <i>Helicobacter pylori</i> quickly and accurately with entry of "h pylori" in medication field. More than 50 "SmartRx" aids are available, and KPNW continues to develop more.
"Smart sets"	<ul style="list-style-type: none"> Utility that supports guidelines by bringing together diagnoses, lab and imaging orders, medication and procedure orders, patient information, and supporting documentation to single tailored screen from which clinician can select appropriate items for patient. This feature helps insure complete documentation of all aspects of visit.
Image ordering	<ul style="list-style-type: none"> For many imaging tests, organization's guidelines are displayed at time clinician orders test. CPR intervention is complemented by periodic feedback to clinicians on both test ordering frequency compared with their peers and percentage time their ordering indications fall outside organizational guidelines.
Referrals to specialty care	<ul style="list-style-type: none"> Guideline information embedded in order pathway provides guidance to referring clinician in appropriate indications for referral, who to call for urgent referrals, what tests to order for referring indication.
Prevention Safety Net	<ul style="list-style-type: none"> Prevention Committee relies on data in CPR to identify women overdue for mammography and Pap screening. Tumor Registry then initiates outreach to these women in the Prevention Safety Net and soon will be able to store exclusion data in EpicCare. CPR provides capability necessary to conduct Safety Net outreach. Beginning mid-1998, all clinicians who log onto EpicCare are presented with reminder at patient contact for members who are in cervical and breast cancer screening Safety Net.
Reports/Summaries	<ul style="list-style-type: none"> Reports and summaries group relevant sets of clinical data about patient and are tailored to incorporate organizational guidelines for decision support. These reports and summaries are routinely printed for clinician review before office visit. Comprehensive summary report in RRS gives dates of patient's most recent mammogram, Pap smear, immunizations, and trended laboratory data along with appropriate testing intervals for particular member. For diabetic patients, report includes most recent laboratory data (glucose, glycosylated hemoglobin, and renal function), dates of most recent eye exam, primary care visit, and emergency room visit. Clinicians can also display encounter data by diagnosis, reason for visit, specialty, or provider.
Medical reference links	<ul style="list-style-type: none"> Each clinician has workstation web browser that is used to access KPNW Intranet resources and Internet. KPNW constructed an Intranet web page that includes collection of 32 clinical practice guidelines, more than 200 other decision-support references, referral protocols for all KPNW departments, and links to Internet reference sources.
After-visit summary (AVS)	<ul style="list-style-type: none"> Printed and given to patient at end of medical office visit. Reinforces patient teaching and provides additional reference information for member's review at home. Can easily have standard text for important conditions added at discretion of clinician. Can include health promotion and prevention messages appropriate for member. Can include educational messages about scheduled referral or procedure.
Yellow/red-dot system	<ul style="list-style-type: none"> CPR augments Tumor Registry's ability to follow up abnormal laboratory and radiology findings and initiate outreach efforts to bring members back for repeat or further testing to confirm or rule out diagnosis of cancer. Suspicious findings identified by Radiology clinicians are labeled as "yellow-dot" exams and entered in Tumor Registry. Tumor Registry staff monitor and insure timely follow-up on yellow-dot studies. Studies suggestive of diagnosis of cancer are labeled as "red-dot" exams and entered in Tumor Registry to insure timely completion of appropriate diagnostic work-up according to protocols developed by clinicians and Cancer Committee.
Population-based care Diabetes Registry	<ul style="list-style-type: none"> Reliable data from multiple databases are used to develop patient registries and reports that track the status of patients on these registries. Epicare's capability for messaging and notation supports a team approach among physicians, allied health practitioners, nurses, and care managers. Using pharmacy, admission, and visit diagnosis data, KPNW has identified with estimated greater than 99% sensitivity and specificity 15,000 active diabetic members. Clinicians and diabetes care managers receive quarterly aggregate of health status and recent test results for diabetic patients in their panels. Published guidelines for managing diabetes are available on KPNW Intranet. KARE (appointment system) flag for diabetes alerts medical office staff at patient visit about possible need for diabetic-focused exams and possible need for diabetes-related testing. Other populations benefiting from registry functions include cardiovascular, anticoagulation, and asthma.



Clinician Acceptance

Clinicians were surveyed two and four months after the EpicCare system was implemented. At two months, 38% of the clinicians agreed with the statement, "EpicCare is worth the time and effort required to use it." At four months, the proportion had increased to 86%. At four months, 89% of clini-

cians disagreed with the statement, "If given the choice, I would return to the old (paper-based) system." The survey showed that clinician attitudes became increasingly positive as they developed proficiency with the system.

Patient Acceptance

EpicCare implementation improved patient satisfaction by allowing clinicians to print out patient-specific instructions on the After-Visit-Summary and by decreasing the waiting time for prescriptions and laboratory tests. Sixty-three percent of clinicians four months after implementation agreed with the statement "Patients seem more satisfied now that I am using EpicCare." Only 6% disagreed with that statement.

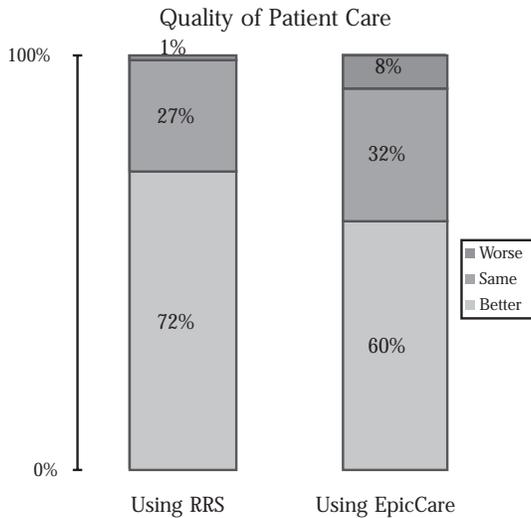


Figure 4. Clinician perception of effect on quality

Clinician Perception of Quality

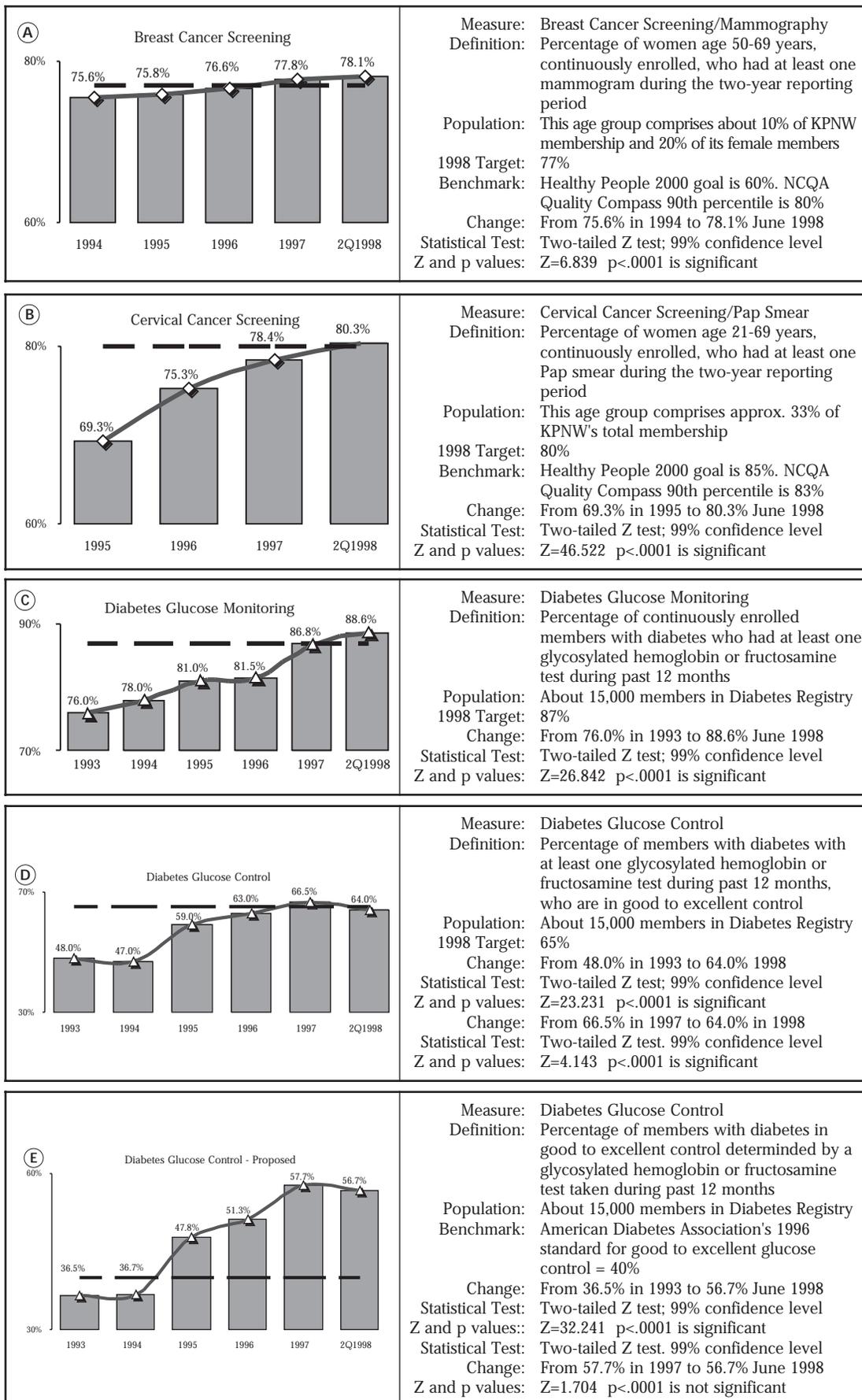
In a cross-sectional study using semi-structured interviews and a survey (N=449), clinicians responded on a 1-5-point scale: (1) Much worse (2) Worse (3) Same (4) Better (5) Much better. Sixty percent of respondents felt that using EpicCare had improved the overall quality of care, compared to 32% who felt that care had not been affected. Seventy-two percent

Figure 5. Clinician perspective of effect on quality: statistics and significance

Survey question	EpicCare mean vs "3.0 - Same" (one-sample test)				RRS mean vs "3.0 = Same" (one-sample test)			
	Test statistic (t)	Mean	df	Sig	Test statistic (t)	Mean	df	Sig
Effect on overall quality of patient care	15.636	3.67	427	<.001	25.624	3.93	424	<.001
Effect on patient-clinician interaction	4.084	3.19	423	<.001	13.846	3.49	420	<.001
Effect on ability to coordinate patient care with other departments and providers	32.43	4.12	423	<.001				
Effect on ability to detect medication errors	15.487	3.55	348	<.001				
Effect on timeliness of referrals	20.329	3.81	408	<.001				
Effect on ability to act on test results in timely way					26.694	4.01	389	<.001

df = degrees of freedom; Sig = Significance

Figure 6. Clinical Quality Charts





of respondents felt that RRS had improved the quality of patient care, compared to 27% who felt care had not been affected. On average, clinicians felt that the CPR had also improved the quality of the patient-clinician interaction, the ability to coordinate the care of patients with other departments, the ability to detect medication errors, the timeliness of referrals, and the ability to act on test results in a timely fashion (see Figures 4 and 5).

Improved Documentation

Northwest Permanente clinicians expressed a high degree of satisfaction with the accuracy, readability, and availability of clinic notes. Eighty-seven percent agreed with the statement that the availability of chart notes had improved with EpicCare. An independent study of primary care records showed that the quantity of information provided in EpicCare notes was at least as good as that found in hand-written notes.

Phone Advice

Of 423 clinicians surveyed in 1997, slightly more than half (51%) thought that EpicCare and RRS contributed to improved telephone advice for patients. Just 16% of respondents thought that the CPR system had not improved telephone advice. In a survey of advice nurses, 90% "strongly agreed" or "agreed" that EpicCare improved documentation, and 100% thought that EpicCare enhanced the delivery of care. In addition, clinicians also reported that the instant accessibility of the record is helpful when they receive calls in the medical office and when they are on call for their practices.

Clinical Quality

Breast/Cervical Cancer Screening (Mammography, Pap Smears)

Rates for both screening exams have improved significantly since implementation of the CPR. In 1998, KPNW was meeting its clinical screening targets for breast cancer at 77%, and cervical cancer at 80% (Figure 6A,B). The effectiveness of the Safety Net process aided by the CPR is shown in the additional cases of breast and cervical cancer identified in this population. Thirty-three cases of breast cancer were found among women in the 1997 Safety Net who were overdue and came in for screening. Likewise, seven cases of invasive cervical cancer were identified in the Safety Net population. KPNW is seeing a decline in the proportion of Safety Net women in the overall eligible population. From 1997

to 1998, the percentage of women overdue for breast cancer screening decreased from 23% to 20%. Similarly, the proportion of women overdue for cervical cancer screening decreased from 22% to 19% of the eligible population.

Diabetic Glucose Monitoring and Glucose Control

In 1998, KPNW was meeting its target of 87% of diabetic members having a glucose control test done annually (Figure 6C). In 1997, KPNW was meeting its 65% target for diabetic members having good to excellent control, though during the first half of 1998, glucose control performance declined slightly (Figure 6D). The Diabetes Steering Committee reviewed additional data and concluded this decline was related to increased screening of the population. In 1999, KPNW is considering redefining its glucose control measure to look for good to excellent glycemic control in all diabetic members, not just those who had a test drawn in the prior 12 months. Performance using this redesigned measure shows steady improvement from 36.5% in 1993 to 56.7% in June 1998 (Figure 6E). Performance on the redesigned measure greatly exceeds the American Diabetes Association's 1996 target of 40% for good to excellent control.

Utilization/Costs

Outpatient Visits

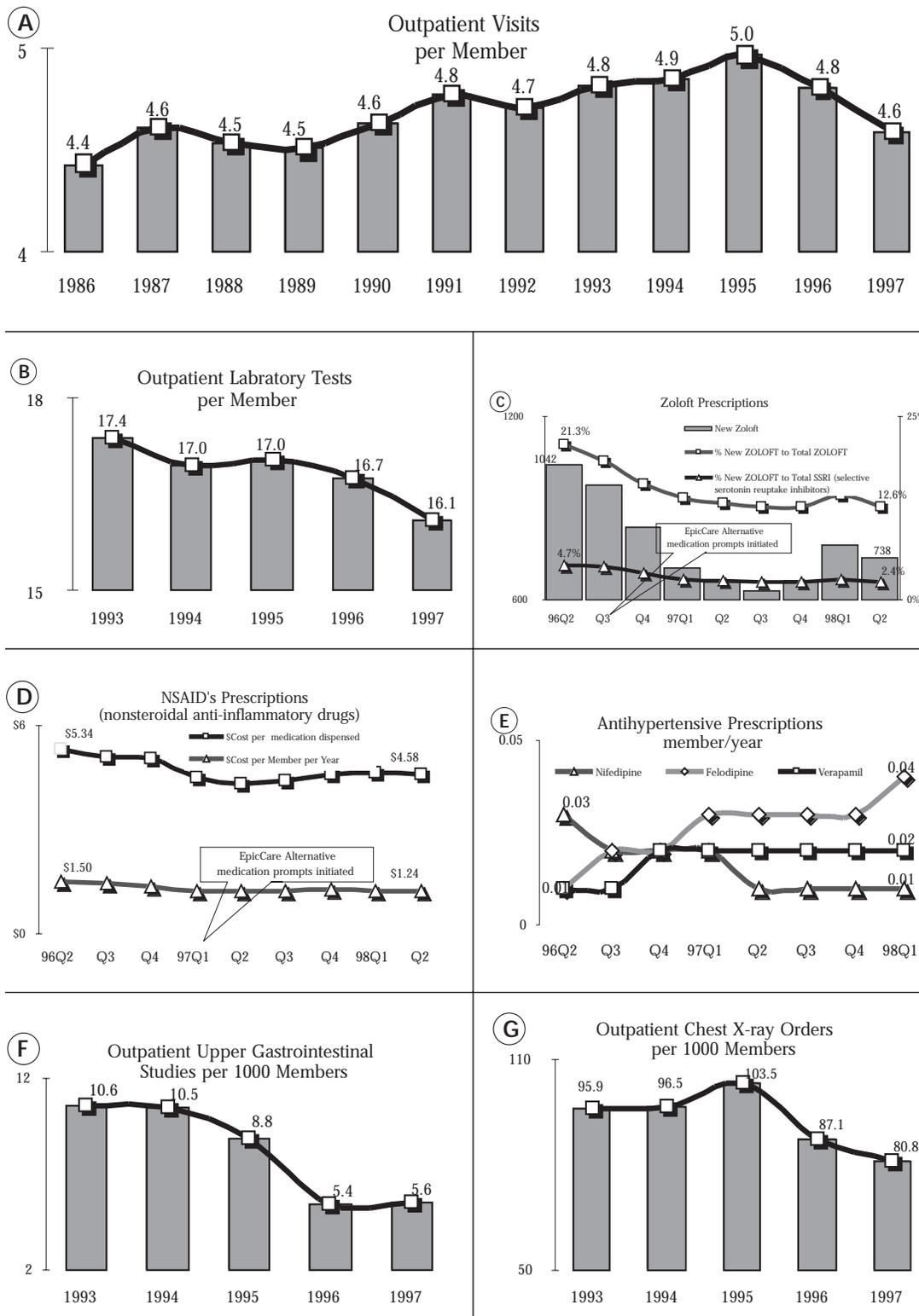
The number of outpatient visits had been gradually increasing over the years to a high of 5.0 visits per member per year in 1995. Since 1995, this number has decreased by 8% with the implementation of EpicCare (Figure 7A). Quick access to patient information, allowing for timely identification and resolution of health issues, often by phone, is probably a major factor in the observed decrease in number of annual visits per member since 1995. We have not tried to determine the cost impact of improvements in utilization. Our membership grew over 12% from 1994 to 1998, and we provided care to our members with no additional medical staff and no worsening of access.

Laboratory Tests

The average number of outpatient lab tests done per member decreased 7.5% from 1993 to 1997 (Figure 7B). This reduction is probably due to the improved ability to access existing results efficiently and reliably, thereby decreasing the number of tests ordered redundantly. We have documented an 8% decrease in lab testing per member but have not costed out the exact dollar savings from this decrease.

"Quick access to patient information, allowing for timely identification and resolution of health issues, often by phone, is probably a major factor in the observed decrease in number of annual visits per member since 1995."

Figure 7. Utilization and cost charts





Pharmacy

KPNW's incorporation of alternative prompts to automatically alert clinicians when medications being ordered are not on the Formulary or are not the organization's preferred alternative has resulted in ordering of less costly, therapeutically preferred medications for certain targeted classes of drugs. Pharmacy has achieved a 29% decrease in the volume of new Zoloft prescriptions dispensed, a 41% decrease in the proportion of new Zoloft to total Zoloft prescriptions dispensed and a 49% reduction in the proportion of new Zoloft to total SSRI prescriptions dispensed (Figure 7C). For nonsteroidal anti-inflammatory drugs (NSAIDs), the pharmacy has brought about a 14% decrease in the average cost per prescription dispensed, a decrease which has resulted in a 17% decline in per member per year cost of NSAIDs. (Figure 7D). The EpicCare alternative functionality successfully supported the initiative to promote use of felodipine or verapamil over nifedipine for antihypertensive therapy (Figure 7E).

Imaging

Clinical practice guidelines embedded in order pathways along with improved ability to easily access existing results have brought about a decrease in certain categories of radiology tests while at the same time improving adherence to guidelines. In a study completed in 1996, the percentage of upper gastrointestinal (UGI) studies ordered in compliance with the guideline rose from 57% to 88%. The volume of outpatient UGI studies has declined by nearly half from 1993 to 1997 (Figure 7F). Outpatient chest x-ray order volume was rising until 1995 and then dropped 22% by 1997 (Figure 7G).

Access to Specialty Care

EpicCare and its embedded decision-support guidelines, along with several other initiatives, have improved timeliness and appropriateness of internal referrals to specialty care. In Spring 1995, 55% of those referred to specialty care were seen within two weeks. By early 1997, that percentage rose to more than 80%. Receipt of referral information has improved from an average of three days to instantaneous upon completion of the referral in EpicCare. Surveyed clinicians (63% of 449 respondents) attributed improved timeliness of referrals to EpicCare.

Impact on Support Functions

Chart Retrieval

Because the medical record is so readily accessible on-line, KPNW is no longer pulling the paper

chart for over 50% of outpatient visits. The number of same day/ad hoc chart pulls has been reduced by more than 250, or 32%, per day. Over the past two years, medical records staff has been reduced by 16 FTEs who pulled charts and did other duties. Beta testers reported that with RRS queries, the need to request an ad hoc chart retrieval decreased by 56%. A recent survey of primary care clinicians showed that 82% no longer wished to have the paper record for "urgent" appointments, and 47% did not want the paper record for "return" appointments.

Phone Calls to Laboratory

The implementation of RRS in 1994 substantially reduced clinician phone calls to the laboratory for results. The volume of calls decreased from 1700/week in January 1993 to 400/week by July 1997, despite a continually increasing volume of orders with membership growth.

Conclusions

KPNW's hypothesis that implementing a comprehensive computer-based patient record could profoundly influence the delivery of an integrated care experience and the provision of cost-effective, evidence-based care has been borne out by many measurement perspectives, and the improvement continues. RRS and EpicCare integrate the delivery of care for KPNW's 430,000 members. Clinicians now have instant access to a comprehensive CPR to enter and retrieve information on any one of 430,000 members who may receive care in any one of 31 inpatient and outpatient settings. In addition, KPNW is able to use EpicCare to provide the clinician with relatively seamless decision support to guide best practice and reduce unnecessary variation. Equally significantly, EpicCare allows the organization to capture clinical data that can be used for business needs, outcomes analysis, and research.

Through its implementation of RRS and EpicCare, KPNW has achieved the Institute of Medicine's definition of a computerized patient record: "An electronic patient record that resides in a system specifically designed to support users by providing accessibility to complete and accurate data, alerts, reminders, clinical decision support systems, links to medical knowledge, and other aids." The infrastructure is in place to continue building processes to increase efficiency and decision supports to enhance the delivery of appropriate care. ❖

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 Publications

Krall MA, Mysinger T, Pearson J, Chin H, McClure P, Collins J. Integrated clinical database in a health maintenance organization. *Medinfo* 1995;8 Pt 1:313-6.

Chin HL, McClure P. Evaluating a comprehensive outpatient clinical information system: a case study and model for system evaluation. *Proc Annu Symp Comput Appl Med Care* 1995: 717-21.

Krall MA. Acceptance and performance by clinicians using an ambulatory electronic medical record in an HMO. *Proc Annu Symp Comput Appl Med Care* 1995: 708-11.

Krall MA, Chin H, Dworkin L, Gabriel K, Wong R. Improving clinician acceptance and use of computerized documentation of coded diagnosis. *Am J Manag Care* 1997;3:597-601.

Chin HL, Krall M. Implementation of a comprehensive computer-based patient record system in Kaiser Permanente's Northwest Region. *MD Comput* 1997;14:41-5.

Krall MA. Achieving clinician use and acceptance of the electronic medical record. *The Permanente J* 1998 Winter 2(1):48-53.

Krall MA, Mysinger T, Pearson J. Utilization and effects of a

results reporting system in an HMO. *Proc AMIA Spring Congress* 1993: 70.

Chin HL, Krall MA, Lester S. Adapting clinical coding systems for the computer-based patient record. *Proc AMIA Annual Fall Symposium* 1997:849.

Schuman E. Coming of age in the age of information. *Journal of the American Academy of Physician Assistants* 1998;11(1):63-6.

Schuman E. Greeting the morning, with comprehensive software. *Journal of the American Academy of Physician Assistants* 1998;11(2):19-28.

Marshall PD, Chin HL. The effects of an electronic medical record on patient care: clinician attitudes in a large HMO. *Proc AMIA Annual Fall Symposium* (in press).

Chin HL, Krall MA. Successful implementation of a comprehensive computer-based patient record in Kaiser Permanente of the Northwest: strategy and experience. *Eff Clin Prac* 1998 Oct-Nov;1(2):51-60.

Sampling of Publications Featuring KPNW's CPR: Fortune magazine, Healthcare Informatics, Healthcare CIO Report, Oregonian, Business Journal, and others

Educational Experience

"Education is when you read the fine print;
Experience is what you get when you don't."

Pete Seeger, Folk Singer