Kaiser Permanente HealthConnect®
HIMSS Davies Award 2011
(Full application with added information post-award)

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MANAGEMENT

1-EHR System Planning

a. EHR Vision, Goals & Objectives: The goal of KP HealthConnect was lofty: transform care and service delivery. To do that, Kaiser Permanente needed to define its vision of the future of health care. This would become the Blue Sky Vision. The Blue Sky Vision concluded that in 2015 "a successful health organization would recognize that the true primary care provider has always been the patient and his or her network of family and friends. The patient's home would be the center of early diagnostics and service, with care givers serving as advisors on service options, clinical efficacy, genetic profile influence, and cost considerations. The Blue Sky Vision, they further concluded, could be achieved with technology that already existed, including long-standing technology such as the telephone. … Four themes comprised this new vision of health care delivery in the future:
Home as the Hub: The home and other nontraditional settings would grow significantly as locales of choice for care delivery, and a patient's care delivery team would expand beyond the physician and other traditional care givers to include other community and family resources.
Integration and Leveraging: Medical services to combat disease would be integrated with wellness activities to enhance overall quality of life as well as prevent and stem the onset of disease. Information technology would provide the vehicle to enable the leveraging of specialized clinical resources and increase patient and family involvement in care.
Secure and Seamless Transition: Technology would allow the care giver to provide better informed and more efficient care to each patient. The computer would not replace human interaction, but enrich it by full availability of integrated longitudinal patient information coupled with the best knowledge and recommendations science could offer.
Customization: Patients would become true partners in their health. Customer-centric care would be at the patients' convenience and customized to their specific health status and personal preferences, leading to a deeper understanding by patients of the care they are receiving and a stronger relationship with their clinicians.

Once the four themes were identified, another set of Blue Sky participants took up the assignment of identifying the range of practical and actionable steps and technologies that would change processes and mobilize the Kaiser Permanente workforce to achieve significant progress on the Blue Sky Vision within five years (by 2008). … They discussed operational implications for KP across five categories: business and clinical processes, technology, information and knowledge management, facilities, and people. Their operational imperative was to make this new era of care delivery as simple, seamless, and intuitive as possible for the patient. It recognized the patient as leader and/or partner in deciding his or her care and the home as the center for much of the care delivery. It also recognized that in the future, care givers would need to adapt to the patient's preferences for receiving information either electronically, by telephone, in person, or all three, depending on the nature of the information. And they would need to share, if not relinquish, the reins in deciding on the patient's health care path… We knew that KP HealthConnect could be the platform to achieve the Blue Sky Vision." (C*onnected for Health*) This was not approached as an IT project. The primary goal was to enable talented clinicians to provide better care to patients, correlating with the "KP Promise"—our commitment to high quality, personalized, convenient, and affordable care.

Achieving the Blue Sky Vision

The first part of our vision was to focus on and complete the implementation of our electronic health record (EHR). Here is how we know its working:

- More than 3.7 million Kaiser Permanente members, 60 percent of the eligible population, have activated their Personal Health Record (PHR) on kp.org, making it one of the most actively used PHRs in the world.
- In Q211 alone, nearly 26 million visits were made to kp.org and more than 188,000 new members registered for access to My Health Manager.
- More than 40 percent of PHR users signed-on five or more times in the last six months.
- Today, more than 850,000 secure e-mail messages are sent each month to Kaiser Permanente doctors and clinicians, demonstrating growing consumer interest in e-visits.
- In just the first two quarters of 2011, more than 14 million lab test results have been viewed online by Kaiser Permanente members.
- In just the first two quarters of 2011, more than 4.7 million prescriptions have been refilled online.
- The BIG Q dashboard incorporates many quality and core value metrics, including improvements from the implementation of EHR, however our EHR is just one of many tools we use to gauge metrics.
- Another source is our member/patient decision support tools, which are available online 24/7.
- These tools help our members/patients take proactive and positive health action.
- Members registered on My Health Manager have access to a wide variety of programs to help them lead healthier lifestyles.
- These include programs that help with weight loss, diabetes management, smoking cessation, and pain management.

b. Leadership & Governance: George Halvorson joined KP in May 2002 with a strong point of view on health care IT. Halvorson had "a long history as the innovative CEO of Health Partners in Minneapolis, nationally known for its commitment to integrated quality care. His leadership in the National Committee for Quality Assurance's development of HEDIS, one of the first tools to provide comparative measures of health care quality and service, was already a well-established part of his legacy in improving health care at a national level." (*Connected for Health*) He believed KP had an obligation to leverage its integration through health IT. KP had always been a leader in health IT. In fact, three regions had already been awarded the Davies Award for implementing their versions of an electronic health record system—KP-Ohio (1997), KP-Northwest (1998), and KP-Colorado (1999). We knew that implementation would surface many procedural issues. To meet the aggressive timeline set forth in the planning stages, KP leaders needed to address issues in new ways. Regional coordination, always a priority and often a challenge, would be integral to the project's success. One way we approached that task was with the creation of the Joint Operating Group (JOG), comprised of operational leaders from programs such as HR, finance, IT, labor-management partnership, medical groups, marketing, and operations. The group met each week. "There was no precedent, no blueprint, for a venture like KP HealthConnect. In fact, it might have been exactly such uncertainty that set the stage for the old paradigm to shift from eight siloed regions with a loose relationship to national functions

to the KP HealthConnect national team helping the regional project teams to achieve a successful implementation." (*Connected for Health*) See appendix 1 for organizational charts.

c. Key Stakeholder Involvement: "Sponsorship was required at the highest levels of the organization, both nationally and regionally. At the national level, Louise Liang, MD, a senior health plan executive, was named to lead the KP HealthConnect project. She was accountable for the budget and timeline and reported directly to the CEO and the board of directors. In addition, the Permanente Federation named Andy M. Wiesenthal, MD, a senior physician executive with a background in quality improvement and IT implementations, to partner directly with Liang. The health plan's chief information officer, Clifford Dodd, was also named as a sponsor to ensure that the IT organization's resources, systems, and processes were in alignment and would provide the necessary support for the initiative." (*Connected for Health*) It was also important to involve representatives of KP's labor union partners. In 1997, KP established the Labor Management Partnership (LMP), a coalition of 26 local unions representing 90,000+ employees. Since implementation would affect most roles in the organization, LMP's involvement was key to our success, which prompted the designation of a full-time staff person on the national team as LMP's representative. Each region also included union representation on its project teams.

d. Needs Identification & System Acquisition: KP needed to find software that would standardize systems across regions, while providing high value tools to improve care quality. It had to be robust enough to unify hundreds of medical offices, dozens of hospitals, and online patient access supporting 8.6 million members. Two vendors could undertake a project of this kind. "One of them was the leading vendor for hospital systems, but had limited experience with ambulatory applications. The other, Epic Systems, was the leading software vendor for ambulatory EHRs and administrative systems, but had only limited experience with hospital applications. Neither vendor had fully implemented its integrated ambulatory/hospital/personal health record software in any health care organization. Neither had worked with a system as large as KP, and there was uncertainty about whether the software from any vendor could be scaled to meet the demands of our size and multi-regional structure. The selection process was exhaustive, including site visits to health care organizations using the systems, such as Mayo Clinic and Geisinger, and multiple demonstrations with question-and-answer sessions between the vendors and our physicians, pharmacists, nurses, and IT experts. External benchmarking and the KLAS reports—the equivalent of the 'Consumer Reports' for health IT—added comparative information. Hundreds of people were involved from throughout KP over a period of six months." (*Connected for Health*) Epic was ultimately selected, despite their minimal hospital experience, because of their strengths in user satisfaction with the outpatient record and administrative systems. Adding to the strong support by physicians, Epic's leadership showed a deep understanding of care delivery and was up-front when they could not deliver a function.

e. Business Case: Kaiser Foundation Health Plan and Hospitals Board of Directors "would be understandably rigorous in their review and oversight of the largest capital project in the history of the organization, an estimated $3.2 billion investment (a figure that grew to over $4 billion) over ten years for the initial implementation and ongoing maintenance of the EHR system." (*Connected for Health*) Halvorson was clear that this was a "bet the farm" decision that required significant investments that would compete with other projects. Very few health care organizations had accomplished what KP was attempting in size and scope, so documented value realization of such an undertaking was sparse. The business case was built in part on the

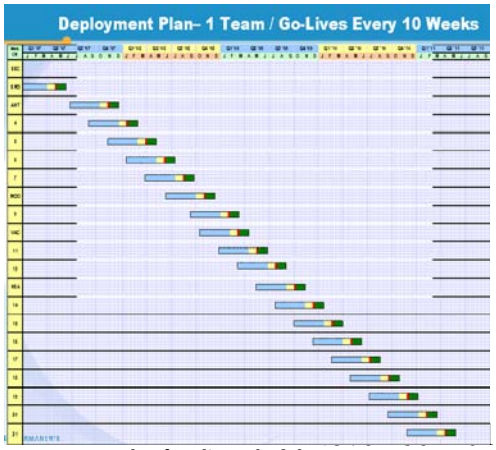
experiences of our Southern CA region and what we could find from other organizations. "In reality, the expanded, fully integrated EHR and related IT systems would support almost 80 percent of the clinical and administrative workflows in the organization, and no one could predict the full nature of the changes, much less the value, that could be gained. Making no assumptions related to increasing member satisfaction, competitive advantage, or growth, the conservative business case made a defensible case that the investment would break even and pay for itself in roughly 8.5 years." Ultimately, the board gave the project more than financial support—it designated the project a number one priority in the business plan for 3 years, linking its development and implementation to every executive's performance goals and incentives.

f. Marketing and Communications: To effectively communicate the vision, implementation and value proposition of the EHR to physicians and staff, KP first had to come up with a name. The naming process was symbolic of the entire implementation, moving from an inconsistent, region-centric decision process to a standard, national decision process with room for regional variation where required. KP HealthConnect was born, reflecting the connection between clinicians and patient, but also symbolizing the connection between different parts of KP. Several strategies were used to support acceptance of KP HealthConnect, including a national communications plan, an intranet site, quarterly inter-regional meetings, and yearly scheduling meetings. The national communications plan established positioning, messages, and strategies to create awareness, build knowledge, manage expectations, motivate users, and build proficiency. A consistent look was developed for materials, which would be used by all regions. The visual continuity reinforced the messaging and ensured consistency. A centralized intranet site supported teams in all regions, housing product demos and configuration documents, meeting schedules, regional project plans, training materials, and a project team directory. As work progressed, it included leadership messages, project progress, and milestones. We also employed weekly e-newsletters; quarterly, in-person meetings; regional communication tactics; and videos.

g. Project Risk Management: KP faced two major challenges during the KP HealthConnect implementation: 1) Regional variation and independence, and 2) A short timeline from vendor selection to implementation. We had very little time from the selection of a vendor to the start of implementation (15 months), which prohibited major workflow redesign. The disparate workflows between regions, medical centers, departments, and physicians, and Epic's belief that an extensive redesign of care delivery was not feasible before implementation meant that we had our work cut out for us. Moving from region-centered development to greater software standardization would alleviate significant boundaries. Epic's prediction proved accurate in many ways, and our aggressive timeline forced us to manage some change pre-implementation.

2-EHR System Implementation

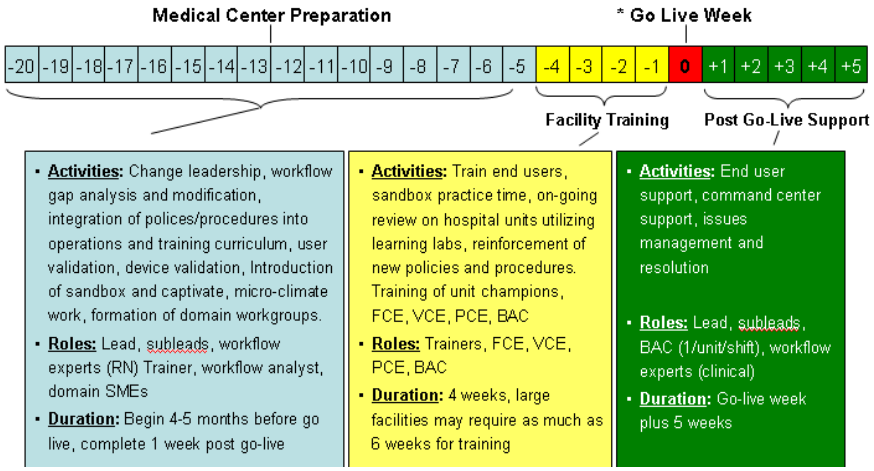
a. Implementation Planning: The KP HealthConnect implementation was a watershed moment for KP in that planning moved from region-specific IT development to a collaborative build process. The collaborative build process involved a national executive steering committee, regional project teams, and Epic Systems. The full participation of all these groups made possible the tight implementation timeline. The vastness of the implementation required



Example of go-live schedule

that it take place one region at a time. The national executive steering committee, in partnership with the regions, worked together to solve conflicts and make adjustments so needs could be met.

b. Implementation Staffing: Partnership between national and regional IT, operational and business leaders, as well as Epic was necessary for a successful outcome. This included collaboration among an operations manager and an IT project manager who reported directly to the executive leaders and sponsors, and worked with the regions. National and regional functions had staff dedicated to the project, and as implementations were completed, seasoned regions would lend staff to regions yet to go-live. Each region built on the experience of the previous. We enlisted a consulting firm to lend expertise at the peak implementation period, and another firm that provided qualified interim staffing for backfill support during training and go-lives. "As parallel regional deployments grew and the number of people involved across the organization reached into the thousands, it became necessary to create an implementation manager position for each region. The managers ensured that communication was sustained between the national team, the regional implementation team, and regional leadership. … The managers worked directly with the regional leadership and team to monitor progress, identify and escalate issues, and ensure that necessary vendor and national resources were available." (*Connected for Health*)



c. Training and Support During Implementation: The true users of the EHR are clinicians and staff. Ensuring their preparedness for adoption was complex and required a great deal of attention. The overall strategy and approach to user training and support during implementation was an extension of a higher level user readiness plan. Ultimately, we needed to be confident that both front line unit leadership and their respective teams had ample opportunity to understand the system's capabilities, work as a team to adjust to new work-flows and processes, develop requisite computer and system skills, build personal clinical content, practice using the system, and gain comfort in using technology with patients present. KP invested heavily in the people side of its implementations, ensuring that the focus wasn't entirely on the technology, which was a key success factor in effective implementations. The user readiness model consisted of a 14-week plan that was executed upon prior to the go-live of each facility. This established a pragmatic foundation for sustainable change, which later proved critical to optimization efforts following installation. The 14-week plan started with 4 weeks focusing on the development of front line leadership, which included a triad relationship of physician lead, nurse supervisor/administrator, and labor steward. The objective was to ensure that all were on the same page, sponsored the effort as a united front, and were prepared to help lead their teams through current and future changes. Triads were targeted by domain of focus or specialty to bring them up to speed on the system and help them with the tools and materials needed to drive the subsequent 10-weeks of

user readiness meetings with their teams, which would be driven by front line leadership with outside coaching from the organization development team. Clinical teams received weekly system demonstrations, discussed workflow changes, learned about downstream impacts of actions, discussed team goals and role expectations, and gained clarification around support throughout the process. End users attended training on system features and functions, compliance, scope of practice, and how to use technology when patients were in the exam room. We ensured that each specialty received job- and role-specific training so physicians and nurses would find the content relevant and useful. In doing so, training was conducted in a practice environment with pre-loaded test patients. The test environment was available to users to practice navigating the system and dress rehearsals were conducted prior to the go live. Dress rehearsals were also very effective for practicing pre-designed and specialty-specific workflows. The duration of training consisted of reduced schedules for clinicians, and comprehensive training in the morning prior to seeing patients. Debrief calls and subsequent training continued for several weeks after going live, allowing for more sophisticated questions.

Pathways to Proficiency

We have developed a robust proficiency improvement program, called Pathway to Proficiency, as a means to identify end users that require more targeted training and education related to system skills, operational workflows, and personalizing clinical content. Pathway to Proficiency has proven to be an effective intervention to help physicians improve their work/life balance as well as provide them the skills required to be successful on the job. Among the myriad of positive feedback received regarding this program, many physicians reported that this effort "saved their careers" and has helped them understand more clearly how KP HealthConnect can help them be more efficient with their In Basket messages.

For physicians we created a 40-hour program called Pathways to Proficiency. We asked chiefs to rank their doctors 1-4, 1 being very proficient and 4 significantly struggling. We required all physicians identified by their chiefs as 4's to attend the P2P classes. This was an incredible success and has been shared with several regions.

MyHelp

A website, called MyHelp, was also developed internally to enable end-users to learn at their own pace. KP HealthConnect training materials (i.e. video demonstrations and other job aids) are accessible and searchable online by skill category or topic of interest. When a Kaiser Permanente end-user logs into MyHelp, the website recognizes which region the user is from and what specific role the user holds. This is important, as the MyHelp website furnishes each end-user with a "prescription" (or curriculum of training materials) that is applicable and relevant to the end-user's job. MyHelp is a robust learning management website that affords trainers the ability to push targeted content and post these training materials within an existing prescription for relevant end-users. If a new initiative is launched, the push content feature is extremely useful to ensure end-users are getting what they need, when they need it.

Regional Perspective - Southern CA: *During initial deployment we trained 55,000+ people on virtually all modules and we trained a large build and deployment and training team of 1,200+ staff over the life of the deployment. We peaked at 300+ trainers while deploying multiple inpatient and ambulatory sites simultaneously. Our approach included training on basic PC*

skills far in advance of application training. The interfaces were turned on long before some providers went live. We offered Mavis Beacon typing software to all providers. We also developed a cadre of physician champions. The project paid for 50% of their time. We also developed a pay it forward process—physicians who had gone before helped support those that were going live now. This was truer for inpatient than ambulatory as go-live was a big bang for IP and a 6 week process for ambulatory. With ambulatory, we trained over 6 weeks at 4 hours per week. At week 3 they began seeing patients at reduced schedules of 50%. By week 5-6, the schedule was 75%. Support staff at 1/4 ratio was located in the module all hours of operation. Physicians learn best from physicians, but are not always great trainers, so we used professional trainers and encouraged physicians to float and answer workflow questions.

3-Ongoing Operation of the EHR System

a. Management Polices & Procedures: All areas impacted by the implementation of KP HealthConnect underwent a thorough analysis to identify effected workflows, needs, policy changes and change management approaches. Most changes involved workflows to incorporate computer use in exam rooms and mobile wireless carts in the inpatient settings. An area with significant impact was inpatient nursing, in which all policies which called using certain forms for documentation of care had to be revised to accommodate the computerized workflow for documentation. Certain practices changed considerably (e.g., barcode medication administration and creating EHR care plans). Additionally, physicians were required to document certain items that they never had to document before. Policy on verbal or telephone orders was changed to instruct providers to enter orders directly or have nurses input orders while in communication with the provider. Operationally, there were significant policy changes required for the HIM areas of our facilities for Release of Information and various disclosures.

b. Impact on Operations: Impact on operations was divided into two groups: preventing negative impact to operations and positive impacts to operations that have resulted from implementation of the EHR. During our go-lives, negative impacts were mitigated by staffing with a regional or on-site command center whose purpose was to field, address, and track all reported issues. Issue resolution helped with future go-lives. We also staffed implementations with physician and nurse champions, as well as non-licensed personnel who were highly proficient with the Epic software (particularly in business areas). This resource pool staffing model was in place post-implementation and provided training and guidance to ensure smooth operations. Once the initial support models concluded, calls for support were routed through our IT Help Desk, where any calls pertaining to the EHR were routed to a special team.

c. Approach to Remaining Paper Medical Record: Certain items remained on paper after implementation, including Code Blue documentation, blood bank forms, documents from outside agencies, patient-completed documents from home, transport documentation, downtime documentation, EEGs and fetal monitoring strips, and any forms requiring patient signatures. A small binder is created for these documents and, within 14 days of discharge, all documents are scanned into the EHR. Once confirmed that they are in the EHR, they are destroyed.

d. Ongoing Planning: We utilize a project structure that includes executive sponsorship, a steering committee, and dedicated project teams. This model was replicated in each region with physicians involved at that level. In the end, hundreds of physicians were involved if we account for all of the superusers as part of the regional project teams. While team sizes have been reduced substantially as initial implementation has been completed, KP chose to move new product additions, Epic offers, and enhancements back into our existing governance structure.

The Board still oversees the programs that demand significant investment. At the national level, there are approval councils to govern specific segments of the business: care delivery, health plan and business/financial. Each region also has approval councils for regionally specific work.

e. Ongoing User Support and training: Post go-live training required a more sophisticated and strategic approach. End users had the system; now it was important to acknowledge that it was not a silver bullet approach to meet all needs. Ongoing training relied heavily on identifying individual needs and segmenting the end user audience into categories of proficiency by skill category. Operational reports were generated through Clarity to understand In Basket maintenance behavior. An assessment tool had trainers observing and rating end users on their effectiveness using the system. Within seconds, a training guide was produced for individuals, demographic groups, or regions. This had a significant positive impact on operations because it reduced the time out of clinic for training. End user proficiency averaged 35% improvement, and in many cases, up to 65% improvement in certain skills. Another example is Pathway to Proficiency, developed to support struggling physicians, but successful upon broader roll-out. Many physicians felt that the one-week, off-site training program saved their careers.

4-Challenges and Lessons Learned

- **Leadership commitment is not a luxury; it's a necessity.** Leadership commitment through funding, priority setting, and executive attention and incentives is essential to accomplishing the technical, programmatic, and cultural changes necessary in a major EHR implementation.
- **A shared vision goes a very long way.** The Blue Sky Vision provided shared goals for use throughout implementation, use of KP HealthConnect, and beyond. It unified leaders, teams, and users. It guided software decisions, prioritization, investments, and innovation.
- **Make the connections for stakeholders.** Positioning the EHR as a strategic investment to transform care and service ensured that it would be taken seriously by operating executives.
- **Special projects call for special teams.** Creating protected space via senior executive leadership, structure, and budget for the KP HealthConnect national team helped to develop new ways of working with the regions and new problem-solving processes.
- **It's all about relationships.** Our software supplier, Epic Systems, shared our goal to improve health care. Our physicians, nurses, labor partners, and all other staff engaged from day one. The changes we made were possible because of their support and commitment.
- **Practice repeatedly, and then practice again.** EHR implementation gave KP a chance to develop new ways of working together, changing the historically semi-autonomous regions into sharing, learning partners linked by technology, trust, and a shared mission.
- **Get ready to see what's wrong.** IT is the "great magnifier" of broken processes. Operational issues must be addressed at the outset or they will still be there later—and harder to resolve.
- **Never underestimate the need for training.** Training should include all departments, not just clinical departments, and it should be user-centric rather than system-centric.

Additional Lessons Learned

- It's first about the patient and people, then about technology.
- Listen, listen, listen some more.
- Start together, diversify when and where appropriate (e.g. clinical content).
- Standardization of anything in the EHR is directly correlated to standards in workflows, practice, supplies, formularies, equipment, physical plant, services etc.

- We are never done implementing.
- Active and participating leadership is critical.
- Make the right thing easy to do.
- Provide less training prior to going live and more "at the elbow" support after go-live.

FUNCTIONALITY

1- Targeted Processes

a. Processes

My Health Manager: One of the most visible signs of care transformation is My Health Manager, KP's PHR that directly links to KP HealthConnect (Epic's MyChart). Today, approximately 3.4 million members use it to manage their health. In 2007, we saw 33 million visits to My Health Manger; that number grew to 63 million in 2010. In 2007, about 300,000 e-mails were sent to providers per month; At YE 2010, that number had grown to 890,000. My Health Manager users are 65% less likely to voluntarily end their KP membership.

Integration: The KP HealthConnect presentation layer that provides data integration services is of significant value. Providers have all of the information they need at every point of care. One region showed that with drug-drug interaction alerts, prescriptions for high-risk medications for elderly patients showed a marked decrease from 2000-2006. Another survey showed that with the electronic medication administration, times and doses were legible and correct, and clinicians found the electronic medication administration a clean, safe and reliable communication tool. Providers using the After Visit Summary score 14 points higher on patient satisfaction surveys.

Improving Proactive Chronic Disease Management: Research indicates that chronic conditions are the single-most expensive health care cost. Data within KP HealthConnect and population management tools developed to interface with the system are providing our care teams with the ability to care for the whole patient. Integrating actionable patient lists at the point of care, population management tools give many PCPs the ability to proactively manage co-morbidities and intervene earlier in disease progression. Another offering through population care tools is e-consults between primary care and specialty providers. One region used the e-monitoring and intervention by nephrologists, in partnership with primary care teams, to increase early intervention among those at risk for chronic kidney disease. Outcomes data indicate a 67% reduction in incidents of late referrals (4 months prior to end-state renal disease).

System Availability: We already had in place robust disaster recovery protocols, using a dual data center approach. While duel data center solutions are typically used for Internet applications, KP chose to leverage it for enterprise applications and designed and deployed an industry-leading electronic medical record availability solution. The decision was made to utilize the continuous availability solution for planned outages as well. KP is the first and only Epic client to utilize this solution for planned outages. The effort has been quite successful and in 2009, Continuous Availability (CA) reduced planned downtime by 70%.

Order Entry and Management: Many aspects of the system are automated by the use of SmartSets, SmartForms, and SmartPhrases, which aid in capturing all required data. Dictation and transcription applications assist some providers with efficiencies in this task. Other automated processes are developed to act on data, such as the natural language processor that can

parse the notes produced and assist in the most efficient medical coding process. Charges are also automatically triggered as a result of documentation, charting, and ancillary results receipt.

b. Provider Roles: Creating a successful EHR depends largely upon the level of clinician engagement throughout the entire process, from visioning to vendor selection to implementation to subsequent use. To identify the physician leaders that would help push KP HealthConnect to success, KP identified three key groups—operational leaders, opinion leaders, and technical adepts. The level of engagement from these key groups can make or break an EHR. All three types of physicians were engaged in the first phase visioning process. In the second phase KP focused exclusively on operational leaders to map out the practical steps of how technology could help fulfill the Blue Sky Vision. Physicians were also engaged in vendor selection and helped establish a set of needs, ensuring that the system procured would be relevant and useful.

c. Overall Staff Response: The organization's positive response to work processes was a direct response to the training and support focused on workflows, clinical content, employee work/life balance, and other factors that provide the bigger picture for end users. Users learned what the downstream impacts of their actions had on patient safety, compliance, revenue capture, operational efficiencies, and clinical outcomes. Having this knowledge baked into the training content provided an opportunity to connect the dots and realize that the technology is the great enabler. When we completed implementation, we learned that implementation never truly ends.

Regional Perspective - Southern CA: "*Deployment personnel were trained in a common change management methodology. Because of our size, the first site may have been deployed 2 years before the last site for some of the modules, so there were upgrades during deployment. During the deployment we sampled user attitudes about the product and there was a very common path people followed, illustrated in virtually all the change management literature. Nobody wants to go back to paper after about 6 months. We created 45+ domain groups from the beginning of the project made up of clinicians who agree on clinical content and order sets used."*

2-Information Access

a. Comprehensive Data: KP HealthConnect captures and stores data from multiple systems and sites and presents a longitudinal patient record, including demographics, progress notes, active/historical problems, medication records, vital signs, medical history, immunizations, preventive health milestones, lab data, and radiology reports. Records generated on paper or in electronic format prior to implementation were incorporated (scanned or data converted) at the time of implementation or are available via defined operational procedures. Records of external services rendered are scanned, abstracted, or available via defined operational procedures.

b. Data Capture: Data is either entered directly into KP HealthConnect or is sent to us by a number of ancillary and interfaced systems. Orders are initiated in KP HealthConnect and then sent to ancillary system for fulfillment in the form of an HL7 message, which is then returned when completed. Some information, like images that are linked to the EHR from image servers, is embedded in the medical record. This includes access to scanned documents (e.g., Advance Directives and external discharge summaries). Dictation is still used in some areas, primarily for notes among surgical specialties. This interface to transcription systems still exists, but volumes are significantly reduced. The preferred method of data capture is directly into the chart using a tool like smart phrases so information is actionable. Providers primarily enter orders, some of which require cosigning. Inpatient pharmacy orders are reviewed by pharmacy personnel for safety and accuracy. Alerts appear upon submission and are managed as part of the regional

decision support teams. Many aspects of the system are automated SmartSets, SmartForms, and SmartPhrases that aid in capturing all required data. Other automated processes are developed to act on this data, such as the natural language processor that can parse the notes produced and assist in the most efficient medical coding process possible. Charges are automatically triggered by clinical documentation, charting, and ancillary system results receipt. Automated charge capture eliminates manual charge entry and ensures appropriate documentation for charges and coding. E&M coding is supported by automated tools and wizards that assist in documentation.

c. Information Availability and Ease of Access: The EHR presentation layer provides a data integration service as it displays a full picture of the patient's medical information. All aspects of the patient's data (demographics, medical history, progress notes, orders, results, problem lists, etc.) are available. It brings all the data held in the databases into usable screens that work for the provider's needs in the particular process at hand. Starting with our existing data sources and legacy applications, data were mapped and loaded using validated import specifications into the EHR system (Chronicles Masterfiles of Epic represent the logical data model). Data that did not fit this profile, such as images, are held on external file systems. Data are secured and systems are HIPAA and SOX compliant. Provider orders placed are sent to a full suite of ancillary systems (pharmacy, pathology, radiology, cardiology), which return results that are automatically routed to the patient chart. Inpatient medication workflows include use of barcoding validation among patients, drugs, and bedside orders to improve safety. There is a single EMPI across KP, although searches are first performed regionally and then, if not found, opened up nationally.

Interregional Sharing of Patient Information

Care Epic - Sharing Patient Records across All Kaiser Permanente Regions

Care Epic is part of the set of Care Everywhere applications implemented in all the Kaiser Permanente regions providing Kaiser Permanente clinicians with the ability to review a Kaiser Permanente member's chart regardless of the member's home region. Care Epic establishes a permanent link to the patient's home chart. The information within this link can be refreshed with the most current information.

Any Kaiser Permanente member from outside the Northern California region who is seen in Northern California can have their charts linked from their home region. In addition, all Kaiser Permanente members in Northern California who travel outside the region and are seen in a Kaiser Permanente facility, can have their chart linked by the other Kaiser Permanente region. The report includes:

- Clinical Summary (patient level information) – Includes: allergies, medications, problem list, immunizations, recenbt encounters, source comments, medical history, surgical history, family history, alcohol and tobacco use, OB and pediatric history.
- Encounter Information (information specific to a particular visit) – Includes: reason for visit, vitals, diagnoses, notes, administered medications, ordered or discontinued medications, prescriptions at discharge, orders and results, discharge disposition, surgery details, episode summary for active OB episode, dictations.
- Results History – Includes: lab and other results in text form.

3- Decision Support

a. Tailored Information Integration: KP HealthConnect has flexible capabilities to display patient-specific information for review and use in patient care situations. Reports in all clinical systems can take discrete data and provide customized views of it, which are attached to profiles, and can be configured for select groups—individual user, a department, and even facility level. For example, reports available to a primary care physician can be been configured to provide domain-specific information, assessment prompts and actions, such as documentation and orders.

b. Decision Support: "CPOE makes important safety information available to the physician and/or pharmacist before a medication is dispensed. For example, a warning about potential interactions with a patient's current drugs could be produced when a physician orders a new drug. Where appropriate, best -practice alerts can be linked to the safety alert not only to warn prescribers about the potential risk of their decision, but also to offer alternative medications. For example, metformin is a drug generally used to control blood sugar levels in people with Type 1 diabetes. Some patients on this drug were arriving for a CT scan with contrast to provide a greater visual differentiation between normal and abnormal tissue. However, the interaction between the contrast agent and this diabetes medication can contribute to kidney damage. Now, when a provider orders a CT scan with contrast for a diabetic taking metformin, a drug-drug interaction fires what is called a 'Best Practice Alert,' such as, 'SAFETY ALERT: This imaging study is performed with contrast and this patient has Metformin on their medication list. Open SmartSet for instructions and follow-up lab recommendations." The SmartSet template contains the default order, standardized progress note, and patient follow-up instructions per FDA guidelines. In this case, the guidelines noted the following: '(1) stop metformin after the CT scan/Imaging procedure, (2) test creatinine level 48 hours post-scan, and (3) evaluate creatinine level prior to patient restarting medication.'" *(Connected for Health)*

c. Order/Clinical Practice Standardization: KP HealthConnect includes a variety of "SmartTools" to streamline documentation and communication. Smart Sets and Orders Sets guide treatment pathways and allow clinicians to easily document patient encounters; code diagnoses and procedures; enter clinical notes; document telephone encounters; maintain problem lists; order lab and radiology tests; send prescriptions; and use the system to send and receive patient-specific messages, calls, and referrals. Criteria that drive specific care plans can be embedded in documentation of assessments. Examples: data recorded in the history and physical can modify an order set. Values recorded in flow sheets can trigger prompts to guide documentation. For example, a Braden scale value of 18 or less will trigger the "Intervention Bundle" and, if documentation is incomplete, the provider receives a best practice alert.

"SmartTools" for Smart Charting	
SmartSet	Allows documentation of all aspects of a patient encounter on a single form from which they can place orders, assign diagnoses and levels of service, complete progress notes, and much more.
SmartPhrase	Allows a few typed characters that automatically expand into a longer phrase or block of text.
SmartLink	Retrieves and displays data maintained in the patient record.
SmartList	Allows you to enter information into a SmartText from a list of pre-configured choices. These are color coded and provide the following choices: Yellow = single or Blue = multiple
SmartText	Consists of standard templates or blocks of text for use with a specific reason for visit, call, or contact. A template can contain words, links, and lists.
OrderSet	Compiles groups of individual orders that are specially configured for a particular purpose.
Navigator	Provides sequence of activities to assist with process of admitting, rounding, consulting, transferring, and discharging.

Rule monitoring
With KP HealthConnect we are able to monitor frequency and compliance for decision support. Our clinical teams are able to modify decision support almost near real time to address changes in practice, medications, seasons, in a central/standard way. Decision support used appropriately provides real time information in the context of the patient to improve care. For example, if an ED physician discharges a patient prior to viewing the final Tropinin result and alert will fire to inform the physician and the physician can stop, look at the result and then decide whether or not discharge is appropriate. There are several mechanisms used for clinical decision support:

- During order entry, clinicians can be guided with best practice alerts (BPAs) to selections based on specific patient information (e.g. weight, height, for dose).
- Also during order entry, the system has alerts for drug-drug interactions and drug-allergy interactions that come from the vendor which is typically First Data Bank.
- In addition, there are some seasonal alerts for flu vaccine in patients over 65 that are setup regionally.
- Another good example of a decision support tool is Epic's Beacon module. This module has been implemented to guide standardized chemotherapy protocols.
- The standardized protocols along with BCMA and the Medication Administration Record (MAR) are used for monitoring drug administration and dosing.
- Over 400 protocols have been created and are being used 85 percent of the time, and available simultaneously to the entire patient care team.

Alerts No Matter the Location
In Kaiser Permanente, the model is for preventive care. This means our clinicians and care providers are incentivized to proactively take care of the patient. This is implemented through notification for preventative tests and/or follow-ups at any point of care, not just in the department where the patient is being seen, but anywhere the patient is being seen across our enterprise.

For example, patient may have come in for a neurology visit. During the appointment, the assistant sees the preventive health prompt that the patient is due for mammogram. At that moment, the assistant will order/get an order placed in the system and the mammogram scheduled, ideally while the patient is there that day if at all possible. These are viewed as patient care opportunities and likely prevent worse things from happening.

4-Workflow and Communications

a. Provider Communications: Several mechanisms are used to communicate best practices and system impacts, including the SmartBook, webinars, internal and external journals, and the "Core Value Metrics" report. The SmartBook is an online, searchable database of demonstrated best practices enabled through KP HealthConnect. Information in the SmartBook supports KP's work in achieving targets for quality, member service, and efficiency. It is maintained by a small national department that provides evaluation and analysis of potential health IT benefits. More than 250 published "pages" outline opportunities to harvest value, with topics like workflow, impacts of best practices, information and support contacts, and evidence for impact estimates.

KP also sponsors a variety of internal webinars, virtual user conferences, and regular conferences to learn from innovative operational leaders showcasing their work and results. One of our most important tools for sharing information is our "Core Value Metrics" report, created by an internal group of analysts focused on mining and interpreting systems data.

b. Knowledge Access: "Communities of practice" for nurses, pharmacists, ancillary services, and physicians by specialty and/or care setting were developed to create the clinical content in KP HealthConnect. The KP Care Management Institute (CMI) provided the communities with summaries of best practice research in their areas to help them make clinical content decisions. Even though previous tools like pocket cards have aimed at making guideline implementation easy for clinicians, the process of creating SmartTools requires content experts to think in great detail about the moment-by-moment flow of care within a clinic visit. At exactly what point in the visit should a statin (cardiac medication) alert appear? When the provider is reviewing the list of current medications? When he or she is signing off on any orders or plans? … With a solid understanding of the process of care, KP HealthConnect builders can begin to create documentation and decision support tools that support the process and reflect the evidence." An internal Web-based clinical library was also created for regional adoption of clinical content.

c. Patient Decision Support: Kp.org provides a number of decision support tools available 24/7 to help patients take positive health action. Members registered to My Health Manager can use 11 healthy lifestyle programs provided by HealthMedia, Inc. These programs cover topics from weight loss and diabetes management to smoking cessation and pain management. Patients receive personalized plans tailored to their specific needs and goals. They can also take a total health assessment, results of which can be included in the EHR for review by providers. Kp.org houses physician-reviewed content on topics such as allergies, asthma, prevention, and women's health. The health and drug encyclopedias contain more than 40,000 pages of information to support self-care and triage for symptoms, conditions, test results, and medications. Another database provides information on natural medications, including possible drug interactions.

5-Data Sharing with Other Organizations and Patients

a. Data Sharing with External Organizations: KP is involved in these HIE relationships:

Live Production Efforts

- KP NwHIN for VLER - includes NwHIN link to VA and DoD in San Diego (live 12/09)
- KP Colorado participation on Epic's Care Everywhere Network (public) - includes HIE connection to 50+ Epic organizations around the country (live since July 2009)
- KP Care Everywhere Network for inter-regional HIE - includes HIE connection between all 8 KP Regions (live since 04/2011)
- KP to Public Health exchanges for Syndromic Surveillance and Immunization Registry submission (live in CA and NW; moving in that direction in other regions)

Significant Efforts in Planning Stages

- CCC - HIE connections will include: Kaiser Permanente, Group Health Cooperative, Geisinger, Mayo Clinic and Intermountain Health Care (initial live exchanges are planned for early 2012). Significant focus for the CCC includes establishing network-wide shared services including identity management (to include patient-chosen portable identifier for ID)
- eHIE Initiative - KP is in process of solution and delivery planning of an enterprise-wide standards based HIE solution to support all exchange modes, content and partner exchanges.
- Evaluation of state HIE inclusion in following states: CA, OR, HI, OH, VA, and Wash DC

- In active review and definition of participation plans for these state HIEs: MD CRISP (Maryland), GaHIE (Georgia) and CORHIO (Colorado).
- KP sponsored NwHIN connection with Social Security Administration (SSA) - in evaluation

b. Data Sharing for Population Analysis and Reporting: Meaningful Use (MU) introduced an increased level of engagement around data sharing with public health agencies. The initial regional gap analysis revealed quite a bit of variation in this area for KP and highlighted gaps in 1) possession of certified technology, 2) use of certified technology to conduct data exchanges with public agencies, and 3) no active data sharing occurring in some regions due to technical or state legal limitations. Two of the five KP Medicare Advantage Organizations (MAO) were immediately prepared to meet one of the public health menu objectives and no regions possessed all certified interfaces, so KP launched efforts to acquire and implement certified interfaces and engage with state public health agencies to conduct data exchanges. As we near the 90-day reporting period for the first year of Stage 1 qualification, all MAOs now possess the certified interfaces and regional teams. MAOs where no data sharing was in place are testing their capabilities to exchange information with public health agencies. For many reasons, KP regions have chosen an exchange of immunization data or syndromic surveillance information. Some reasons have been the desire to institute data sharing in areas where state agencies are prepared to receive information electronically and whether bioterrorism surveillance programs exist in the state or with county public health departments. In regions where KP is qualifying for MU incentive funding for both eligible hospitals and eligible professionals, regional teams have also chosen to invest efforts in the data sharing menu objectives that benefit both hospital and professional providers. Monitoring the quality of MU implementation, as mentioned in an earlier comment, has been embedded in KP's ongoing assessment and tracking of MU readiness. Performance improvement activities at all levels have occurred to increase performance and enhance consistency in performance across hospitals and professionals. As Medicare Advantage Organizations, KP does not have to participate in the Quality Reporting core objective. However, the measures associated with this objective align closely with HEDIS and Joint Commission reporting in which KP is already participating and publicly reporting performance. The corresponding, well established quality improvement infrastructure supporting ongoing improvements in care delivery continue across all regions, regardless of MU participation.

Quality Reporting Example
PCS / Quality
Core Measures-Pneumonia

Falls
- NCFLS0001 Falls Schmid Assessment w/in 8 Hours of Admission
- NCFLS0002 Falls Schmid Daily Assessment
- NCFLS0003 Falls Precautions For 3+ Schmid Scores
- NCFLS0004 Falls Occurred and Documented

Inpatient Notes
- NCNOT0001 Inpatient Pended Notes
- NCNOT0002 Early Adopter Notes Detail
- NCNOT0003 Early Adopter Notes Trending

MAR - Medication Administration Record
- **NCMAR0001 Bar-coding overrides for Given Medications**

- NCMAR0002a Top Reasons for Medication Barcode Overrides by Department
- NCMAR0002b Top Reasons for Armband Barcode Overrides by Department
- **NCMAR0003 Barcoding Overrides for Given Medications by User**

Pain
- NCPAN0001 Pain Assessment within 8 hrs of Admission
- NCPAN0002 % Pain Assessment Every Shift
- NCPAN0003 Pain Reassessment within 1 Hour of Pain Medication

Pressure Ulcers
- NCPUL0001 Pressure Ulcer Braden Assessment within 8 Hours of Admission
- NCPUL0002 Pressure Ulcer Braden Daily Assessment
- NCPUL0003 Pressure Ulcer Precautions for 18 or less Braden Score

Restraints
- NCRST0009 Percentage of Restraint Days

Universal Protocol
- NCUPT0001 Universal Protocol OpTime Timeout Documentation

Vaccine
- **NCVAC0001 Vaccine Report - Pneumovax and Influenza Vaccine**

Verbal Orders
- **NCVER0001 Verbal Orders Signed within 48 Hours**
- **NCVER0002 Verbal Orders by Ordering User**
- **NCVER0003 Verbal Orders by Provider Specialty & Department**
- **NCVER0004 Verbal Orders MRN Detail**

Misc. Quality
- NCMSC0001 Gestational Age Data Entry Audit
- NCPBL0001 Hospital Encounter Problem List Exception Report Admitted
- **NCPBL0002 Problem List Entry Compliance**
- **NCPBL0003 Problem List Entry Compliance Summary**

c. Data Sharing with Patients: The implementation of KP HealthConnect opened online medical record access to members via Epic's MyChart module. Some secure, password-protected information was already available through kp.org. Now, a full PHR system needed to be implemented into the existing site with minimum disruption. Today, kp.org users can see the most important parts of their actual health record—the same record their doctors use—including test results, allergies, diagnoses, immunizations, prescription lists, summaries of past office visits, secure messaging, and proxy access (the ability to act for a family member). Creating an integrated and secure online experience was just one step in providing patients with a view of their EHR. It was also important to establish guiding principles to protect use of the health data.

Consistency: Some health systems allow physicians to decide which patients have electronic access to their records and are allowed to send e-messages, an approach that is inequitable and overlooks the fact that access to one's health record is an important empowerment tool.
Accessibility: The member portal should provide online health information to all members. We currently provide access to all capable adults, incapacitated adults via an approved proxy, and children under twelve or thirteen (age varies by state) via their parents or other providers.

Security: We go to great lengths to ensure that kp.org adheres to industry standards for security and conduct ongoing security testing to ensure process updates. KP's policy is to not share personal information without explicit permission. We never sell information or host advertising. **Transparency**: KP physicians do not withhold patient data from the PHR at their discretion. All of the data in a patient's chart originates with the patient—it's their blood and urine, their lungs being x-rayed, their blood pressure that is too high or too low. The patient is legally entitled by HIPAA to a copy of their medical record. For these reasons, KP established from the beginning that we would make online access to the record as complete as we could—within the limits of the law—while avoiding predictable harm to patients. Some necessary exceptions apply: 1)Some diagnoses are blocked to prevent patient harm, in particular those related to abuse; 2) Other diagnoses have been modified to be understandable to patients, such as "history of neuroendocrine cancer" instead of "HX of neuroendocrine CA, and 3) A diagnosis of paranoid psychosis displays as "mental health disorder," to avoid potentially harmful patient reactions.

Listening to Member Input: Every effort is made to make kp.org work for members. We employ user testing, surveys, focus groups, and more. The voice of members and patients has been critical to the success of kp.org. A formal in-person Member Advisory Panel meets periodically to serve as a sounding board and think tank for existing features and possible enhancements, and member input has been expanded to include a virtual advisory group, with more than 30,000 participants.

Clinical Oversight: Physicians routinely review all kp.org health articles and provide input on priorities and feature enhancements. A Clinical Advisory Group, including physicians, nurses, and labor partners, tackles difficult recommendations for test result access and diagnosis display.

Patient Portal - Functionalities

My Health Manager: One of the most visible signs of care transformation is My Health Manager, the online personal health record on kp.org that directly links to KP HealthConnect. We are providing patients with access to the same clinical information their doctors see, including lab results and unique tools to interact with their provider and the health plan (i.e. appointment management, pharmacy refills). My Health Manager goes well beyond standard PHRs and adoption has increased with the addition of each new tool. As of October 2011, approximately 3.7 million KP members actively use My Health Manager to manage their health care. In 2007, we saw 33 million visits to My Health Manger; that number grew to 63 million in 2010. In 2007, approximately 300,000 secure e-mails were sent to providers each month; as of 2010, that number is 890,000.

An example of how My Health Manager has helped us to provide better and safer health care to patients was in the case of Southern California wildfires. Despite medical office building closures, members and providers had access to the vital information when and where they needed it, enabling continuity of care. Many members were redirected to other KP offices where care teams, whom they may have never seen before, had full access to their records. With the use of remote access to KP HealthConnect, providers were able to help our members avoid the unnecessary risk of commuting during this time of crisis by providing telephone and e-mail visits. Members were also able to use My Health Manager on kp.org to handle routine health care needs, including refilling their prescriptions, which could be delivered directly to their home or their pharmacy of

choice. Data also indicates that providing access to a PHR linked directly to the EHR replaces both office visits and phone calls. Early results from a study published in the American Journal of Managed Care showed a 14 percent reduction in office visits and an 8 percent reduction in phone calls among My Health Manager users. Lastly, My Health Manager users are 65 percent less likely to voluntarily terminate their membership with KP.

The following are functions that can be performed by patients online through My Health Manager on kp.org:

- Email doctor
- Schedule, change or cancel appointments
- Act for a family member (i.e. parent, child)
- Refill prescriptions
- View medical record information:
    - View test results
    - Allergies
    - Health care reminders (due for flu shot/mammogram)
    - Health summary
    - Immunizations
    - Ongoing health conditions
    - Past visit information
    - Track my health
    - Wallet card
- Health coaching
    - Healthy lifestyle programs through HealthMedia, Inc.
        - Total Health Assessment (Succeed)
        - Eat Healthy (Nourish)
        - Lose Weight (Balance)
        - Quit Smoking (Breathe)
        - Reduce Stress (Relax)
        - Back Pain (Care for your back)
        - Chronic Conditions (Care for your health)
        - Chronic Pain (Care for pain)
        - Depression (Overcoming depression)
        - Diabetes (Care for diabetes)
        - Insomnia (Overcoming insomnia)
- Learn about health plan
    - My plan and coverage information
    - Eligibility and benefits
    - Estimates
    - Out-of-pocket summary
    - Claims summary

Monthly premium bill

6-Secondary Uses of EHR Data

a. Administrative Uses: Secondary uses of the data are many, including but not limited to, improving quality, research, best practice development and refinement, ongoing optimization both from a workflow and a charge capture prospective, reporting to state and federal agencies for a variety of reasons, meeting and documenting meaningful use measurements, etc.

b. Clinical Data Acquisition: Data is available in discreet forms that can be utilized for reporting and includes most everything except free text fields in progress notes. KP HealthConnect captures all data from fields in smart sets; diagnoses; problems; medications; demographics; preferences; and flow sheets, such as vital signs, laboratory values, test results that are reported as a value or as a status (e.g. Test or study narratives that are written in free text would not be discreet data – but the overall status of normal vs. abnormal could be captured). Reports are generated using native functionality within the EHR (e.g. Patient Lists, My Lists, Reporting Work Bench) or by applying business objects to Clarity. Libraries of standardized and customized reports are available through other methods to committees and reporting groups.

c. Patient Safety: EHRs do more than automate data; it enables appropriate standardization of practices, minimization of design variation, and implementation and maintenance of SmartTools, which allow physicians to focus on delivering care to patients rather than on routine information. Health IT is increasingly integral to clinical decision support. With paper charts, providers (when they can locate charts) have "encounter-level data"— data that is true as of a given event, representing information from a moment in time. An EHR provides what is called "patient-level data," which covers patients over time, not just on a given day. Like demographic information, it may be verified, but it's not redocumented at each encounter unless changed. Examples include allergies, medications, problem lists, medical and surgical history, and social history. Having better data is more efficient and effective. The first benefit is the ability to access meaningful data at each point of care, even if data is older, because this can "improve practitioner decision making by matching an individual patient's characteristics in the computerized knowledge base with powerful software algorithms that deliver information and recommendations to the clinician almost instantaneously. Physicians still have the opportunity to practice the art of medicine, but they are now guided by science and technology." (*Connected for Health*)

The goal of a safe system is to make it difficult for individuals to make mistakes, address errors when they occur, and monitor performance. The strategy we employ at KP to improve patient safety through KP HealthConnect is guided by the following approach: Identify areas of risk to patient safety; **e**valuate the likelihood of reducing risk and/or improving reliability through KP HealthConnect; and assess factors, such as impact on clinical workflow, ease of use, and patient preferences, to prioritize improvement opportunities. In line with industrial safety science and a concept called the "hierarchy of controls," KP developed a model to assess the likelihood of reducing risk and improving reliability through systemic changes. According to the theory, there is a logical order of effectiveness that a system designer or process owner can use to evaluate the potential efficacy of a host of "controls." Controls can be mechanisms to help ensure that a simplified, standardized process functions over time as designed. For example, within KP HealthConnect, a safety alert generated by a medication order for a particularly hazardous drug may be more effective in reducing harm than a policy regarding prescription practices. Building on that example, removal of the particularly harmful medication from the prescriber's drug formulary—the list of drugs at his disposal—and from local storage bins (fundamental design changes), where feasible, may be even more effective than the alert. Areas of risk to patient safety are primarily recognized through analysis of internally reported events;

benchmarking with industry leaders and organizations; and review of literature. Key opportunities we have identified include medication safety, improving the timeliness and reliability of diagnosis, and patient engagement. In considering improvement in these areas involving technology, we follow the hierarchy of controls and "human factors" design principles:

- Minimize variation in practice
- Reduce reliance on memory
- Improve access to information
- Flag harm
- Use constraints and "force functions"
- Facilitate follow-up
- Engage the patient as partner in safety

"A National Help Desk and remediation process called PART was created to address issues that cannot be managed locally. PART stands for the main procedural steps:

- Preparation—clarifies incident report, rules out user error, and determines if incident is a potential risk to patient safety;
- Assessment—determines urgency based on the severity, scope, and likelihood of occurrence, what immediate action is needed, and which regions are impacted
- Remediation—refines the analysis of impact and develops a plan of action addressing immediate mitigation and longer-term resolution, and determines remediation
- Track—tracks the incident to completion and validates successful remediation

Incidents identified as potential patient safety issues are addressed and resolved within two to 24 hours. The national KP HealthConnect team, subject matter experts, and partners from Epic, are paged to a bridge call to take action to mitigate the problem and implement workarounds." (Doug Bonacum in *Connected for Health*)

Unintended consequences – PART

PART stands for the mains steps of the KP Patient Safety process: Preparation, Assessment, Remediation, and Track. This process was implemented to facilitate potential patient safety defect/code issue resolution across the program. During PART events we would see the need to search for certain triggers and data to determine whether or not we had a systematic issue. However, we also learned this same approach could be used proactively to monitor patient safety and to support patient safety initiatives.

Some of these activities started in our Antioch hospital, which opened its doors already on KP HealthConnect, a new hospital and no chart rooms. KP HealthConnect gave us a way to perform automated trigger surveillance, quality monitoring and automated reports to enhance the identification, prevention and mitigation of harm to patients. A few examples of this surveillance used today for proactive monitoring include; find all chemotherapy medications in the hospital, find all patients with critical lab values, find all patients on Tropinin. This information, which can be viewed from anywhere with appropriate security and can quickly be acted upon. The surveillance opportunities were an unintended consequence, but extremely beneficial tool, which can only be performed with the use of discrete data in an EHR.

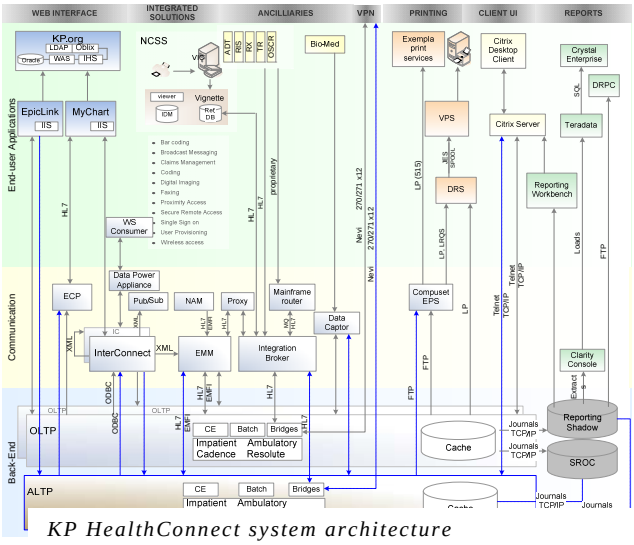
6.1. Research: KP's EHR has transformed research within the organization, providing a massive and robust data source with the scalability to pinpoint specific populations or conditions. One study on gestational diabetes mellitus (GDM) found that 5-7 years after delivery, children of "untreated" GDM mothers were nearly twice as likely to be overweight. Researchers also found that the increased risk of childhood obesity disappeared if the mother's GDM had been treated—even among

severe cases. A study of this scale, which assessed the outcomes of 10,000 women with GDM and linked them to their children's weight five years later, would have been impossible without an EHR. Using the power of KP HealthConnect, researchers are delving deep into complex, multi-layered information to develop, validate, and implement care strategies. They follow particular treatment regimens and analyze patterns of care, which will empower physicians with proven treatments and tools to track how well they work for individual patients. All of this results in better care.

TECHNOLOGY

1-Scope and Design of EHR System

a. System Description: Access points into KP HealthConnect include a variety of touch points, including: computers in facilities, personal computers outside of the facilities (remote office, VPN access), kiosks, and WOW (workstation on wheels–mobile carts). In 2010, KP HealthConnect began a pilot with Epic's Haiku, which gives physicians the ability to provide care and track high-risk patients from any location on a mobile device.



KP HealthConnect system architecture

b. Application Design: Data Exchange with outside providers is one way to enhance the member experience. Care Epic is a feature that facilitates data exchange between Epic instances in different organizations. Data received by the other organization becomes part of the chart and displays in read-only format under "Care Everywhere" in Hyperspace. A two-way link allows organizations to share charts with each other. Updates are not automatic, but can be triggered, with certain encounter types triggering data acquisition via the link while others triggering manually from within an encounter.

c. System Architecture: The system architecture of KP HealthConnect includes:

- KP HealthConnect from Epic Systems
- Database – Cache
- Datacenter shared services such as network, active directory, etc.
- SAN storage or application storage: EMC
- Clones: Separate SAN storage for back-up
- VTL
- Citrix
- P6 / P7 AIX frames – IBM
- Wintel – HP Blades
- OC-48 redt WAN links (AT&T and Sprint)
- Cisco switches
- Unix
- Teradata
- Clarity

EHR data is centralized and housed in multiple data centers. Facilities are distributed, so deployment of our EHR is distributed. From a technology view, we use Citrix to leverage our distributed nature. Virtualization eliminates the need to physically deploy KP HealthConnect physically in each facility.

Shadowing: Shadows are replicas of the EHR database. They are a Cache feature that allows global update activity in one instance to be duplicated real-time in another instance. Use of shadowing provides a reliable structure for applications. KP HealthConnect has the following types of shadows: Reporting Instance (extracting data for use by Clarity process); DR Shadow (use in Continuous Availability); and SROC (Shadow Read-Only Copy). The purpose of shadows is to reduce

performance impacts, increase data availability (especially during downtime), and increase enterprise resiliency. The basic components of KP's EHR servers are layered. The lowest layer is the physical hardware of the servers. The second layer is low-level firmware that provides software control. Hardware and firmware layers normally define an individual machine. The third layer is the operating system and is often hardware-dependent implementation of UNIX, but also runs on OpenVMS, Linux, and Windows servers. The fourth is the OS-specific logical volume manager and file system software. The fifth layer is Cache database (InterSystems) and the final is Epic software.

d. Interoperability: We believe that interoperability among health systems in the country is integral to taking health care to new levels. Connecting disparate systems allows for improved care quality, greater patient safety and improved efficiencies. In 2011, KP, Mayo, Geisinger, Intermountain, and Group Health created an interoperability consortium—Care Connectivity Consortium—to pioneer effective connectivity of information, while protecting confidentiality and using standards-based IT.

e. Customization/Optimization: With the goal to move all eight regions to a single EHR platform, it was important to recognize and allow for regional variation to ensure that the EHR was accepted and successful on all levels. To balance these needs, regions began implementation with a standard core system that they could later customize. Regional representatives shaped that system through a collaborative build process. Software decisions such as configuration settings, clinical content, medical terminology, basic security, decision support tools, charting templates and tools, and standard reports were addressed during this process to achieve consensus on the most vital functions. Any customizations would need to meet two requirements: 1) Maintenance of data integrity and 2) Protect regional interoperability. During the collaborative process, national and regional experts made thousands of decisions that directed parameters to optimize and enhance care. These included:

- Data standardization – Standardizing data formats across regions was critical to improving care. During a collaborative design session, KP reduced 2,000 disparate office visit types to 250 standard appointment types. Changes must be reviewed and approved for variation control.
- Clinical content standardization – The clinical content in KP HealthConnect is one of the most important components of quality improvement through shared information. Developing standard, high-value content that's relevant to each discipline and region is a huge undertaking that requires input from nurses, pharmacists, ancillary services, and physicians. To create standard clinical content for all, communities of practice decided what was needed to enable the best care.

Workflow Design Process

Epic's method for initial collaboration is a process called Design, Build, Validate. This approach gathers a team(s) together to work out the initial collaborative workflow processes and system settings. At Kaiser Permanente, this process engaged representative from all eight regions. The national team, along with Epic, hosted/facilitated the sessions, which took place over several months. The end result was the initial Epic-Kaiser Permanente Collaborative Build. Following the collaborative build, the regional teams followed a similar process called VDB: Validate, Design, and Build. During this process the regions validated the recommendations and settings from the collaborative build and created settings that were characterized as regional build. An example of regional build items were the hospital order sets and the ancillary orders (dependent on the ancillary ordering system, e.g. lab, radiology, pharmacy).

This process also took a few months. Following these processes the system was tested, training environments were created and the training curriculum was created. Following the training, the first site was implemented. Some of these foundational processes still occur

today when new modules are implemented. The cascading approach allows Kaiser Permanente to set some standards, consistent settings, while still allowing the regions the local customization where needed.

Globalization vs. Customization
How KP Southern California prioritizes requests for decision support:
1) Requests can be submitted by anyone in the region via multiple menued sites on our intranet that support clinical content and decision support. We also do periodic survey monkey scans to pick up new requests.

2) Items on request include description of proposed Decision Support aid, current performance on the topic, size of population targeted, and impact of the proposed rule on various specialties and different user types.

3) Our regional DS committee (a portion of our optimization committee) is co-chaired by the CMIO, Director of Quality, and Director of Operations.

4) Selection Criteria include each of the following
- net value to population
- confidence on achieving intended benefits
- ease of development
- ease of deployment
- sponsorship

Each criterion is weighted on a scale of 1 to 5. The average is then taken, and typically a proposal must exceed a threshold of 3.5 before work begins to implement that rule. Decisions go to the optimization committee for final evaluation, prioritization, and approval. Once approved there is a specifications call, build, pilot and regional deployment.

f. Scalability: All existing regional EHR systems were replaced with the full suite of Epic products, and all existing ancillary systems were integrated with the system. KP ensured Epic software licenses met demands of the regions. A total of 18 copies where purchased, with the majority used in the largest regions (Northern and Southern CA), ensuring optimum user response times.

g. Emerging Technologies: We take an evidence-based approach to new technology assessment and adoption. New and emerging health IT products and services are analyzed for their potential to improve care quality, service, affordability, and/or professional satisfaction. With the complexity of health care, KP's approach is multidisciplinary, involving early input from all stakeholders. The pace of technology continues to accelerate, but we keep our focus on key strategic care delivery and business priorities rather than the hype surrounding new products. This has not constrained our leadership in innovation, which is in our DNA. With 35 Stage 7 Awards, we look to telehealth care models, mobile health, analytics, simulation, robotics, virtual reality, and other technologies that provide glimpses of the future of health care. KP explores these technologies by providing resources and tools to encourage innovators to experiment, learn, and operationalize new technologies.

Sidney Garfield Center for Health Care Innovation:
The Garfield Center is a multi-million dollar 37,000-sf technology and space design laboratory where leading-edge technologies are tested in simulated real-world scenarios to identify issues with performance, reliability, interoperability, scalability, and usability in

workflow simulations. Technologies are also tested in context; for instance, the Operating Room of the Future allows KP to put new OR products through their paces, including interoperability with other devices, prior to placing them on the national OR equipment formulary. Often significant value is obtained by discovering that new technologies will fail in simulated real-world stress tests. This allows KP to screen out unsuitable technologies at an earlier, less costly stage of investigation. The Garfield Center was launched in 2006, and remains the only technology laboratory of its kind and scale in health care today. As a result, this unique facility won FastCompany's 2010 Most Innovative Companies in Healthcare award and has drawn over 33,000 visitors since its launch, including top federal and state officials, healthcare organizations, academic institutions, numerous foreign delegations, and intense media attention.

Innovation and Advanced Technology Group (IAT): The IAT team includes technologists, clinicians, and business analysts that conduct future scans of emerging technologies likely to enter the mainstream in 2-5 years, and offer guidance and recommendations to stakeholders. New technologies are brought in for further testing, sometimes using immersive simulation scenarios. Some have made it into production and many more have failed evaluation, but these failures contribute as much, if not more, to our understanding of the rapidly changing health technology landscape. IAT's mission is three-fold:

- **Innovate.** IAT conducts broad secondary industry research and brings in promising new technologies for primary research, followed by in-person review and then recommendations. It also provides tech assessment of human factors design and modeling and simulation capabilities.
- **Cultivate.** IAT operates the multi-million dollar Innovation Fund, which offers grants to foster internal innovation. Employees with ideas can apply to prove or disprove it within 6-12 months.
- **Connect.** IAT administers KP Ideabook, a social networking tool with a community of 20,000+ internal innovators sharing ideas and resources. IAT also sponsors Innovation Hunters, advocates connecting IAT with regions and functional areas for idea exchange and technology transfer.

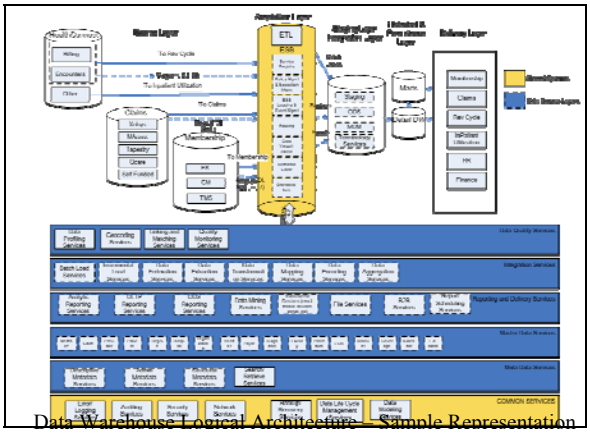
KP Innovation Consultancy: This internal innovative group has expertise in industry-leading methodologies (e.g., IDEO) and works with a broad range of internal groups to design and implement innovative processes, tools, and spaces that improve care and professional satisfaction.

Innovation Learning Network (ILN): Founded by KP, the ILN is a consortium of innovative organizations whose objective is to share and disseminate information about health care innovation—its challenges and enablers, lessons learned, and new opportunities. Member organizations include Adventist Health, Ascension Health, CHF, CHW, CIMIT, Health Plan Alliance, Indian Health Services, the NHS (UK), Partners Healthcare, UPMC, and the VA.

Garfield Innovation Network (GIN): This is an internal grassroots network of innovators who share information and news about innovation.

Today, KP's EHR is a seamless, robust, fully operationalized system that is an essential foundation for future technologies and care models. The 1-2 terabytes of data collected each day is now a longitudinal patient database larger than the Library of Congress. KP has initiated efforts to leverage this data through analytics tools, including data mining, CDS, and predictive analytics.

h. Data Warehouse: In addition to a large data population driven by 8.8 million members, other factors create complex needs for data integration



Data Warehouse Logical Architecture – Sample Representation

and consumption. Careful consideration was given to not opt for a monolithic, single data warehouse, rather adopt a "guided rail" approach, which provides adequate flexibility, yet good architectural foundation for expansion and growth. Emphasis was also given to adoption of a multi-tiered paradigm. Detailed subject area-specific data warehouse and ODS solutions have been built using in-house design (e.g. membership and claim data warehouses) and vendor-provided products (e.g. Epic Clarity for Care Delivery). These are available at regional or national levels. Datamarts (e.g. Revenue Cycle) have also been created to meet specific analytical and reporting needs. Physical deployments have been done both on MPP (e.g. Teradata) and on SMP (e.g.,Oracle RAC) architectures. Industry standard tools (Informatica, Ab Initio) have been used for ETL. A Metadata-driven approach has been used and supported by tools like ASG Rochade. Data stewardship has been established in key areas and is supported by implementation of data profiling and quality tools like SAS Dataflux. Integration of these toolsets is being attempted to further leverage, monitor and improve data quality. Several initiatives are underway on "BIG Data" next generation platforms, including analysis of unstructured data. Evaluation, pilots, and benchmarking of standards like HL7 RIM are being done from a data integration and clinical model perspective. Clinical Data is primarily available via Epic's Clarity, which extracts and persists data daily, and is deployed regionally on Teradata platforms. We are rapidly expanding our use of Clarity for patient care, meaningful use, revenue (credit remediation, unbilled revenue recovery), and operational reporting. Major extractions take this data to downstream systems where they are integrated with other sources (pharmacy, labs, etc.).

2-Security and Data Integrity

a. Security/Confidentiality and HIPAA Compliance: KP uses commercial and proprietary tools to protect its information and computing assets. The perimeter of the network is firewalled, and intrusion prevention systems provide constant surveillance and protection against unauthorized access. Remote network access requires two-factor (token) authentication. The security event management system monitors security events in real time and batch, depending on origin of the security event data. Events are collected and analyzed, usually within minutes. Other system events, such as local system security logs and account provisioning change flags, are batched into the system on various schedules. All of these events are correlated with each other for relevance and, if weighted high enough, alerts are sent to the Security Operations Center (SOC) immediately. If there are anomalies that have rules established for review of correlated events, or event types, daily reports are produced and reviewed by the SOC. Brute force attempt is one of the event types that KP monitors for alerts, among others. Production servers are housed in KP's national data centers, where a variety of physical measures secure the information. Examples of safeguards include round-the-clock guard service, video monitoring, locked/restricted internal areas, visitor escort services, uninterruptible power supplies, and fire suppression systems and logical access controls at operating system and application levels. Data access is restricted by job functions, location, and other factors. Updates to electronic records are logged in accordance with health information management requirements. Additional technical controls, such as encryption of laptops and electronic media and deployment of data loss prevention tools, also provide information protection. KP HealthConnect and its source legacy applications have been designed to restrict access to patient information based on a workforce member's job function, under the concept and policy of "Minimum Necessary." Some patients' records are further protected by a "break the glass" function. This may apply to persons such as celebrities or government officials. When "break the glass" is applied, the workforce member who is attempting to access the record is given a warning message. If he or she continues the process, the activity is reported to management and if the access was not necessary to provide treatment or carry out some other necessary purpose, the workforce member may be subject to discipline. KP

information security policies are based on external and internal drivers including law, industry standards, technological advancements, and business strategy. Policy topics include:

- Information Asset Classification
- Security Risk Management & Evaluation
- Facilities Information Security & Privacy
- Protection Against Viruses
- Backup of KP Electronic Information
- Network Security
- Electronic Media Handling
- Email Systems and Messaging Functions
- System Activity Monitoring & Auditing
- User Access Management
- Mobile Computing & Teleworking
- Application Security Requirements
- Business Continuity & Disaster Recovery
- Use of KP Computing Systems/Devices
- Business associate reqs to safeguard PHI
- Sanctions by KP Against Workforce Members Who Fail to Comply
- Secure electronic storage of patient data
- Notifications Regarding Unauthorized Disclosures of Patient Information
- Privacy and Information Security Policies, Procedures and Documentation
- Data security/privacy incident Mgmt

Policies are written at a high level and convey management's intent for KP's overall security posture. They are implemented at the enterprise, regional, and local levels through a combination of standards and procedures. ISO 27002, NIST 800-53, and CobiT are among the frameworks that have been referenced in the development of the policies and related instruments. All employees must complete annual training on the enterprise code of conduct (Principles of Responsibility or POR). Workforce members are required to attest that they've read, understood, and agree to abide by the POR, which includes: Information confidentiality and security; preventing/detecting fraud, waste, and abuse; meeting government expectations and cooperating with regulators; respecting our workforce; avoiding conflicts of interest; and reporting concerns. Sanctions, up to and including termination, may result from non-compliance. All employees and clinicians are covered by these policies.

b. Data Quality and Integrity: To ensure continuous system availability, ongoing monitoring is performed. One component is to ensure the application is writing to disk. Daily database integrity checks give IT the ability to foresee any potential hardware issues that may cause database degradation. They are done on off-hours to minimize performance impact to business. A metadata driven approach with Data Quality profiling and monitoring is used for continuous improvements.

c. System Integrity and Disaster Recovery: Information is essential for our staff and patients, who depend on access to HIT systems. As a paperless organization, the convenience of virtualized information requires a system that is always available, 24x7x365.

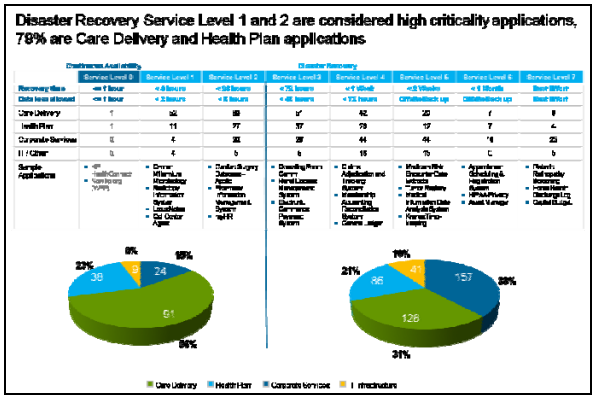
- **Strategic Context:** Includes business, information, application, and infrastructure.
- **Business strategy:** Integrated delivery, real time, affordable care; virtual encounters, home as a hub, consumer centric; collaborative, behavior modifying preventive care; able to adapt quickly
- **Information strategy:** Integrated data and quick assimilation to new sources; interoperability; information & tools at right place and time; single source of truth, semantic interoperability
- **Application strategy:** Standardized workflows, reduce variability; promote re-use of Business Rules; defined policies, metrics & SLAs; value realization from KP HealthConnect
- **Infrastructure strategy:** Multimedia, multi-channel access; available; resilient & maintains performance SLAs; provision quickly, agile; minimize Total Cost of Ownership

After observing and evaluating work in hospitals and medical centers, IT leaders partnered with clinicians to understand the affects of system downtime and impacts to operations to better understand clinicians' concerns: to have patient data available 24x7x365, with uninterrupted access required even during downtime for system maintenance, and to build a solution using best-of-breed design principles. Expensive process re-engineering, data disclaimers or training should not be

required to use the new solutions and users should not be burdened with the complexity of determining what to do or which system to use during an outage. To the clinician, it means *always* being able to access and act on information, trust data integrity, and not worry about disruptions.

Continuous Availability: KP evolved a disaster recovery program into Continuous Availability (CA), defined as: CONTINUOUS OPERATIONS + HIGH AVAILABILITY = CONTINUOUS AVAILABILITY Continuous Operation includes user support, even during unplanned outages. Design principles include planning for additional growth capacity. A highly available system can be used heavily. CA applications are designed to eliminate any single point of failure and allow online hardware, network, operating system, middleware and application upgrades, patches and replacements. These are designed to eliminate outages from unplanned outages and/or disasters, which requires two physical copies of the application that are geographically separated. Sometimes 100% availability is not possible due to limitations of the application, database or other technologies. In such cases, recovery point objective (RPO) and recovery time objectives (RTO) must be documented for all outages.

The vision of delivering a continuously available system sparked the CA program, which provides support for disaster recovery, planned maintenance, and unplanned outages, and goes beyond the highest class of service. CA can be used on a regular basis to safeguard data while reducing downtime. RTO is the duration of time within which an application must be restored after a disaster to avoid unacceptable levels of consequences for the business. KP HealthConnect has an RTO of ≤ 1 hour and its RPO (the point in time to which data must be recovered following disaster) ≤ 5 seconds.



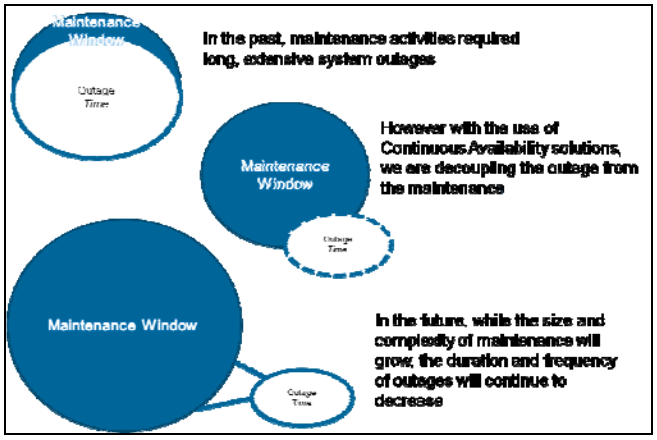
Disaster Recovery Service Level Breakdown

Disaster Recovery: To prepare for disaster recovery, we utilize replications of the KP HealthConnect databases between national centers. Data is synchronized using a shadow process, so if a national data center becomes unavailable, the alternate copy would be up to date. After a brief switchover period, users would have full application functionality that would seamlessly run out of KP's alternate data center. During the switch-over process while neither the primary or secondary applications are available, a read-only copy (shadow) is available. Data for the shadow is copied from the system locally to a separate database at each data center, ensuring there is always information available. Facilities are equipped with Disaster Recovery PC (DRPC) computers, which are connected to emergency power, and download information from KP HealthConnect.

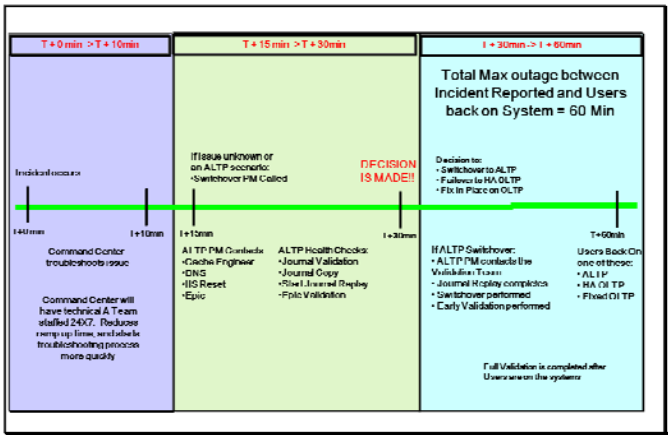
Planned Outages: Planned outages tend to be most costly due to the user impact on business. For a typical planned outage, each hour of downtime requires extended staff and resources, and usually occurs during off-peak hours to minimize disruption. KP is decoupling the outage from the maintenance window, meaning that system unavailability is minimized thanks to alternate copies of the applications and database. While system maintenance can be more complex and frequent, most s can occur on the system when users are inactive. The staffing requirement to support this work is greatly reduced and disruption minimized, allowing for faster return to operation.

Unplanned Outages: Traditional disaster recovery practices must be built into any IT system – especially in health care. However, when one system component fails, it should not bring down the entire system. KP builds redundant components at the data center level to minimize risk of localized failure. When impacted, components can be switched to a different data center without disruption.

During outages, it's easier and more efficient to switch users to the alternate copy rather than troubleshoot the primary system. To support availability, we employ industry-leading technologies and processes to ensure the integrity of our system. In unplanned scenarios, we maintain a Rapid Response Team, on-call 24/7, to lead a bridge and conduct switch-over, to restore connectivity.



Decoupling the outage from the maintenance window.



Switchover timeline for an unplanned outage

ALTP Switchover Process: The process of switching users from the active data center instance to the passive instance is referred to as the ALTP – Alternate Transaction switchover process. Both the primary and passive systems are online and active, with the passive system at a lower run level (warm standby). Data is replicated via Epic Shadowing process, to ensure that the databases are synchronized. During both planned and unplanned outages, users are moved to the SROC (Shadow Read Only Copy) while the active instance is brought down and the passive instance is brought up. The new active copy can be utilized indefinitely –there is no immediate need to switch users back to the prior instance of KP HealthConnect. The alternate (passive) instance becomes the new primary instance, and users can conduct business as usual. Unlike other disaster recovery systems, which are generally reactive, data at both data centers synchronize. During outages, users have access to multiple systems to ensure either full or partial access to patient records. In some cases, downtime procedures include using paper that will require reentry into the EHR system. However, during downtime, there is always a read-only copy of data available. Use of new processes and technology helps to lessen the interruption of normal business activities. During planned downtime activities (i.e., maintenance activities), users are moved to the SROC (Shadow Read Only Copy), while the switchover to the CA copy is underway. Downtime Reporting (DRPC) handles downtime situations, which can occur for many reasons (data center outage, WAN or power outage, LAN outage, application maintenance). DRPC provides a mechanism for reverting to paper for these outages. DRPC allows the site to perform report batch printing during downtime.

Minimal Downtime Release (MDR): MDR is an Epic process for code implementation upgrades. To enhance patient care, we conduct ongoing maintenance updates to incorporate fixes and enhancements. During a planned upgrade, we utilize the MDR process in order to decrease the impact to business, resulting in a reduction of the overall data recovery costs. Previous release upgrades spanned 48 hours, since reduced to as little as 4 hours. Most upgrades are done on the passive environment while providers continue to serve members. Previously, seasonal upgrades on average required a 2- 4 hour outage. With MDR, the total outage time is reduced to 30-40 minutes.

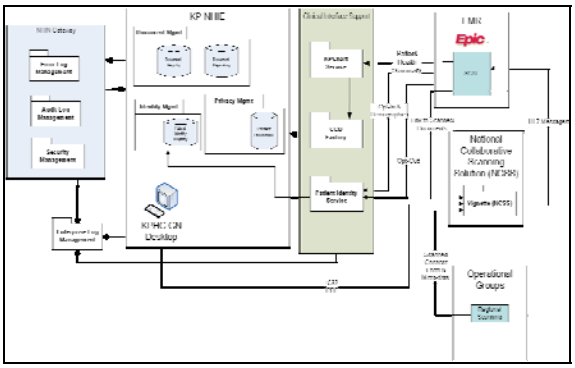
SRDF: SRDF/A is EMC storage level replication that keeps environments in synch, provides the ability to refresh environments on demand, and provides fast and secures data replication. It mitigates

the risk of data corruption between databases. Using clones, source side data corruption is only replicated to that clone, lessening risk of corrupting both sides before it's identified and remediated.

d. Data Archiving and Storage: The CA system components are part of our comprehensive backup and recovery strategy. With replication, data is mirrored between the primary and alternate systems located in geographically separate data centers, so there are multiple copies, clearly reducing risk. Having a second copy of the application stack and data does not eliminate the need for regular back-ups. Each EHR instance has two database clones, which are physical copies of the data from storage drives to physically separate disks within the same storage cabinet. Clones are the primary source for a complete server restore and provide a database copy if both primary databases were unavailable. Jobs run nightly to copy from the primary to the clone, alternating daily. Once the nightly clone process is complete, data is copied to a Virtual Tape Library (VTL) and also to physical tape via Tivoli Storage Management (TSM). Thirty versions of the database are kept on VTL for 30 days. Data is then copied to physical tape that is moved offsite for storage. Data is always retained. A patient may be deleted (logically) from the system, but not physically, allowing KP to respond to audit, legal, and government requests.

3-Standards

KP has a high level of data standardization and sharing internally and externally, and makes significant investments to maintain top-level standards adoption. The NwHIN is a set of standards, services and policies that enables secure health information exchange over the Internet. The KP HealthConnect-GN executes a suite of web services specified in standards published by the Office of the National Coordinator (ONC). These services constitute the NHIN Core Services and facilitate interoperability among organizations, such as Health Information Exchanges (HIE), attached to the NwHIN. Each is required to implement these services. The following milestones currently define the NwHIN project Q4 2009, VA Project Pilot: enable data exchange with the VA Q12010, DoD Inclusion; enable data exchange with the DoD Q22010 -Q12011, Phase 1B; extended functionality, Phase 1C: enhancements to web services functionality which include C32 documents and C62 unstructured document.



Design Summary – Solution Components – NwHIN Project

a. Common User Interface Standards: Because we use Epic across the enterprise, the look, feel and functionality of the EHR is similar, but not exactly the same. At the time of the initial ambulatory and inpatient implementations, our eight regions operated very independent business operations and a conscious decision was made to sacrifice enterprise full standardization in some cases for speed of implementation. However, each of the eight KP regions implemented common builds within their respective regions. Each has a governance process in place to address maintenance and regional build changes. Additionally, there are certain elements of the KP HealthConnect build that were built collaboratively and are maintained centrally, hence the name Collaborative Build. Items in this area are tracked and maintained nationally, as is the inpatient nursing documentation flow sheet build. Lastly, our Convergent Medical Terminology (CMT) framework is maintained nationally with regular updates that are pushed out to the regions. In Beacon Oncology, we also use common protocols across the country. We recognize the cost of variation within KP and efforts are underway to increase standardization across the enterprise. As major new ancillary systems are implemented, they are done so in a standardized fashion.

b. Data Model

- To standardize terminology across sites and providers, we employ Convergent Medical Terminology (CMT), which includes links to SNOMED CT, LOINC, ICD-10, RxNorm and other standards both by direct incorporation of the standards and by including extensive cross-maps to US standards. All of CMT is freely downloadable from the US National Library of Medicine (NLM) by medical domain, and the internationally relevant parts from the International Healthcare Terminology Standards Development Organization (IHTSDO) as part of the SNOMED CT International Release. CMT also encompasses a software toolset that is being incorporated into the international release of IHTSDO SNOMED tooling, and is available soon.
- Additional internal data modeling currently uses the HL7 version 3 reference information model.
- Software from Epic Systems Corp. as its primary medical records software. CMT and the standards mentioned above are incorporated into implementation of Epic products.
- HL7 messaging standards + the HL7 model for internal/external interfaces and interoperability.

c. Standards

- Data exchange standards: LOINC, SNOMED CT, ICD-9 and ICD-10, RxNorm and First DataBank vocabulary standards in data exchange for lab results, clinical problems and procedures, billing and claims, eRx and medication list exchange, respectively. KP uses HL7 v.2.3 1nd 2.3.1 extensively for data exchange with external business partners and stakeholders including commercial reference labs and authorized public health agencies. KP uses HL7 clinical document architecture (CDA) in conjunction with IHE profiles including XCA and XDS.b for clinical document exchange with authorized providers of care for treatment purposes.
- Document standards: CCD in production operations to exchange patient demographics, problem list, med list, allergies, immunizations, lab results, and vital signs, with other providers.
- Health care IT Standards Panel (HITSP) interoperability specifications or capabilities: implemented in production operations the HITSP C32 specification of CCD. As part of the NHIN, KP has implemented the HITSP TP13 Manage Sharing of Documents, HITSP T23 Patient Demographics Query, HITSP C80 Clinical Document and Message Terminologies, HITSP C83 CDA, CCD info. modules, HITSP C32 Medical Summary Document, and HITSP specifications.
- Use of ANSI ASC X12 transactions: A major proportion of billing, claims, eligibility, and other HIPAA transactions, are done electronically using the HIPAA-specified ASC X12 transactions, and the specified NCPDP transactions for med formulary, benefits and related transactions. Not all counterparties are ready to undertake electronic transactions, so the percentage is not 100%.
- IHE (Integrating the Health care Enterprise) profiles adopted: KP implemented in production operations the IHE XDS.b and XCA profiles for sharing clinical documents in near real time for treatment, along with the supporting IHE component specifications such as CT. As a participant in the NHIN production pilots, the version of these specifications implemented by KP is identical to the version implemented by US VA and DoD, allowing joint implementation of the Virtual Lifetime Electronic Record (VLER) for veterans who are shared patients.

4-Performance: Our business and IT partnership has allowed us to develop systems and processes that meet user expectations. As such, IT provides value for business. System Pulse helps monitor Epic systems by consolidating system messages from various sources (servers, Caché, Epic environments) in a central data repository which is accessible through a web-based front end. The website provides a dashboard for monitoring system's overall health and performance and interfaces for configuring rule-based alerts, viewing reports, and configuring settings. It allows you to view system's overall health, as well as the health of individual components. My Health Manager on kp.org allows members to access information contained in their EHR. Patients expect this

information to be available all the time. Because an increasing number of members access information online, it's part of the Continuous Availability solution.

VALUE

While we have documented specific dollar savings, our greatest benefits are the resulting improvements in clinical quality and patient service. As noted earlier, KP HealthConnect was designed and developed specifically to transform care and service vs. provide a financial ROI.

Capital and Operational Efficiencies:

- Patients are more likely to show up for office visits when they are booked online. "Failed to keep" appointment rates for those booked online are up to 50% lower than those made by phone.
- In one KP region, we saw a 95 percent reduction in dictation costs resulting from the implementation of KP HealthConnect. In another region, we saw a savings of more than $120,000 in dictation costs in just one year post-implementation. In a third region, we experienced a 36 percent reduction in dictation costs upon implementation of KP HealthConnect.
- We also saw savings in costs of printed forms almost immediately after implementing our electronic health record. In just one of our eight regions, we saw a $1.4 million decrease in printing expenses of annual outpatient forms alone.
- In one region, more than 22,000 square feet were vacated at fifteen medical facilities when medical records centralized. Estimated savings between $0.4 and $3.3 million in one year. KP is now building new hospitals without medical record storage areas.
- In one KP region, the implementation of electronic health records resulted in a 54 percent reduction of archival storage space, saving more than $200,000 in one year.
- In one region, 83 percent of clinicians found that the system's alerts helped them in ordering a specific diabetes test (HbA1c) for their diabetic patients, especially during an office visit.

Tobacco Status: In one KP region, capturing tobacco status in KP HealthConnect in nursing patient lists allowed us to rapidly identify members who smoke at admission, on the unit during initial assessment, and during emergency department visits. Doing so resulted in increased reliably from 50% to 100% in TJC Core Measures within 6 months. The performance improvement initiative encouraged rapid and redundant identification of smokers, aiding us in providing intervention and enrolling patients in smoking cessation programs. Nurses can cross check and identify members who smoke, offering them smoking cessation material and nicotine replacement therapies (NRT). Physicians use KP HealthConnect SmartSets to assist with NRT ordering and program enrollment.

A Different Kind of Mobile Health: In July 2009, a 1,780-square-foot mobile medical vehicle with real-time remote access to KP HealthConnect was installed at its home island of Hawaii (the Big Island) to make healthcare more accessible for KP members. Housing the island's only mammography machine, the MHV brings mammography screening in-house (previously contracted out). In just the first year, mammography screening rates increased among KP women aged 42-69 by 3% overall. The mobile vehicle houses a state-of-the-art digital mammography machine and video telemedicine, and provides a variety of services: Mammography, general health screening, pap, pelvic and breast exams, urinalysis, cholesterol and glucose testing, and immunizations. Because of its direct link to KP HealthConnect, scheduling and tracking can be done in the vehicle. The mobile health vehicle is on an alternating schedule, at or near the medical center in each location, and bringing mammography in-house has led to the ability to identify care gaps at intake and send needed orders electronically to InBaskets for signature (before, patients made mammography appointments directly with vendor). Test results are immediately input to KP HealthConnect, rather than relying on vendor records transcription. The mobile health team includes a nurse practitioner, medical assistant,

and mammography technologist, with physician services available. Almost 3,000 visits were done in the vehicle in the first year, with annual projections of 3,200 pap/general health screenings.

Derm at a Distance: In one of KP's largest regions, virtual "roving" dermatologists (VRD) used a virtual consult model/telemedicine, resulting in 67% same day access with a 33% reduction in referrals to dermatology. The region developed VRD consult models to increase the number of consults seen the same day as the initiating PCP visit. The program was initially piloted in one service area with the following results:

- 90% of patients waited 25 minutes or less for the Dermatologist consult
- 79% of patients found the VRD to be convenient
- 71% of patients would use the VRD service again

The workflow is as follows: The PCP initiates documentation using a SmartPhrase in KP HealthConnect and the medical assistant photographs the patient's affected area. The MA then uploads the photo into KP HealthConnect and routes the patient chart to the VRD. The VRD then reviews the chart and photo, sends a treatment plan to the PCP, who communicates the proposed treatment plan to the patient during that same initiating office visit.

Email use linked to HEDIS scores: One KP study, published in Health Affairs, found that secure e-mail between patients and physicians leads to improved HEDIS quality of care measures, with an improvement in the effectiveness of care for patients with diabetes and hypertension. More than 556,000 secure patient-physician e-mail threads, containing more than 630,000 messages, were logged throughout the study. Patients initiated 85 percent of those threads, which shows that health IT is empowering patients to better manage their health care. Results included 2.0 percentage-points to 6.5 percentage- points improvements in glycemic, cholesterol and blood pressure screening and control. KP physicians participating in the study reported that the use of secure e-mail messaging has been highly successful for diabetes patients, enabling them to follow instructions to the letter.

Convenience, Satisfaction, Efficiency and Clinical Quality: Two KP studies published in Health Affairs in 2010 show that a comprehensive electronic health record can increase consumer convenience and satisfaction and provider efficiency while maintaining clinical quality, and that connecting patients directly with their care providers and giving online access to important medical information was critical in adoption of online tools. The first paper found that between the implementation of KP HealthConnect in 2004 and 2007, office visits per member decreased 26.2 percent, total scheduled telephone visits per member increased nearly 900 percent. Secure e-mail, which began in late 2005, increased nearly six-fold by 2007. In addition to the convenience of fewer office visits and the benefits of faster resolution of health issues, e-mail and scheduled telephone visits saved consumers the often overlooked out-of-pocket expenses for travel, parking, and time lost that would otherwise be spent on other pursuits. A second paper showed that members find the greatest use in a website that facilitates e-connectivity with their health care team, allows them to view key components of their medical records, conduct clinical transactions online, and provides them with information so that they can make knowledgeable decisions about their health.

Saving Lives Through Better Sepsis Care: KP Northern CA built into KP HealthConnect standardized orders, documentation tools, alerts and other means to prompt effective interventions for sepsis in all care settings. The computerized records also allow KP's Division of Research in Northern CA to collaborate with clinical leaders to aggregate anonymous patient data and analyze the test results and clinical outcomes of thousands of sepsis patients. That analysis led to the identification of a subpopulation of patients who are at increased risk of developing an infection and require additional treatment and monitoring. As a result, the hospitals implemented follow-up testing

and preemptive rounding programs to ensure this population improves as expected. In addition to the significant reduction in deaths due to sepsis, the average length of stay for KP Northern CA patients with sepsis dropped by more than 17 percent in one year after implementation.

Electronic Messages Reduce Unnecessary Tests: According to a paper published in AJMC, electronic messages sent to physicians when they ordered a blood test for elderly patients reduced unnecessary D-dimer tests, which often test false-positive for the elderly. Upon receiving an alert in KP HealthConnect explaining the inaccuracy of the test for ages 65 and older and suggesting a radiological test as appropriate, the rate of the tests for patients over 65 decreased significantly, from 5.02 to 1.52 per 1,000 patient visits, a relative reduction of D-dimer orders of 69.7 percent.

1-Documenting the actual value of the EHR system

Meaningful Use: Thanks to our mature EHR implementation, KP is well-positioned to participate in the Meaningful Use Incentive program, which has provided both a useful yardstick by which to assess our implementation, as well as an opportunity to fine-tune a couple of areas. Our five Medicare Advantage Organizations (MAOs) are all participating and expect to qualify in the first year. Of our two non-MAO regions, which are not eligible to participate in the HITECH program, one is participating in our qualification preparations and the other is considering joining the effort. After conducting a gap analysis, remediation efforts unfolded to target key areas of opportunity:

- In many areas KP's mature adoption of EHR technology prepared us well for MU requirements. Clinical use of the technology in the areas of documenting patients' problems, medications, medication allergies, as well as use of electronic prescribing and CPOE are examples of clinical practices that were already well established and pervasive across the inpatient and ambulatory staff and physicians. The development of MU reports for these areas in each KP region documents this consistency and level of use. Some regions, however, took the opportunity to apply additional checks, such as hard stops in the EHR, to ensure consistency across individual physicians. In other cases, regional teams, even in regions not eligible for MU incentives, fine tuned tools, such as the after visit summary, so that all required and optional elements (e.g., allergies, point of care testing results) were included in the EHR tools shared with our members.
- The regional gap analysis also revealed operational inconsistencies, such as in the area of demographic data capture. MU helped highlight these differences and guided regional leaders in their development and execution of performance improvement approaches. Some regions enhanced EHR capabilities to meet the MU standards for this objective; others trained front line registration staff to capture the information in a sensitive and accurate fashion. All regions enhanced their auditing of the data capture of these demographic elements to track performance. Again, this occurred even in regions not eligible to participate in the MU incentive program.
- In the area of IT capabilities, MU accelerated enhancements to our EHR and improved standardization in some areas. For instance, Health Information Management (HIM) departments across different regions utilized different technology to capture and track release of information to patients and other requestors. MU certification required KP regions utilizing non-Epic software to evaluate whether their vendors would undergo certification. In all cases, KP learned that the vendors were not planning to seek MU certification, thus requiring KP to uniformly adapt the Epic HIM ROI module. The experience of early KP adopters of this module encouraged other regions and MU requirements facilitated regional investment in implementing this module and training HIM staff. In time for 2011 MU reporting and qualification, all participating regions and one non-participating region will have fully operationalized this module.
- The final Core Objective related to ensuring the privacy and security of our members offered KP an opportunity to revisit our risk assessment processes and procedures and further enhance our

documentation and reporting. Meaningful Use has brought these requirements to the forefront and engaged a broader KP community in understanding our commitment to privacy and security.

Across the board, MU provided us the ability to surface well-established best practices, make improvements where needed, and to fully document and communicate broadly how the organization is accomplishing these activities through the use of certified technology.

2-Success in Meeting Expectations of the Project Goals, Objectives and Business Case

"After the long and sometimes arduous process of KP HealthConnect implementation, Jack Cochran, MD, executive director of The Permanente Federation, congratulated the implementation teams for a job well done and then, borrowing a line from a colleague, quipped, "Welcome to the starting line." He was referring to the beginning of the process of value realization. Despite the enormous effort to implement an EHR, the accomplishment only achieved a necessary but insufficient condition for real change in health care. The process to achieve value—clinical quality improvement, operational efficiencies and cost savings, and improved consumer satisfaction—is neither straightforward nor easy." (*Connected for Health*)

Aligning KP HealthConnect Goals with the KP Promise.

High Quality of Care	Clinical information available 24/7 Unsurpassed clinical outcomes Real-time clinician access to recommended best practices National leadership in patient safety Enhanced research capabilities to support evidence-based care
Personal Care	Use of up-to-date clinical, social, and patient preference information Providing patients with information for shared decision making Enhanced personalized care
Convenient	Patient access to information via telephone, Web, and secure messaging Support for patients' participation in their own care Efficient access to care to minimize wait times and out-of-pocket costs Superior integration and continuity of care across specialists, settings, and time
Affordable	Reduced cost of care and improved visit experiences Elimination of waste associated with paper medical records Elimination of costly in-person services unless medically necessary or desired by the patient Streamlining IT and administrative processes and costs

Approach to 'Value for Harvesting.' Many benefits of KP HealthConnect have required deliberate policy changes, workflow redesign, focused and committed leadership, and/or an openness to entrepreneurial innovation on the part of knowledgeable clinicians. For example, improved patient safety can result from the implementation of Level 1 drug-drug interaction alerts. And chronic care management can be improved by electronic registries and EHRs that enable specialists to monitor and consult electronically in the primary care of entire populations of patients. But such benefits often require new workflows and possibly augmented and/or changed roles for care team members. As we like to say, 'Expensive new technology plus old business processes equals expensive old business processes.'

A good example of this type of benefit realization occurred in KP's Hawaii region when nephrologist Brian J. Lee wanted to find a way to reach beyond the traditional individual patient referral process so that specialists could help monitor and manage the care offered to an entire population of 10,000 patients with chronic kidney disease. He and his colleagues designed a quality improvement pilot, using an electronic database of lab results to identify and rank for risk all chronic kidney disease patients. Using KP HealthConnect, Lee electronically monitors the primary care delivered to the most high-risk patients to ensure it's in line with evidence-based treatment recommendations and, whenever appropriate, provides unsolicited e-consults to the patients' primary care physicians. In

effect, he turned the referral system on its head. In many cases, Lee recommended that patients be referred to a nephrologist for more intensive care. In others, the primary care physician was given the treatment plan necessary to prevent the need for referral. Making this inverted referral system work required not only the patients' electronic records, but dramatic changes in the relationship between specialists and primary care physicians, as well as the active support of clinical leadership. Results of Lee's five-year project showed that it increased early intervention for high-risk patients and reduced by two-thirds the number of late specialist referrals—those occurring within four months of the onset of end-stage renal disease. Early referral is essential in order to make changes that slow the disease.

Approach to Transforming Care: We are still learning what is possible with technology-enabled health care. We have not yet fully realized the right approach to transformation, but we believe that these are the necessary components:

- *Aligned incentives*—Confirmation that what improves the overall health care system ultimately benefits all components of the system (doctors, hospitals, health plans, patients).
- *A shared vision*—Four years after the creation of the Blue Sky Vision, KP executives were interviewed to understand if the initial premise was still relevant, and the consensus was a resounding yes: patient empowerment, quality of care, member service, leveraging technology to allow for efficient and effective care processes —all had become part of the organizational DNA.
- *Capability to identify, support, and disseminate care innovations*—Encouraging innovation and learning at all levels of the organization and having a format for sharing these innovations supports the ability to engage providers and staff in care transformation.
- *Collaboration and cultural transformation*—Consistent application of new health IT tools has helped KP's far-flung regions and providers overcome some of the limits of isolation and resistance to innovations "not invented here." A good example of how our clinical culture changed is the story of our Inter-regional Oncology Chiefs Group, representing hundreds of oncologists, which came to an historic agreement to work across regions to define and share a common set of clinical, evidence-based protocols that would be embedded into one single build for the KP HealthConnect Oncology module (called Beacon).
- *Top leadership support*—Successful care transformation requires new levels of cooperation among regional and national clinical operations leaders and support for regional innovations.
- *Not standing in front of fast-moving trains*—We have witnessed a genuine sea-change in ambulatory care as patient interactions via telephone or secure e-messaging have come to account for 41 percent—and growing—of primary care patient contacts. The availability of the secure patient-physician messaging functionality presented our physicians with many questions and concerns, but the medical group leadership embraced the notion that, in the end, it would contribute to more convenient and better care for the patient.
- *Freeing of data*—Critical to ultimate transformation is and will be the use of the mountain of data that KP HealthConnect collects and stores and are still in the process of harnessing and mining that data. Each day we have more examples of the potential improvements possible—cutting-edge research, clinical outcome reporting, operations reporting, new information to understand patients' health needs and preferences, and improved monitoring for patient safety risks." (*Connected for Health*)

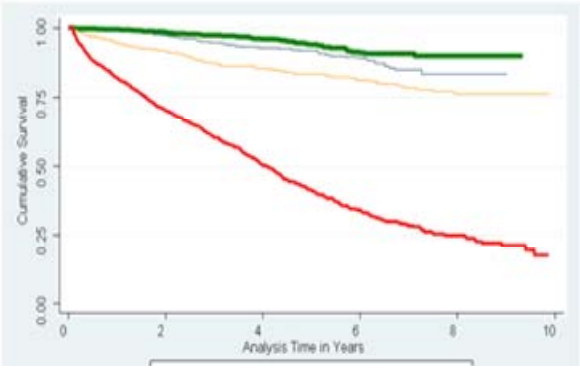
3-Success in Achieving Desired Change in Targeted Processes

Collaborative Cardiac Care Service – Collaborative Teams Improve Cardiac Care with Health Information Technology: KP Colorado has significantly reduced the mortality rate for patients with heart disease, which is the nation's number one killer for both women and men. Using team-based

medical best practices and computer-supported care registries, doctors and clinical care teams reduced overall mortality by 76 percent and cardiac mortality by 73 percent. Coronary Artery Disease is the dangerous buildup of plaque inside the coronary arteries. Cardiac mortality refers to all deaths related to heart events. The ability of clinical care teams to coordinate their efforts in cardiac care is greatly enhanced by the availability of electronic health information—which provides instant access to patient information—and evidence-based clinical care guidelines and protocols.

Chronic Conditions: The Major Health Care Cost Driver: Ten percent of U.S. patients account for 80 percent of all health care costs, and 75 percent of those costs are related to chronic conditions. CAD affects 80 million Americans and is one of the five top chronic conditions that drive the vast majority of health care costs. It remains the leading cause of death in the United States. Poorly managed, CAD too often results in hospitalization and early death. The American Heart Association and the National Heart, Lung and Blood Institute estimate that the total U.S. medical and social cost associated with heart disease and stroke was $475.3 billion in 2008.

Managing Chronic Conditions: Empowering People with Technology: Clinicians at KP are working in teams and across departments and using electronic health information to help prevent manageable diseases, like CAD, from becoming life-threatening crises. The care teams in Colorado tackled CAD by creating a new electronic care registry and support program called the Collaborative Cardiac Care Service. Recognizing the importance of early treatment and intervention, every patient who presented with CAD was enrolled in the program for both short- and long-term care.

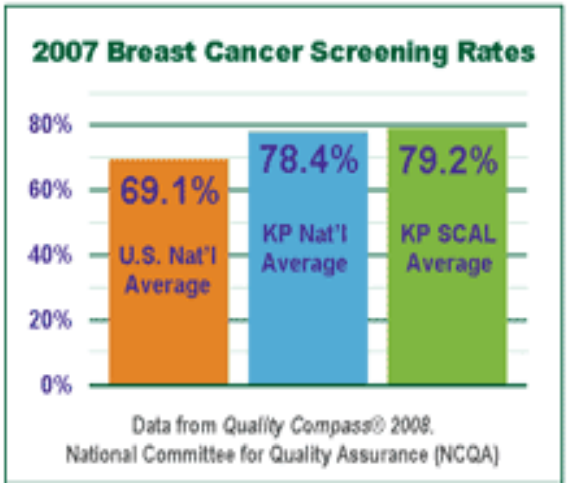


Physicians, nurses and pharmacists, using proven CAD risk-reduction strategies, work collaboratively with CAD patients to coordinate care. Activities such as lifestyle modification, medication management, patient education, lab results monitoring, and management of adverse events are all coordinated across multifunctional teams.

The program is driven by agreed-upon, consistent clinical care guidelines and protocols that are integrated into KP HealthConnect as decision-support tools to guide the care teams, at the point of care, as they treated more than 12,000 CAD patients. Immediate access to reliable, evidence-based information at all points of care enables each care team member to support a given patient's care plan, encourage treatment adherence, and allow disparate care teams—from primary care to pharmacy to rehabilitation centers—to coordinate care, regardless of setting.

Clear Results - Better Survival Rates and Reduced Need for Emergency Interventions: The results were impressive. Nationwide, research indicates that fewer than 20 percent of CAD patients are expected to survive 10 years after their first heart attack. The coordinated, evidence-based care, enabled by KP HealthConnect and an electronic care registry, increased that survival rate dramatically. It is estimated that more than 135 deaths and 260 costly emergency interventions were prevented annually, as a result of improved care. The program also achieved the following results:

- patients have an 88 percent reduced risk of dying of a cardiac-related cause when enrolled within 90 days of a heart attack, compared to those not in the program
- the number of patients meeting their cholesterol goal went from 26 percent to 73 percent
- the number of patients screened for cholesterol went from 55 percent to 97 percent



Breast Cancer Screening Better Care through Coordinated Teams and Health IT

KP has become a national leader in breast cancer screening, demonstrating the improved quality of care that results from coordinated health teams and electronic information sharing. Information technology is helping caregivers coordinate activities throughout the organization. Clinicians and staff are using these new and constantly improving IT tools to communicate and coordinate with each other between departments and with patients. These strategies made KP Southern CA a national leader in breast cancer screening rates in 2008.

The Importance of Early Screening and Detection: Women have a 13.2 percent lifetime risk of being diagnosed with breast cancer. That risk increases to a 1-in-7 chance as women reach their 60s. Unfortunately, too many women delay mammography or are not screened at recommended intervals. Reasons for delay include making the time, avoidance of discomfort, lack of understanding, fear of diagnosis, body image/self-consciousness issues, mobility, and geographic issues. Because 96 percent of all early-stage breast cancers are curable, actions such as early screening, detection, and treatment can reduce the death rate by 20 – 50 percent.

Engaging the Patient - A Coordinated Approach with an Informed Personal Touch: Addressing these many challenges required identifying new ways to engage women in breast health. Using an electronic database, we sent out routine notification letters to women who were due or overdue for their mammography screening. Even with simultaneous educational and awareness campaigns, the multidisciplinary care teams found that more direct and personalized interventions were required to increase the number of women receiving mammograms.

To go beyond sending reminders, care teams began conducting active outreach programs. Up-to-date clinical information, tied to an electronic scheduling system, allows trained call center staff to make phone calls and personally contact women who have not scheduled their mammography appointment. The call center staff then is typically able to schedule an appointment on the spot.

Recognizing that this outreach may not be enough to overcome resistance, many care teams added in-reach strategies to encourage all KP staff and caregivers to check whether a patient they are interacting with needs a screening appointment, and then schedule it for them immediately.
KP HealthConnect notifies physicians, clinicians and employees if a patient is due or overdue for a mammography screening. This electronic notification has been coupled with an internal campaign to create a "pink culture." Some medical centers have created incentive programs (movie tickets, drink vouchers and other giveaways) to encourage all staff and clinicians to participate in these efforts and remind women of their pending or overdue mammogram at every point of service. As a result of these in-reach efforts, women are more frequently sending us testimonials about their positive experiences in being convinced to get their mammogram at unusual "touchpoints," such as ophthalmology (see testimonial at left) and allergy (see video testimonial on kp.org/future) exams.

Proactive Office Encounter and Employee Performance Sharing Program Better Care through Coordinated Teams and Health Information Technology

KP's Southern CA region has increased the use of preventive cancer screenings and effectively encouraged improved maintenance of cholesterol by coordinating care across all who touch patient's

lives and integrating incentives and information technology. The proactive office encounter program fosters cooperation among providers: Clinical care teams composed of doctors, nurses, medical assistants and other staff work together to identify opportunities to engage patients and provide support and encouragement for positive action across the continuum of health care services. In addition, front-line union employees are financially rewarded through a performance sharing program when quality care goals, many affected by these types of screenings and preventative measures, are achieved.

The Challenge: Increasing Use of Preventive Care: Individuals in the U.S., regardless of insurance status, receive only about 55 percent of recommended health care, according to a 2004 RAND Corporation study. From preventive health screenings to routine monitoring and maintenance of treatable chronic health conditions, U.S. citizens under-utilize available basic care services.

Recognizing the need to improve delivery of health prevention services, KP's Southern CA region created the proactive office encounter program to identify and target patients with chronic medical conditions and encourage them to be active participants in their own care. The program uses all members of the clinical care team in a coordinated and collaborative effort to engage, encourage and support patient health. The information and tools provided have helped increase preventive screenings and improve treatment adherence.

The Solution: A Total Team Effort Supported by Information Technology: The program's proactive engagement begins for patients before they visit the doctor's office. The process starts with the automated creation of care checklists for all patients whose records indicate gaps in care. Clinical care teams review the checklists which include recommended preventive care and suggested actions to support patient use of that care. Based on the identified gaps in care, medical assistants initially contact patients to discuss the need for preventive screenings and routine care, such as cancer screenings and tests for abnormal blood sugar or cholesterol levels. When patients arrive at their scheduled visit a doctor, medical assistants or nurses review the pre-visit discussion and provide additional information based on physician recommendations. Following their appointment, patients are provided with an after-visit summary, patient education materials, prescription refills as appropriate, and follow up appointments are scheduled. Clinical care teams can determine whether members are adhering to their prescribed medication by analyzing refill trends.

Further, improvements in quality outcomes are encouraged through specific reward programs that provide financial bonuses to front-line when regional and annual goals are met. This system, established through an agreement with KP and its partnering unions, invests in the workforce and the collaborative teamwork it takes to meet these quality goals. Care teams are encouraged to turn each patient encounter into a "successful opportunity" to increase appropriate use of preventive and basic care. Success is measured not by how many people are scheduled or referred for screenings, but based on how many patients actually get the recommended screening. "Successful opportunities" now account for 10 percent of the total performance sharing bonuses available to care providers.

The Results - Significant Improvements in Screening for and Treating Disease. KP's Southern CA region has improved disease screening and treatment rates, which lower long-term health costs by preventing or successfully managing problems. Most importantly, these improved health outcomes save lives. Along with other concurrent improvement initiatives, the proactive office encounter has contributed to a 30 percent increase in colon cancer screenings, an 11 percent increase in breast cancer screening five percent increase in cervical cancer screening, and a 13 percent improvement in cholesterol control. If the program continues to advance at its current rate, it's projected that more than 10,000 lives will be saved per decade.

"**Reducing Hospital-Associated Pneumonia:** While evidence for many practices in medicine is not firm, developing a consistent baseline of care where there is sufficient evidence promotes learning and performance improvement. By establishing shared protocols for care, we are able to make better decision using what evidence we have, execute on those choices, measure results, and ultimately improve practice. One example is the development and use of shared Order Sets within KP HealthConnect.

All of our medical centers aim to eliminate ventilator-associated pneumonia, or VAP. Pneumonia accounts for approximately 15 percent of all hospital-associated infections and 27 percent and 24 percent of all infections acquired in the medical intensive-care unit (ICU) and coronary care unit (CCU), respectively. It has been the second most common hospital-associated infection after that of the urinary tract. The primary risk factor for the development of hospital-associated bacterial pneumonia is mechanical ventilation, with its requisite endotracheal intubation (CDC, 2005). Despite the frequency of occurrence, VAPs, are considered preventable. The Institute for Health care Improvement (IHI) provided information on the prevention of VAP in the form of scientifically grounded steps referred to as care bundles, which have been shown to reduce VAP rates (IHI, 2008). In 2005, KP's Baldwin Park Medical Center in Los Angeles set a goal of zero incidences of VAP, established in concert with the IHI's "Saving 100,000 Lives Campaign." The strategy was to establish paper-based protocols that included: IHI's ventilator bundle (a set of five practices that when done together have been shown to improve safety), hand washing, and oral hygiene. Daily multidisciplinary rounds were also established, led by an ICU physician and attended by all appropriate staff , including RNs and pharmacists. The average incident rate in 2005 was 3.0 per 1,000one thousand patient days. In October 2006, with KP HealthConnect implementation, the same protocols were embedded into KP HealthConnect ICU Order Sets relating to admissions, invasive ventilation, and sedation. As a result of having these protocols embedded in the EHR, the average incident rate dropped 60 percent in the first year of implementation in 2007. Since then, the cumulative rate is 1.6 per 1,000thousand days, representing a sustained reduction of 36 percent below the pre-intervention rate of 2.5. We continue to look for new ways to leverage KP HealthConnect to improve patient safety and reliability. We do this also with awareness that some of our decisions may have inadvertently created risk." (*Connected for Health*)

Barcoding: What CPOE offers on the "front-end" of the medication management process (that is, prescribing), barcoding offers on the "back-end" (that is, administering). A barcode is an optical machine-readable representation of data, most commonly seen in supermarket checkout systems. Data is encoded on both the medication and the patient (on a wristband), both of which are scanned at the point of care. While studies conducted in VA hospitals in the early 1990s showed that the use of barcodes reduced medication administration error rates by up to 86 percent (Meadows, 2003), estimates presented at a recent patient safety conference sponsored by the Center for Business Innovation indicate that only 2 percent to 6 percent of hospitals are currently using them to reduce medication administration errors. At KP, every hospital is implementing barcoding with KP HealthConnect.

"While nurses are still trained and held accountable for the so-called "Five Rights" of medication administration (right patient, right medication, right dose, right route, and right time), barcoding offers an additional set of checks and balances at the point of medication administration. An assessment of early results is impressive. In one of our medical centers, the medication administration error rate has decreased by over 50 percent; in another, the percentage of medication and armband overrides documented in KP HealthConnect dropped from 27 percent to 7 percent; and at a third center, such overrides dropped from 13 percent to 4 percent. Like any new technological

solution, barcoding does not come without a new set of problems. In addition to the challenge of learning a new technology, there are changes in workflow that need to be designed as well. Also, nurses may be confronted with system glitches that can drive the use of workarounds in order to complete their tasks on time. The following account provides further insight into the challenges one of our medical centers faced and what staff and management did to successfully address them:

'Barcode Medication Administration: In our Northern CA hospitals, we implemented barcode medication administration (BCMA) as part of an EHR "Big Bang" (implementing all applications in all clinical units, all the same day). The technology includes a unique identifier (barcode) on the patient's wristband as well as barcodes on every dose of medication and IV solution. We utilized barcode scanners mounted on wireless mobile carts to enable medication administration at the patient's bedside. The nursing workflow involves scanning the patient's wristband to check patient identification and open the patient's electronic medication administration record in KP HealthConnect. This ensures we have the right patient. The nurse reviews medications due on the record and then scans each medication, verifying the right medication, right dose, right route, and right time. The effectiveness of a BCMA safety system cannot rely on technology alone. Many factors must be solidly embedded to create and maintain a culture of safety. They include:

- Leadership Expectations: The nursing leadership must prioritize BCMA as a required workflow for every medication administered.
- Organizational Standards: Nursing leadership set a standard of 5 percent or less overrides (bypassing the barcoding process), which became a major goal for every medical center.
- Nurse Competency: Nurses need to practice BCMA with actual patient wrist bands and real medication barcodes in a safe "play" environment prior to use on patients. Competency documentation of each nurse prior to go-live is a key metric.
- Reports: During the first few weeks after go-live, daily reports of medication over-rides by facility, clinical area, and nurse allow for immediate feedback to nurses who create workarounds unless closely monitored. After achieving the goal of 5 percent or fewer overrides, monthly reports assist nurse managers in sustaining the correct workflows to prevent medication errors.
- Feedback and Reward Mechanisms: Providing simple but positive feedback to individual nurses who demonstrated correct and consistent BCMA workflows was an easy and effective success strategy.'

— Ann O'Brien RN, MSN, Director of Clinical Informatics (*Connected for Health*)"

"Medication Administration: Another valuable innovative practice change based on both high-tech and low-tech solutions involved a new approach to medication administration. With the help of our internal innovation consultants who had learned IDEO design approaches, KP MedRite was established to standardize and enhance the process of giving patients their medications. The national time and motion study referenced earlier found that nearly 20 percent of a nurse's work time (an average of 17.2 percent) was spent administering medication. We knew that dispensing medications and tracking them was a major patient safety issue that could be improved with KP HealthConnect and related process changes. Before KP MedRite, nurses had described the many distractions that prevented them from feeling safe about medication administration. In fact, we documented that, on average, a nurse had at least one interruption by another staff member during the course of administering medication.

With the EHR as a foundation, front-line staff designed a process that capitalized on KP HealthConnect functionality, integrated additional technology, and redesigned the workflow to be consistent throughout inpatient units. To combat the interruption problem, nurses began wearing a brightly colored sash or vest while administering medications so their colleagues would know they

should not be interrupted. Non-interrupt or sacred zones were also marked off around the medication dispensing machine. On the technology side, our Northern CA region took the lead in using barcode scanning technology for medication administration, as described in the following sidebar. These innovations resulted in a 50 percent reduction in the number of staff interruptions during medication and an 18 percent increase in the on-time administering of medications in our test sites. These innovations are being shared with other health care providers to benefit patients outside of KP." *(Connected for Health)*

"Clinical Decision Support - Making the Right Thing Easy to Do: Clinical decision support at the point of care is one of the principal opportunities for patient safety and quality improvement offered by EHRs such as KP HealthConnect. The U.S. Office of the National Coordinator of Health Information Technology, among others, has recognized decision support as fundamental to achieving significant benefit and 'meaningful use' of EHR systems. Delivering effective decision support, however, poses many challenges, including:

- Capturing discrete ('coded') data required by the system to make accurate inferences;
- Choosing the interaction model (optional versus automatic) and display mode (intrusive versus non-intrusive) appropriate to the situation;
- Considering workflow and human factors, including limitations of human attention and cognition;
- General clinical information overload and the real and perceived impact of decision support leading to 'alert fatigue;' and
- Barriers to adoption and use of clinical content generally and decision support in particular.

Given these considerations, useful decision support in a particular domain and circumstance might be a well-designed flow sheet or report, perhaps with a particular cell or value highlighted to draw the user's attention. In other cases, available access to advisories, results of prioritization or predictive modeling, or context-specific knowledge resources might be optimal. Finally, certain situations warrant intrusive alerting with optional or required responses (so called 'forcing functions'). In all cases, and particularly as intrusiveness (and thus workflow interruption) increases, effective decision support must be accurate, important, relevant, and actionable. KP HealthConnect contains many examples of effective clinical decision support. We learned early on that achieving benefit involves more than simply building excellent tools. Reports by region and by department demonstrated wide variation in use, with those departments that had active and engaged KP HealthConnect leaders and local champions far exceeding the use of safety-related decision support tools compared to those that did not. All KP regions have built clinical evidence and guidance into ordering and charting templates, such as 'SmartSets' and 'Order Sets.' All regions have also implemented both nonintrusive and intrusive alerts and advisories.

The Northwest region in 2009, for example, had more than 70 custom medication safety alerts, divided about equally into drug-drug interactions, drug-condition appropriateness, prescribing in the elderly, and renal dosing issues. In addition, there were more than 50 other safety-related advisories, mostly focused on recognizing high-risk diagnoses in the ED. Following implementation of alerts for high-risk drugs in the elderly, these prescriptions showed a sustained improvement of about 22 percent compared to baseline. A similar alert, triggered when the anti-nausea medication promethazine was prescribed in children under the age of two years, reduced this hazardous event to essentially zero. In addition to warning against risk, these alerts suggest and facilitate preferred prescriptions or actions, thus going beyond 'making it hard to err' to 'making it easy to do the right thing,' which unquestionably constitutes meaningful use."
—Michael Krall, MD, NW Clinical Content and Decision Support Lead (*Connected for Health*)

"Managing Medication-Related Alerts: The integration of real-time, in-process decision support tools within EHRs holds great promise for improving quality and patient safety by intercepting potentially problematic orders before they are carried out. Frequently cited examples of these tools are those related to drug-drug, drug-food, drug-disease, minimum/maximum doses, and drug "allergy" screening. CPOE systems are typically designed to pop-up alert messages when a medication order is matched with a potential problem in the systems' databases. Most CPOE systems utilize clinical content databases for medications from commercial providers (for example, First DataBank®, or MediSpan®). The advantage, both clinically and operationally, is that the prescriber can modify offending medication orders in real-time, before the medication order is passed to the patient and/or the pharmacy. Historically, drug-related problems were initially screened and identified downstream from initiation of the order, at the pharmacy processing the prescription. The pharmacist would then need to put the patient on hold while the prescriber was contacted to resolve the medication-related alert that fired within the pharmacy system. KP's expectations and assumptions when we began work with our vendors to design and implement a CPOE system (both for inpatients and outpatients) was that we would get the following medication-related alerts, and that these alerts would be appropriately targeted to situations of true clinical validity:

- Drug allergy checking;
- Basic dosing guidance (dose range checking);
- Formulary decision support;
- Duplicate therapy checking; and
- Drug-drug interaction (DDI) checking.

As we gained experience with the system, it was clear that the acceptance rate for the vast majority of the drug-related alerts was unacceptably low (less than 10 percent), and complaints from prescribers about 'irrelevant alerts' and 'too many alerts' rose exponentially. We realized that to optimize the utility of decision-support alerts, we would need to work very closely with the system vendor(s) to ensure that the CPOE software appropriately utilizes the clinical content database. We also needed to obtain data necessary to evaluate the appropriateness of DDI alerts and to devise a process to do that. And finally, we needed a clinically and operationally credible process for the ongoing evaluation of alert data to take informed action to improve selectivity, sensitivity, and specificity of alerts to avoid 'alert fatigue.' KP's medication alert management process now incorporates at least the following activities:

- Actual case experience within KP that involved significant adverse events;
- Comprehensive review of recent look-back data regarding actual alert rates and acceptance rates;
- Compelling evidence from internal KP clinicians and/or external expert sources that our DDI severity levels need modification.

As a result of these early challenges and our ongoing determination to improve the clinical validity of decision-support alerts, we now have moved from a less than 10 percent acceptance rate for severe DDI prescriber alerts to a current 2009 rate of more than 30 percent, which exceeds what is most frequently cited in the literature. We will continue our dogged determination to improve the sensitivity, selectivity, and specificity of all medication-related alerts, with a goal that all drug-related alerts are accepted at least 50 percent of the time."
—Carey Cotterell, pharmacy quality and patient safety leader, Southern CA (*Connected for Health*)

"The Emergency Medical Risk Initiative: Despite several ongoing, targeted risk reduction initiatives, the frequency of medical malpractice claims made against Kaiser Permanente has remained relatively flat, with slight severity increases year over year. Close to half of these claims result from diagnosis-related issues. An exhaustive Kaiser Permanente study of the causes of these

adverse events revealed opportunities for systematic improvements in every stage of the diagnostic process. The events, however, were not grouped into a particular setting or medical specialty. The only isolated setting for which we could identify a clear grouping was the emergency department (ED), which was the setting for about 11 percent of all diagnosis-related claims. We also determined that the course of treatment for about 40 percent of all diagnosis-related cases included an encounter with an ED. The initial search for a targeted education intervention for the ED led to a vendor's comprehensive system for risk reduction. The system focuses on the diagnostic process to help eliminate a failure or delay in diagnosis and includes clinical content for diagnostic decision support, clinical risk reduction education, and regular feedback to clinicians regarding their documentation performance. The decision support, in the form of risk prompts that serve as physician reminders, prevents cognitive traps and leads to more complete documentation in the medical record. A test of this system, known as the Emergency Medicine Risk Initiative (EMRI), was commissioned in 2005 to assess the applicability of the EMRI program to Kaiser Permanente. The goals were to:

- Demonstrate that a prompted medical record will improve the quality of physician documentation as measured by the EMRI audit;
- Test a systematic program of continuous improvement for management of emergency medicine risk that includes education, real-time bedside tools, and a performance assessment; and
- Assess the feasibility of incorporation of the decision support, audit, and reporting functionality into KP HealthConnect.;

Five Kaiser Permanente EDs piloted the program using a manual version of the decision support/prompting documentation tool. This demonstration included a pre- and post-audit of a sample of records to determine compliance with specified risk factor documentation. In addition, the educational component was evaluated. The manual tool resulted in improved scores on the clinical documentation audit and increased compliance in gathering information and acting on key indicators of patient risk. For maximum adoption and benefit, the pilot experience confirmed the need to incorporate the decision-support elements into the flow of the EHR. A survey of pilot site physicians about their experience with the system found that 41 percent of respondents were using prompts and found them helpful; 88 percent had taken online education and found it helpful; and medical record audit feedback helped improve documentation and diagnosis. On the basis of the pilots, it was decided that the chart template containing the decision-support elements and the audit and monitoring program would be incorporated in the KP HealthConnect collaborative build for all Kaiser Permanente EDs." (*Connected for Health*)
—Mark Littlewood , director, Risk Management and Patient Safety, The Permanente Federation

4-User Satisfaction

Staff Satisfaction and Engagement: Despite our most sincere attempts to prepare people for implementation of the new system, the transition from paper to electronic documentation was still a challenge for many. The following is from Ziporah Watt, an intensive care unit staff nurse at Southern CA's Riverside Medical Center: "The myth that 'computer charting' is quick, easy, and time-saving was dispelled in the first KP HealthConnect training class I attended. The information imparted was overwhelming. It was quickly apparent that learning to use the system would be a long process and that these new skills would take time to hone. When we started using the system, it was a paradigm shift for everyone to be able to care for patients with much more information available to us than we were accustomed to on the paper record. The change affected my workflow, patient care delivery habits, and how I communicated with others. It also became clear that many workflows needed to be improved, which led to some significant efficiency gains. Having experienced

KP HealthConnect for some months, it's easy to see that the system instills good habits in nurses: documentation is more thorough while communication and referrals are stronger. But despite the wealth of information that KP HealthConnect brings to my fingertips, it is still important that we talk frequently and openly with one another to ensure high-quality care." (*Connected for Health*)

User Satisfaction Survey: As part of a system upgrade in 2010, the Northwest region decided to conduct some extensive end user surveying in an effort to come up with objective measurements. These included a number of issues tracked in Remedy, the effects on revenue capture, quality stats at the hospital, as well as productivity. They also wanted to measure subjective perceptions of KP HealthConnect. They distributed one survey in April and sent the identical survey in November. For the first time, they now have data that shows what people truly think of KP HealthConnect. They asked people to rate statements such as:

- KP HealthConnect promotes efficient patient flow during a hospital or medical office visit.
- User feedback is integrated in to upgrades and training.
- KP HealthConnect improves communication between teams.

Across the region, every area showed improvement, with more people agreeing with each statement than people in disagreement. The highlights included:

- An 8% growth in people who agree that user feedback is integrated into upgrades and trainings.
- 84% (+4%) of people agree that "KP HealthConnect makes it easy to review the information that I need, when I need it."
- 94% (+3%) are neutral or agree that KP HealthConnect improves communication between teams.
- 39% growth in physicians who agree that KP HealthConnect provides decision support that allows them to provide better care or avoid errors.

5-Success in Meeting Other Corporate Objectives

The Cost of Downtime: Beginning with the first pilot of Continuous Availability (CA) in 2009, this program has delivered significant value and savings to KP. Reductions in outages result in a significant soft business benefit. Additional benefits from a CA solution have been identified for kp.org, backup storage, and testing equipment.

		Annual Savings ($ 000)									
CA Benefit	Type	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Storage equipment savings	Hard IT	-	3.8	2.8	1.4	3.8	1.4	2.8	3.8	1.4	$21
Testing equipment savings	Hard IT	-	-	1.03	1.03	1.03	1.03	1.03	1.03	1.03	$7
Subtotal		-	3.8	3.83	2.43	4.83	2.43	3.83	4.83	2.43	$28
Planned KP HealthConnect downtime reduction	Soft Business	3.1	11.3	11.3	13.2	13.2	13.2	13.2	13.2	13.2	$105
Unplanned KP HealthConnect downtime reduction	Soft Business	-	-	0.15	0.50	0.50	0.50	0.50	0.50	0.50	$3
kp.org downtime reduction	Soft Business	-	-	-	1.5	6.1	6.1	6.1	6.1	6.1	$32
Subtotal		3.1	11.3	11.5	15.2	19.8	19.8	19.8	19.8	19.8	$140
Total		$3.1	$15.1	$15.3	$17.6	$24.6	$22.2	$23.6	$24.6	$22.2	$168

Continuous Availability Benefits Summary – KP

Approximately $105 million in soft benefits have been identified from a reduction in KP HealthConnect planned downtime for regions with KP hospitals.

Drivers			
Hours of planned outages saved	X	Business outage cost per hour per licensed bed ($61.43)	Est. benefit through 2017: $105 million

	NCAL	SCAL	HI	NW	Total
Utilized licensed beds	2708	2497	184	129	5518
Annual outage hours saved with Continuous Availability	902	303	31	31	1267
Annual outage hours saved with Continuous Availability and automation	1018	380	37	37	1472
Continuous Availability savings (2009-2011)	$16.2	$8.1	$0.6	$0.6	$25.7
Continuous Availability savings with automation (2012-2017)	$49.5	$25.5	$2.5	$1.8	$79.3
Total savings (2009 to 2017)	$65.7	$33.6	$3.3	$2.4	$105

Assumptions

- Outage cost per hour per licensed bed based on Northern California downtime impact model – $61.43
- Baseline outage hours derived from 2009/2010 maintenance calendar
- Annual outage times after Continuous Availability implementation are estimated to be 8.25 hours per hospital (2009 – 2011) and 2.75 hours per hospital including automation (2012-2017)

Benefit calculation with Continuous Availability

"Reducing the Overuse of Antibiotic Treatment for Viruses: Although viruses do not respond to antibiotic treatment, physicians nonetheless prescribe these medications to about half of all patients with colds and upper respiratory infections, and up to 80 percent of patients with bronchitis. Such overuse has been implicated in the emergence and spread of antibiotic-resistant bacteria, particularly Streptococcus pneumoniae, which is the leading bacterial cause of community-acquired pneumonia, meningitis, and otitis media in the United States. To help reduce inappropriate antibiotic prescribing, Kaiser Permanente's Institute for Health Research conducted an intervention to educate patients and physicians about antibiotic overuse (Gonzales and others, 1999). Investigators used data from the pre-–KP HealthConnect EMR during a four-month period over two successive years to assess the effect of the intervention on antibiotic prescription rates for patients diagnosed with uncomplicated bronchitis. The first year had no intervention. The second year involved a full intervention that consisted of printed materials on antibiotics and colds, flu, and bronchitis mailed to patients of one primary care clinic, as well as clinic office posters on the inappropriate use of antibiotics. In addition, the intervention taught clinic providers about evidence-based management of bronchitis and how to say 'no' to patient requests for antibiotics. Two clinics served as control sites without any interventions, and another clinic received only educational posters. Using highly specific data from the EMR, researchers matched antibiotic prescriptions to patient office visits that resulted in diagnoses of bronchitis at each of the four clinics. The study found that prescription rates at all four clinics were similar during the first year of the study; but at the clinic receiving the intervention, the prescribing rate dropped from 74 percent to 48 percent. Furthermore, the EMR data showed that return office visits within 30thirty days for either bronchitis or pneumonia remained consistent throughout the study, demonstrating that reduced level of antibiotic prescriptions did not expose more members to bacterial respiratory infections." (*Connected for Health*)

"Providing Value to Nurses: The KP HealthConnect implementation process supported other key nursing practice changes. One of the earliest examples of this collaborative effort was the development of Nurse Knowledge Exchange (NKE), a standardized process developed with the assistance of IDEO, an innovation and design consultant, for shift change between the arriving and departing nurses. When our nurses first gathered to design the nursing clinical content for KP HealthConnect, they were asked, "What processes in your hospitals do you find challenging?" The top two responses were nurse communications at shift change and bed management. Before NKE, patients described the hospital floor during shift change as a "ghost town," since nurses would exchange information or shift reports behind the closed doors of a conference room or staff lounge. One component of NKE includes a standardized data template that serves as the key communication tool, assisting the departing nurse in preparing patient information for the shift change. The departing

nurse conveys this information to the arriving nurse at the patient's bedside, and key information such as diet and expected hospital tests are also written on a whiteboard in the patient's room. This standardized process also ensures patient awareness of their status and ensures accurate expectations for their care. During the NKE pilot phase, we found that the time an arriving nurse spent preparing to see a patient was reduced by 50 to 75 percent. Thus, NKE eliminated the "ghost town" effect—and patients felt more involved in their care. The standardized data template is now embedded in KP HealthConnect, ensuring that accurate, consistent information is available on each patient no matter who is delivering the care." (*Connected for Health*)

Environmental Impact of EHRs: An analysis by KP, published in Health Affairs in May 2011, showed that use of health information technology can dramatically reduce greenhouse gas emissions and produce other important environmental savings. The study estimated that electronic health records could lower carbon dioxide emissions by as much as 1.7 million tons across the entire U.S. The study was built on a unique model that evaluated the effects of EHR use on greenhouse gases, waste, toxic chemicals and water use within the KP system. The analysis found that KP's comprehensive use of health IT:

- Avoided the use of 1,044 tons of paper for medical charts annually
- Eliminated up to 92,000 tons of carbon dioxide emissions by replacing face-to-face patient visits (and the associated travel) with virtual visits
- Avoided 7,000 tons of carbon dioxide emissions by filling prescriptions online
- Reduced the use of toxic chemicals, such as silver nitrate and hydroquinone, by 33.3 tons by digitizing and archiving X-ray images and other scans
- Resulted in a positive net effect on the environment despite increased energy use and additional waste from the use of personal computers

"Central Venous Catheter Insertions: Patients who need frequent intravenous medication, blood, fluid replacement, or nutrition often have a tube or central venous catheter (CVC) placed into their veins, where it can remain for days and even weeks. However, CVCs can cause infections when bacteria grow in the catheter and spread into the patient's bloodstream, resulting in a catheter-related bloodstream infection (CRBSI). Each year, about 250,000 cases of CRBSI occur in hospitals throughout the United States, with an estimated mortality of 12 to 25 percent, or about 14,000 to 28,000 deaths annually (Centers for Disease Control and Prevention, 2002). These central venous catheters are inserted into about one-half of all patients in intensive care units (ICUs), putting ICU patients at particular risk. For years, such infections had been accepted as an unavoidable problem, but that has changed. The Kaiser Permanente Sunnyside Medical Center ICU, in Clackamas, Oregon., has gone nearly three years with zero infections at the time of this writing—an achievement that would have been virtually unimaginable for any ICU just a few years ago. Sunnyside physicians, ICU charge nurses, the IV team nurses, and infection control specialists teamed up to enable this transformation, with the help of KP HealthConnect. To begin, a group of quality-minded and evidence-based ICU physicians agreed to perform a 'bundle' of multiple best-practice elements, based on guidelines from the Centers for Disease Control, when inserting CVCs. A key strategy was 'to make the right thing to do the easy thing to do' for the physicians. Toward that end, a KP HealthConnect SmartTool was included, which requires the physicians to document performance of each aspect of the bundle in a checklist, thus both reinforcing knowledge of the bundle with each insertion and documenting adherence to the bundle for data collection purposes. IV team nurses who insert CVCs have a similar process for ensuring sterile insertion technique and universal adherence to the bundle. After the CVC is inserted, meticulous ongoing catheter care is required to avoid infection. The Sunnyside ICU conducts daily, multidisciplinary ICU rounds that utilize a checklist that assesses if the CVC is still needed. Sunnyside's remarkable success is due to physicians and

nurses who understand that the overall quality of care depends on the reliable delivery of many small elements of care by different people at different times—a level of coordination almost impossible without IT support, which transforms best intentions into hard-wired excellence of care delivery. Sunnyside's success in this area has provided confidence and a model for other quality improvement initiatives in the ICU, such as bundled measures aimed at reducing complications relating to invasive mechanical ventilation. KP HealthConnect is being reconfigured to once again make the right thing to do the easy thing to do. What is more, the Sunnyside success has set a high bar for ICUs throughout Kaiser Permanente, all of which are in pursuit of the same goal." (*Connected for Health*)

"Orthopedics and the Total Joint Replacement (TJR) Registry: Of the approximately 350 orthopedists within the Permanente Medical Groups, a small group emerged early on as eager adopters of KP HealthConnect. They readily took on the tasks of designing SmartTools for their common clinical situations and tamed the long lists of procedures and order sets on behalf of their colleagues. Whereas previously, they had come together across regional lines for educational conferences and high-level interchange among their department chiefs, they now embarked on detailed reviews of work processes and clinical needs. Thanks to the existence of common master files utilizing standardized medical terminology across all regional copies of KP HealthConnect, dedicated informatics-oriented orthopedists were able to develop tools for their entire specialty. They built, refined, and posted a variety of SmartTools on an Intranet site and also put out educational tools to assist their less technology-adept colleagues in learning to use the tools. With help from the legal and regulatory staff in sorting out varying scope of practice requirements that existed across state jurisdictions, they were able to provide tools that took advantage of staffs' highest level of training and licensure. Though the orthopedists varied in their prior use of electronic documentation tools, they were already sophisticated developers and users of data, as exemplified in the Kaiser Permanente TJR registry. This registry began even before the full roll-out of KP HealthConnect and consisted of detailed clinical data on patients and devices used for total joint replacement (knees and hips), trauma management, ACL knee repair, and spine surgery. Thanks to work by the orthopedic chiefs, assisted by scientists and statisticians, we now have data on more than 75,000 joints registered, providing a vast amount of real-world information concerning different technical approaches to various surgeries and devices, matching patient characteristics to expected outcomes.

Orthopedists can now use features of KP HealthConnect to allow for easily performed functional status surveys of orthopedic patients at periodic intervals following surgery to better determine which procedures and devices are most effective for which patients. Data for the surveys can be gathered either during office encounters with patients or by 'pushing' surveys out electronically to patients of various surgical cohorts through My Health Manager, the web-based personal health record, at pre-specified intervals. They also enabled more automated data collection in the operating room and in the office through the use of barcoding functionality in the inpatient KP HealthConnect application and the use of SmartPhrases and SmartText in the ambulatory setting. Finally, they enabled enhanced data capture and analysis to help guide future practice by specifying a limited set of documentation choices.

One result of this work is that Kaiser Permanente now has the nation's largest and fastest-growing population-based TJR registry. Armed with data collected since 2001, Kaiser Permanente orthopedic surgeons can make more informed decisions about the most effective TJR implants and clinical practices. They are also able to better identify patients at higher risk of complications.
This kind of comprehensive, comparative data and analysis enables us to address one of the great deficiencies in American health care, which is the lack of good, evidence-based comparative information about what works. In Sweden, for instance, a national hip replacement registry has

demonstrated a 50 percent reduction in surgical revision rates nationwide following identification and promotion of best practices among Swedish hip replacement surgeons. The revision rate in the United States, comparing Centers for Medicare and Medicaid Services data to the Swedish data, appears to be approximately twice as high as the rate in Sweden (Kurtz and others, 2007). In orthopedics, new technologies come on the market frequently, but there has been insufficient tracking of their comparative effectiveness by independent parties to determine how well each new surgical procedure or device performs over time. The FDA, for instance, only requires device manufacturers to test their products against doing nothing, as opposed to alternative existing devices. Without this information, orthopedic surgeons cannot identify best practices or recommend the most reliable implants. The use of less effective implants and surgical substances, like cement, too often results in the need to do complete surgical revisions, a major burden for patients and a major contributor to spiraling total health care costs. Hip and knee total joint replacements, for example, are already the second highest cost for Medicare, and the overall annual cost is expected to rise to $65 billion per year by 2015 (Kurtz and others, 2007). With the TJR registry and KP HealthConnect, we can now conduct, evaluate, and synthesize research into actionable clinical-care guidelines. One internal study, for instance, evaluated the best way to hold new joints in place. Manufacturer recommendations varied. Some patients had basic cement, some had hybrid surgical approaches plus cement, and some were uncemented. Until we evaluated the data, no one knew whether there was any difference in the survival time of the implanted joints based on the adhesive approach used.

Analysis of the TJR registry data revealed there was a significant difference. The uncemented implants had a lower survival probability than either the hybrids or the cemented implants, as shown in Figure 6.1. In addition, registry data led to a reduction in the number of minimally invasive hip and knee procedures, which had promised, but did not deliver, reduced pain for patients. The data also resulted in practice changes with respect to implant selections when it was shown that certain new implant technologies were more costly than existing technologies, with no difference in outcomes (Paxton and others, 2008). When that data was shared across the organization, care practices changed and fewer patients ended up needing replacement implants. Data combined with shared learning made a difference in patient care (and the resulting cost of care) for the people who didn't need to have the surgery done twice." (*Connected for Health*)

"Urology—Standardizing Evaluations and Reducing Radiation Risks: As with the orthopedists, the more than 200 Permanente urologists constitute one of the largest single specialty practice groups in the country. For them, KP HealthConnect meant an opportunity to do focused, pragmatic research on areas of pressing concern. One of the most common referrals in outpatient urology is for asymptomatic micro-hematuria (painless blood in the urine). Our urologists estimated that, as a group, they saw more than 40,000 cases each year. But when they examined how they handled this clinical problem, they discovered wide variability in which patients were recommended for further invasive studies. Furthermore, they were becoming increasingly concerned about the amount of ionizing radiation that patients received with CT urography and were dissatisfied with the very low rate of actually finding serious genito-urinary disease and cancers. They saw the opportunity in KP HealthConnect to standardize their medical evaluations, track their data, and hone their approach to this common clinical condition. In pursuing this quality improvement project, the urologists first commissioned an evidence review of the available scientific studies from Kaiser Permanente's Care Management Institute, which confirmed their suspicions that very little high-quality evidence existed to guide practice. So they worked across regions and asked our laboratories to consistently stratify and report hematuria. They then developed SmartTools that, like for their orthopedic colleagues, allowed for accurate, discrete, and consistent data in the EHR. Evaluation plans were also captured via standardized order sets, so that the positive results from diagnostic procedures such as cystoscopy

and CT urography could be captured and analyzed. However, standardizing the evaluations meant that potentially more patients would be sent for CT examination looking for tumors or kidney stones. In the light of recently published reports detailing the cancer risks of ionizing radiation, they urologists consulted with radiology colleagues to minimize patient risk. What followed was the development of a standard protocol for two-phase CT urograms, which reduced by one third the radiation incurred by the patients. The results of this standardized evaluation are expected to drive further research in urinary cancer markers and establish new thresholds for hematuria requiring additional testing and evaluation." (*Connected for Health*)

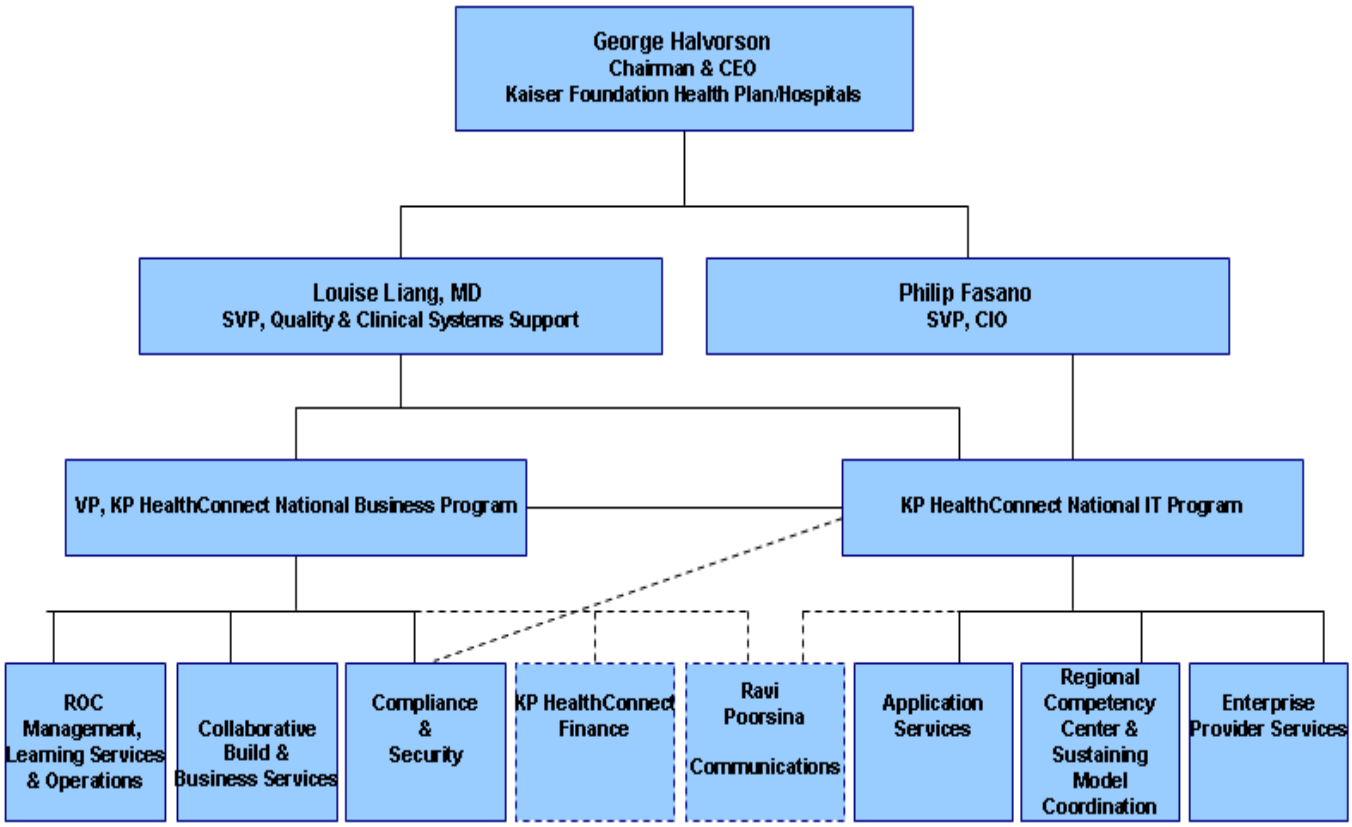
"Standardizing Protocols in Oncology: After the implementation and stabilization of KP HealthConnect, Kaiser Permanente became aware that the vendor, Epic Systems, was developing a new application for use in oncology. Assisted by specialty pharmacists and KP HealthConnect staff, we evaluated the functionality of the new product compared to home-grown systems already in use across Kaiser Permanente. While the existing systems were finely tuned to the needs of the oncology practitioners, the need to interface them with KP HealthConnect and the desirability of integrating the oncology treatment module into the clinical record proved to be a strong incentive for doing a national collaborative build of the Epic application for all of Kaiser Permanente. An additional driving force was the increasing need to understand the practice patterns of oncologists, as cancer increasingly became the leading cause of death and as cancer drugs soared in cost. For the first time, we had the opportunity to understand the prescribing behaviors of our oncology clinicians, a feat that previous IT and pharmacy systems had not allowed. With the emergence of new quality measures being published by the American Society of Clinical Oncology (ASCO), more insight into cancer treatment was imperative.

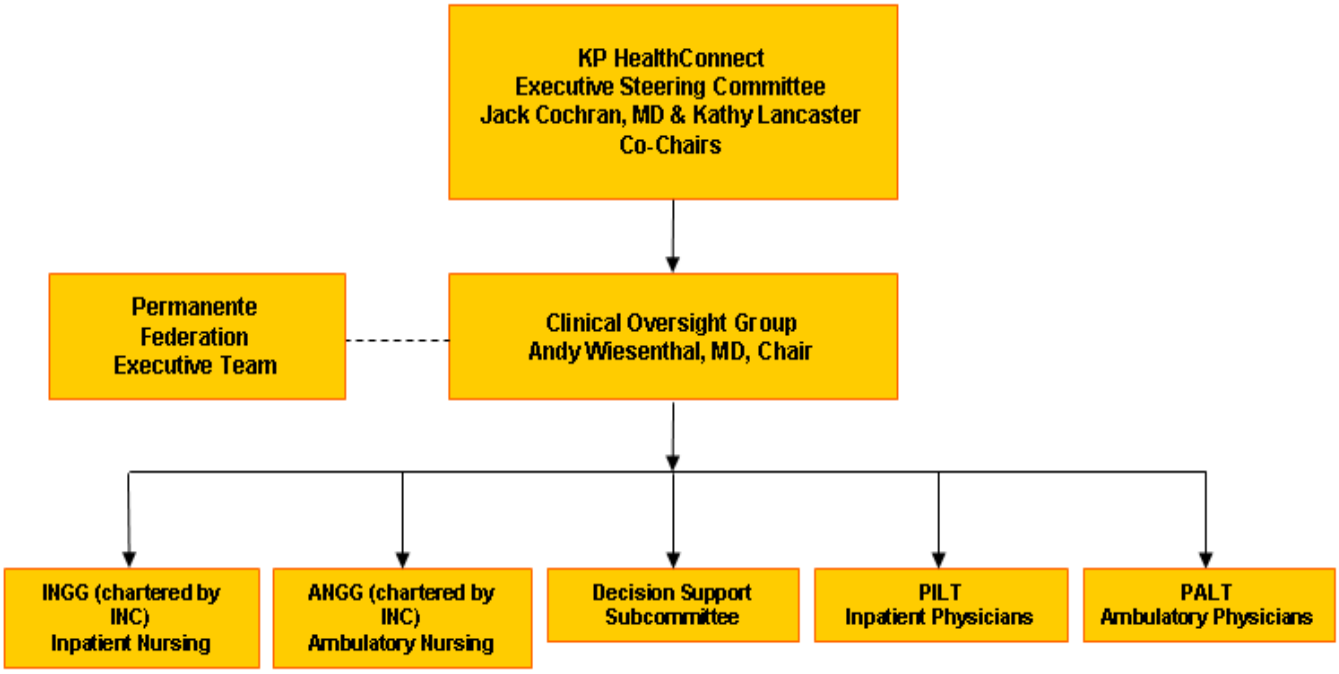
Under the leadership of the oncology chiefs and with one half-time, dedicated hematologist-oncologist, work was prioritized to address the most commonly utilized adult chemotherapy protocols, followed by those used in pediatrics, neuro- and gyn- oncology, and clinical trials support. Through frequent conference calls and the work of a dedicated oncology specialist pharmacist, they identified and standardized more than 230 protocols for the major adult cancers. Common nursing content was also developed and used across clinics. SmartTools were developed reflecting the protocols and physicians were able to enter the 'intent'—curative or palliative—of the chemo regimen ordered. Thus, linkage of protocols, to subsequent clinical experience and complications of the patient enabled a better understanding of real-world practice outcomes than those from highly selected patients in randomized clinical trials.

The standardized protocols are meeting the bulk of clinical need, since they are being utilized over 80 percent of the time. In addition, new tools have been requested from Epic to facilitate the customization of protocols. Once data is available from all oncologists, we will be able to feed data back to them to inform practice, as we have done with primary care for many years. We also hope that tools to easily identify patients who are eligible for experimental clinical trials will facilitate enrollment. In addition, metrics around efficiency in practice, such as infusion chair utilization, and safety metrics, use of alerts, analysis of possible adverse events, have been developed and are being used. Since oncology medications are highly toxic, medication errors are of very serious concern. We wanted to be absolutely certain that the implementation of the EHR did not lead to unintentional harm. Therefore we monitored the number of medication errors in the first medical center to implement the new system before, during, and after the implementation, and were relieved to find no increase during implementation, and that errors decreased after implementation." (*Connected for Health*)

"Screening and Treatment for Domestic Violence: The topic of domestic violence is not one commonly associated with the use of EHRs. Traditionally, many clinicians have been reluctant to even ask questions about domestic violence for fear the patient will respond in the affirmative, presenting the clinician with a challenging situation. An intense focus on this hidden clinical problem, which is a major cause of illness, injury, and death among women between the ages of 18 and 65, has resulted in a comprehensive, multidisciplinary program throughout Kaiser Permanente's Northern CA region to screen health plan members, identify high-risk patients, and refer them to appropriate services within Kaiser Permanente and/or community-based programs. The program, launched in a single service area in 1998 by Brigid McCaw, MD, MPH, now features clinical training in patient screening and identification for all primary care and specialty departments, web-based treatment guidelines, and evidence-based screening and assessment tools embedded in KP HealthConnect (called the "DV SmartSet")… Extensive multilingual educational materials, including brochures, pocket cards, and resource information sheets, are posted or otherwise available throughout the region's medical offices and a public website (www.kp.org/domesticviolence). Since the program was spread throughout the Northern CA region, the number of Kaiser Permanente members identified as affected by domestic violence has increased three-fold, and, notably, most of the identifications have been made in primary care offices rather than emergency or urgent care departments, where victims typically appear following an actual injury. This suggests that at-risk individuals are being identified and offered counseling before they are injured. This EHR-driven domestic violence program is now being implemented in various forms throughout all Kaiser Permanente regions. It has been nationally recognized as an innovative and model approach to a major, but often unrecognized, medical problem with awards from numerous national and local organizations for making a major difference in the lives of thousands of women and children." (*Connected for Health*)

Appendix 1: Deployment Organizational Charts (staffing changes have occurred since)


George Halvorson
Chairman & CEO
Kaiser Foundation Health Plan/Hospitals
Louise Liang, MD
SVP, Quality & Clinical Systems Support
Philip Fasano
SVP, CIO
VP, KP HealthConnect National Business Program
KP HealthConnect National IT Program
ROC Management, Learning Services & Operations
Collaborative Build & Business Services
Compliance & Security
KP HealthConnect Finance
Ravi Poorsina
Communications
Application Services
Regional Competency Center & Sustaining Model Coordination
Enterprise Provider Services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