FULL REPORT

SNOMED International

KAISER PERMANENTE

# SNOMED CT Case Studies

SNOMED CT
The global language of healthcare

Case for Investment

# Case Studies

## Business Transformation

Kaiser Permanente (KP) is the largest nonprofit healthcare plan in the United States, with over 12 million members. In 2002 KP hired George Halvorson as its CEO with the urgent need to integrate care across the entire KP organization by leveraging health information technology, and as a way for KP to obtain a competitive advantage in healthcare delivery.

## HealthConnect

KP selected Epic Systems to deploy the HealthConnect clinical information system and the My Health Manager patient portal in all KP locations. The KP HealthConnect deployment became the reference SNOMED CT deployment in the U.S. and globally.

## Day 1 Benefits

The use of HealthConnect provided immediate benefits to clinicians and patients:

- Improved patient safety with comprehensive, legible electronic patient health records.
- More efficient inpatient and outpatient care with 24/7 access to complete patient health records.
- Elimination of duplicate tests (e.g. laboratory, radiology) through availability of electronic orders and results.
- Improved patient engagement by KP clinicians demonstrating that “we know you”, and patients don’t have to repeat the same information about allergies, medications, and other elements of their medical history.

## Medium Term Benefits

The Harvested Value from the SNOMED CT–embedded HealthConnect system that required policy changes, workflow re-design, committed leadership, and an openness to innovations by knowledgeable clinicians. For example:

- Improved patient safety due to the implementation of level 1 drug-drug interactions.
- Reduced cost of medical records operations.
- Re-engineered workflows to improve quality outcomes while reducing waste and costs. For example, the use of population and management analytics that resulted in a significant drop in patient harm, and an improvement in HEDIS and cost of care rates. By 2009 KP was above the 90th HEDIS percentile across the U.S. for breast and colorectal cancer screening; controlling high blood pressure; cardiovascular LDL control; and diabetes LDL control.

**Long Term Benefits**

The Transformation of Care benefits from the SNOMED CT-embedded HealthConnect system included:

- Improved capability to identify, support and disseminate health care innovations, for example: Panel Management resulted in a decrease in office visits, an increase in telephone visits and an increase in secure messaging communications and patient portal interactions. Over a 3-year period physicians saw on average 6% more of their panel of patients, thereby increasing capacity or throughput. Physician work satisfaction increased significantly, and the patient-physician "relationship" measure improved by up to 64%.

- Increased opportunity for collaboration and cultural transformation, for example: Patient Portal – clinicians initially felt that patients were not ready to see their health data without the physician acting as an interpreter. A cultural change was needed. This was achieved through the required clinician leadership, communication and collaboration. In addition, KP now uses a 30,000 person virtual advisory group to advise on it My Health Manager patient portal direction.

- The ability to conduct better manage population health, for example: Collaborative Cardiac Care Service (CCCS) was developed by KP Colorado to improve the health of patients with Coronary Artery Disease (CAD). By 2010 CCCS was following over 12,000 CAD patients and demonstrated improvements in cholesterol screening and reduction in low-density lipoprotein cholesterol. The CCCS has achieved a 76% reduction in all-cause mortality associated with CAD in the patients followed by the service.

- Identification and dissemination of best practices and clinical guidelines, for example: KP accelerated its patient safety performance by: closing the loop of diagnostic test results; enhancing CPOE and decision support; creating drug surveillance features and new ways to detect harm. It reduced Ventilator-Associated Pneumonia rates by 60% in the first year and has a sustained reduction of 36%below the pre-intervention rate.

- For the detailed Kaiser Permanente Case Study see Appendix 5 here.

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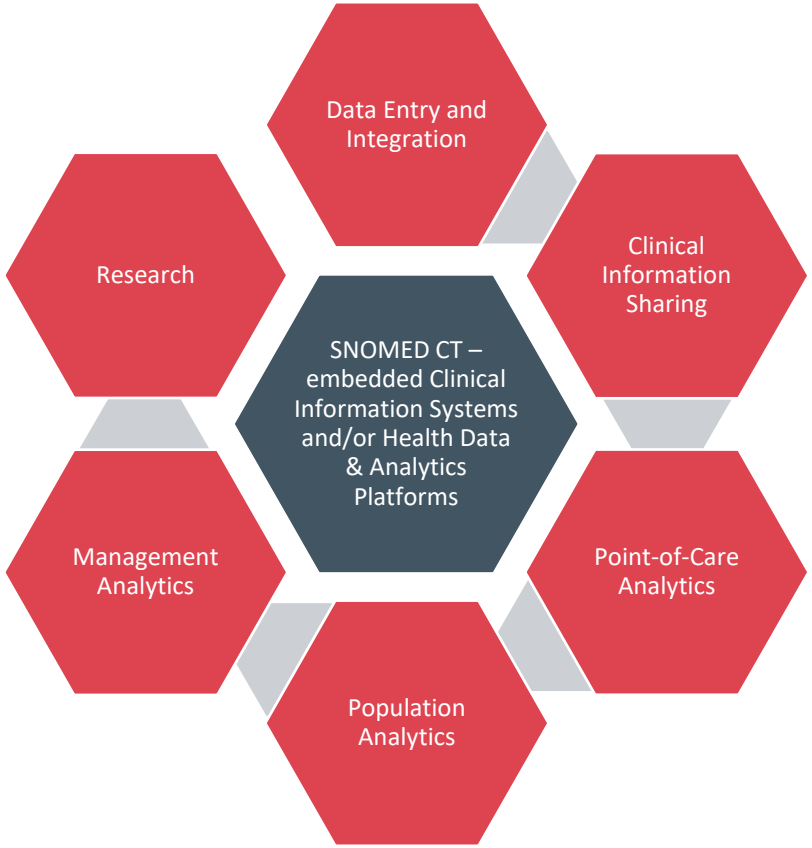
Kaiser Permanente

# Case Study #2

## Health Connect: Enabling the Transformation of Care Delivery

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### United States – Kaiser Permanente, Oakland, California

- Kaiser Permanente (KP) is was founded in 1945 and is made up of three distinct but interdependent groups of entities: the Kaiser Foundation Health Plan, Inc. and its regional operating subsidiaries; Kaiser Foundation Hospitals; and the regional Permanente Medical Groups. KP operates in eight US states (Hawaii, Washington, Oregon, California, Colorado, Maryland, Virginia, and Georgia) and the District of Columbia, and is the largest managed care organizations in the United States.
- Kaiser Permanente is the largest nonprofit healthcare plan in the United States, with over 12 million members. It operates 39 hospitals and more than 700 medical offices, with approximately 300,000 personnel, including more than 85,000 physicians and nurses. In 2019 it had operating revenue of USD$84.5 billion.
- As one of the nation's earliest adopters of electronic health records (EHRs), KP has achieved organization-wide use and integration of health information technology. HealthConnect, the organization's clinical information system project using the Epic Care EHR was started in 2004, and fully deployed in 2010, for a total cost of around USD$4 billion.
- The story of the KP HealthConnect implementation is detailed in the book "*Connected for Health, Using Electronic Health Records to Transform Care Delivery*"[1], the contents of which has been used to create much of this case study.
- KP had a history of digital health excellence that reached back to the 1960's. However, in 2002 KP hired George Halvorson as its CEO with the urgent need to integrate care across the entire KP organization by leveraging health information technology, and provide KP with a competitive advantage in healthcare delivery.

1. Liang L et al, "Connected for Health, Using Electronic Health Records to Transform Care Delivery" a Jossey-Bass Publication, 2010, ISBN 978-1-118-01835-4

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- In 2003 Halvorson, among other actions, started the transformation effort with the completion of the Board-approved IT business case[2]. To support the HealthConnect investment KP anticipated that use of the EHR system would result in increased efficiencies, improved clinical decision making, better care coordination, reduced medication errors, and new levels of patient engagement. The business case quantifies 36 financial benefits, which fall under the broad categories of reduced operating costs, increased revenues, and reduced capital expenditure. A positive cumulative net cash flow was calculated and a cost-benefit analysis identified a break-even point 8.5 years after the 2004 project initiation.
- The next step was to "start with the end in mind", in this case, value realization by improving the quality of care through the power of evidence. A Blue Sky vision was created that had four themes: Home as a Hub; integration of medical and wellness activities; secure and seamless transitions of care; and care that is customized to the patient. Next came the complete re-design and transformation of the health care delivery processes at KP.
- KP also developed 5 principles for its HealthConnect implementation: business-led; common platforms, processes and services; a preference to buy vs build; a single vendor integrated system; a system that can meet 80% of the KP needs.
- KP selected Epic Systems to deploy HealthConnect in emergency, inpatient, outpatient, laboratories, pharmacy, imaging, public health, membership and financials/benefits areas in all KP locations. It also provided bedside documentation, electronic ordering with clinical decision support, a patient portal (My Health Manager aka MyChart) and a suite of population management tools. KP also became a leader in developing interoperability among US healthcare organizations.

2. Garrido T. et al., "Making the Business Case for Hospital Information Systems – A Kaiser Permanente Investment Decision", Journal of Healthcare Finance, February 2004. https://www.researchgate.net/publication/7896965_Making_the_Business_Case_for_Hospital_Information_Systems-A_Kaiser_Permanente_Investment_Decision

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### United States – Kaiser Permanente, Oakland, California

- KP HealthConnect uses an array of international standards, chief among those is **SNOMED CT**. Others include LOINC (lab), DICOM (imaging), RxNorm (drug) and NIC,NOC,NANDA (nursing)[3]. **SNOMED CT** was chosen over ICD and CPT because it provided a richer, more granular expression of the data that is more familiar to clinicians. Further, coding patient care data using **SNOMED CT** could then be easily leveraged for clinical decision support, clinical and population analytics, as well as public health interventions. Starting in 2010, KP has generously donated its **SNOMED-CT** embedded Convergent Medical Terminology to SNOMED International to benefit all health care providers in the US and globally.
- A key component of the KP HealthConnect deployment was the meaningful involvement of clinicians (e.g. physicians and nurses) from the visioning, vendor selection, clinical process re-design, as well as to the system build, go-live, use and the on-going transformation. It was recognized early that the deployment of KP HealthConnect won't make clinicians necessarily faster in all situations, but they should be better.
- The use of HealthConnect to support the transformation of care delivery at Kaiser Permanente is still viewed by the health care industry as a landmark clinical information system deployment for a large integrated health care system, not just in the U.S., but also globally. Today, a decade later, Kaiser Permanente is recognized as an employer of choice (e.g. a best place to work in IT for the past 10 years), excellence in care (e.g. top scores for quality and service), as well as for its innovative leaders.

3. Wiesenthal A., "Kaiser Permanente HealthConnect" – A Large Scale EHR Deployment Using SNOMED CT" HINZ Conference presentation, 2007. See https://www.slideshare.net/HINZ/kaiser-permanente-healthconnect-ehr-and-snomed

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## HealthConnect: Enabling the Transformation of Care Delivery

**United States – Kaiser Permanente, Oakland, California**

KP took an immediate, medium-term and long-term perspective on realizing the benefits from HealthConnect

1. Day 1 Benefits of HealthConnect (immediate)

The clinical use of HealthConnect provides immediate benefits to clinicians and patients.

- Improved patient safety with comprehensive, legible patient health records.
- More efficient inpatient and outpatient care with 24/7 access to complete patient health records.
- Eliminate duplicate tests (e.g. laboratory, radiology) through availability of orders and results.
- Improve patient engagement by KP clinicians demonstrating that “we know you”. Patients don’t have to repeat the same information about allergies, medications, and other elements of their medical history.

2. Harvested Value from HealthConnect (medium term)

Many of the benefits of KP HealthConnect have required deliberate policy changes, workflow re-design, committed leadership, and an openness to innovations by knowledgeable clinicians. For example:

- Improved patient safety due to the implementation of level 1 drug-drug interactions.
- Reduced cost of medical records operations.
- Re-engineered workflows to improve quality outcomes while reducing waste and costs (see two examples overleaf)
- Reduced cost of regulatory compliance and other reporting activities.
- Savings from legacy system retirements.

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## HealthConnect: Enabling the Transformation of Care Delivery

**United States – Kaiser Permanente, Oakland, California**

EXAMPLE I: Re-Engineered Clinical Workflows - KP Hawaii Quality Improvement for Patients with Chronic Kidney Disease

- Specialist nephrologists, such as Dr. Brian Lee at KP Hawaii[4], were used to managing individual patients that had been referred to them by a GP. Specialists had never been involved in driving improvements in care for, in this case, the entire patient population of 10,000 people with chronic kidney disease.
- Dr. Lee and his colleagues used laboratory results to identify and rank by risk all patients diagnosed with chronic kidney disease.
- Using the **SNOMED CT**-embedded KP HealthConnect Lee then monitored the primary care delivered by primary care clinicians to the most high-risk patients to ensure that it was in line with evidence-based treatment recommendations, and when appropriate, he provided unsolicited e-consults to the patient's GP.
- In effect Dr. Lee inverted the traditional referral process. This required access to patients' electronic records, but also dramatic changes in the relationship between specialists and GPs, including the support of the clinical leadership.
- Results of Lee's initiative showed that it increased early intervention for high-risk patients and reduced by two-thirds the number of late specialist referrals – those occurring within the four months of the onset of end-stage renal disease. Early referral is essential to make the changes that will slow the progression of the disease.

4. Lee and Forbes., "The Role of Specialists in Managing the Health of Populations with Chronic Illness: The Example of Chronic Kidney Disease" The British Medical Journal, 2009. See https://www.bmj.com/content/339/bmj.b2395.full

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## HealthConnect: Enabling the Transformation of Care Delivery

**United States – Kaiser Permanente, Oakland, California**

EXAMPLE II: Re-Engineered Workflows – Population and Management Analytics

- During 2003-2004 the KP Board and senior executives began to look at performance oversight in the areas of quality, service and patent safety. The accountability shift from a position of "we believe we deliver the highest quality care" to "the numbers tell the real story" took time to develop and evolve.
- Three-year, system-wide goals were introduced at KP including the commitment to reach the 90th percentile on all the NCQA HEDIS (Healthcare Effectiveness Data and Information Set)[5] quality measures and the Joint Commission's National Hospital Inpatient Quality Measures[6]. These objectives were tied to staff compensation and pay-for-performance structures.
- As a result of this focus KP created "Big Q" a organizational dashboard, using management analytics, that reported on quality, service, safety, risk management and resource stewardship in both inpatient and outpatient care settings. The resulting transparency was a catalyst for change.
- The result was a significant drop in patient harm, an improvement in HEDIS and cost of care rates, as well as improvements in hospital and outpatient service performance.
- By the end of 2008 KP was above the 90th HEDIS percentile for breast and colorectal cancer screening; controlling high blood pressure; cardiovascular LDL control; and diabetes LDL control, as well as above the 75th percentile for cervical cancer screening.

5. See https://www.ncqa.org/hedis/
6. See https://www.jointcommission.org/

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**United States – Kaiser Permanente, Oakland, California**

EXAMPLE II: Re-Engineered Workflows – Population and Management Analytics con't

- Following advice from the Institute for Healthcare Improvement the next step for KP in improving transparency was to move beyond the traditional clinical quality perspective and add information on lives saved.

**Translating Clinical Metrics to Lives Saved (2004-2008 Q4)**

| Metric | Increase | Savings per Decade |
|---|---|---|
| Cholesterol Control | 16.8% | 1,350 lives |
| Blood Pressure Control | 36.6% | 4,890 lives |
| HbA1C < 9.0 | 7.8% | 738 lives |
| Smoking Cessation | 14% | 787 lives |
| Breast Cancer Screening | 11.3% | 565 lives<br>4,349 Stage 4 cases prevented |
| Cervical Cancer Screening | 5.8% | 38 lives |
| Colon Cancer Screening | 24.2% | 3.838 lives |
| **TOTAL** | | **12,206 lives saved** |

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## HealthConnect: Enabling the Transformation of Care Delivery

**United States – Kaiser Permanente, Oakland, California**

EXAMPLE II: Re-Engineered Workflows – Population and Management Analytics con't

- … and further, information was translated into cost savings or resource stewardship.

| Linking Quality Improvements with Financial Outcomes | |
|---|---|
| **Potential Savings from Reducing Harm** | **Amount** |
| Estimated Savings from reducing LOS cost for Methicillin-resistant staphylococcus aureus (MRSA), *C. Difficile*, and urinary tract infections | $34,000,000 |
| Estimated savings based on extrapolated CMS costs for coded harm from falls and coded pressure ulcers | $17,000,000 |
| Potential savings from medication reconciliation on admission | $9,000,000 |
| Annualized savings estimate by reducing costs associated with BSI, VAP and surgical site infections | $8,000,000 |
| Conservative savings estimate (10% of admission savings) above from medication reconciliation at admission, discharge and other indirect savings | $900,000 |
| **Total (projected savings may be incremental because some processes were in place and achieving some impact)** | **$68,900,000** |

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## HealthConnect: Enabling the Transformation of Care Delivery

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3. Transformation of Care enabled by HealthConnect (long term)

The third area of Value Realization was the longer term Transformation of Care supported by HealthConnect.

- Improved capability to identify, support and disseminate health care innovations.
- Increased opportunity for collaboration and cultural transformation.
- Identification and dissemination of best practices and clinical guidelines.
- The ability to conduct better manage population health.
- Expanded and more responsive research capabilities.

EXAMPLE III: Healthcare Innovations – Managing the Panel

- In the early 2000's, the primary care physicians at KP, like elsewhere, were caught in the daily grind of providing reactive care to increasingly sick patients. While HealthConnect allowed them to focus more completely on each individual patient, very few had the time or energy to think about the health care needs of the population of patients that they cared for – their patient panel. Many of their patients never came to their clinic, making them effectively invisible.
- Two primary care physicians at the Hawaii Permanente Medical Group felt there had to be a better way – what they called Total Panel Ownership (TPO). TPO focused on the primary care team's (e.g. physicians, nurses, medical assistants) relationship with the entire patient population. The team needs to "own and manage the panel", rather than the appointment schedule. This change in focus required a redesign of primary care processes.

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EXAMPLE III: Healthcare Innovations – Managing the Panel con't.

- To roll-out the TPO approach KP deployed innovation teams and a change package (e.g. data driven workflows, relationship-based care so the team "knows" the patient, more convenient ways to interact with patients including less face-to-face visits and more telephone visits, and collaborative care planning and decision making with the patient).
- KP HealthConnect functionality supported the new TPO workflows. For example: the generation of health maintenance alerts (e.g. vaccinations, disease screening) and appointments scheduled; unlike pre-EHR telephone visits, all relevant patient information is available to the clinician; real time processing of lab and medication orders; completion of clinical notes is completed during the call; and an immediate "After Visit Summary" immediately sent to the patient.
- The net result of TPO was a decrease in office visits – a 9% reduction per 1,000 members. Correspondingly there was an increase in telephone visits (e.g. in 2010 in Hawaii 30% of same day primary care visits were provided by telephone),as well as secure messaging communications and the patient portal interactions. Over a 3-year period physicians saw on average 6% more of their panel of patients, thereby increasing capacity or throughput.
- Almost all primary care innovation teams improved their quality performance, with 50% out-performing their regions. Quality measures also improved for the innovation teams faster than their regional counterparts.
- Finally, physician work satisfaction increased significantly, and the patient-physician "relationship" measure improved by up to 64%.

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EXAMPLE IV: Collaboration and Cultural Transformation – The *My Health Manager* Patient Portal

- Kaiser Permanente started interacting with patients online (e.g. health advice, discussion groups) in the mid-1990's in its Northern California region. These innovations were expanded and by 1999 KP Online had 117,000 users. In 2003 with the adoption of HealthConnect new opportunities arose with the Epic MyChart module to provide KP members with secure access to their medical records. KP branded it My Health Manager and made it available to all 8.6 million members.
- My Health Manager features included provision of test results, allergies, diagnoses, immunizations, prescriptions, summaries of past office visits, with the medical data sourced from KP HealthConnect. In addition, appointment booking, health assessment tools and encyclopedias, plus secure messaging services were provided to patients. To assist KP put in place a patient advisory group that by 2010 had expanded to a 30,000 person virtual advisory group.
- As was expected, many clinicians initially felt that patients were not ready to see their health data without the physician acting as an interpreter. Having patients access their records at the click of a mouse was unsettling to many clinicians. A cultural change was needed. This was achieved through required clinician leadership, communication and collaboration.
- By 2010, My Health Manager had 3.3 million users or 63% of KP membership over 13 years of age, with around 80,000 new registrations per month. The most visited features were test results, "email your doctor" and online medication refills with around 72,000 patient visits per day to the portal in 2010.
- In 2020, My Health Manager and the underlying product Epic MyChart remain leaders in the patient portal space, globally.

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EXAMPLE V: Population Health – Coronary Artery Disease

- Coronary Artery Disease (CAD) is one of the top five chronic conditions that account for the majority of health care costs. In 2010 it was the leading cause of mortality in the U.S. contributing to 40% of all deaths. Kaiser Permanente of Colorado developed the Collaborative Cardiac Care Service (CCCS) to improve the health of patients with CAD[7].
- Within 24 hours of hospital discharge all patients hospitalized with a cardiac event are enrolled in a 3-6 month educational and case management program with a nursing team and a pharmacy team. CCCS works collaboratively with patients, primary care physicians, cardiologists, and other health care professionals to coordinate proven cardiac risk reduction strategies for CAD patients. Activities include lifestyle modification, medication management, patient education, laboratory monitoring, and management of adverse events, The CCCS team uses HealthConnect and HealthTrac to document all interactions with patients, track patient appointments, and collect data for evaluation of both short and long-term patient outcomes.
- By 2010 CCCS was following over 12,000 patients with CAD. CCCS demonstrated improvements in cholesterol screening (55% to 96.3%) and reduction in low-density lipoprotein cholesterol (LDL-c) <100 mg/dL (22% to 76.9%). Approximately 85% of these patients were receiving statin monotherapy The CCCS has shown a 76% reduction in all-cause mortality associated with CAD in the patients followed by the service. Patient and physician satisfaction has been high with CCCS.
- The program received the Care Continuum Alliance's Leadership Award in 2009 for the best use of technology to improve patient health outcomes.

7. Sandhoff et al., Collaborative Cardiac Care Service" Permanente Journal, 2008 Vol 12 No. 3. See https://www.thepermanentejournal.org/files/Summer2008/cardiac-care.pdf

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EXAMPLE VI: Population Health – Mammography Screening

- In the early 2000's studies showed that early mammography screening, detection, diagnosis and treatment can reduce the breast cancer death rate by 20 to 50 percent, since 96% of all early stage, localized breast cancers are curable.
- IN 2003 KP set up "Operation Innovation" to identify and contact all women who met the age recommendations for mammograms, but had not been screened in the last 18 months.
- The program included use of the KP HealthConnect clinical information system to create the population cohort, track the mammography screening status of each target member, and record the results and procedures of each women.
- In addition, a wide range of methods were used to contact members, as well as conveniently and rapidly provide their mammograms (e.g. mobile mammography units) and results (e.g. a specialized team of clinicians was used to reduce the time for mammogram result-to-biopsy-to-diagnosis-to-surgical consultation).
- The program achieved a dramatic increase from 79.5% to 92% of eligible women receiving regular mammograms between 2004-2007. In addition there was a reduction in the time from the initial suspicion to the diagnosis of breast cancer from a median of 19 days to 9 days, with 79% of patients diagnosed within the target of 14 days.
- By 2008, Kaiser Permanente achieved the best breast cancer screening rates in the United States[8].

8. National Committee on Health Assurance., "NCQA 2008 Quality Compass" Healthcare Effectiveness Data and Information Set (HEDIS).

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**United States – Kaiser Permanente, Oakland, California**

EXAMPLE VII: Best Practices and Clinical Guidelines – Patient Safety

- The Institute of Medicine's seminal report "*To Err Is Human*" published in 2000 was a wake-up call to the health care industry, and a call-to-action for Kaiser Permanente. CEO George Halvorson recognized the opportunity to use KP HealthConnect to reduce preventable harm/injury to patients, improve the delivery of evidence-based care, and assist clinicians through the timely provision of information and decision support.
- With the focus on patient safety KP HealthConnect provided immediate benefits: legible, detailed longitudinal patient data, including the problem list, available 24/7; alerts (e.g. drug-drug interactions) and dose restrictions; and evidence-based order sets. KP then accelerated patient safety performance by: closing the loop of diagnostic test results; enhancing CPOE and decision support; creating drug surveillance features, as well as new ways to detect harm.
- **Reducing Ventilator-Associated Pneumonia (VAP)** – VAP is the 2nd most common hospital-associated infection, and is preventable. In 2006, the Institute for Health Improvement's (IHI) ventilator bundle of five best practices were embedded into the KP HealthConnect ICU order sets. As a result the average VAP incidence rate reduced 60% in the first year and has a sustained reduction of 36% below the pre-intervention rate.
- **Automated Harm Detection** – KP deployed the IHI Global Trigger Tool directly into HealthConnect as a way to identify adverse events, quantify the risk, degree and severity of harm. This adverse event surveillance capability allows KP to search all hospital inpatient records in real time and quickly identify and alert any quality/safety issues, as well as improve patient safety across the entire organization.

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## HealthConnect: Enabling the Transformation of Care Delivery

### United States – Kaiser Permanente, Oakland, California

EXAMPLE VIII: Research

- KP has been conducting health care research since 1943. By 2010 it had eight research centres across the U.S. conducting epidemiological and health service research, making it one of the largest research programs in the country. Most of the research is published in the peer-reviewed "*Permanente Journal*"[9] or other leading health care publications.
- With HealthConnect KP is able to easily access longitudinal, standardized clinical data on all its members. This "super-charged" KP's research efforts. By way of example, a few early EHR-enabled research papers are highlighted below.
  - **Population Research** – A landmark study on gestational diabetes mellitus (Hillier)[10].
  - **Patient Safety** – Utility of alerts in laboratory and prescription ordering (Raebel)[11], and effects of EHR alerts for contraindicated prescriptions among elderly patients (Smith)[12].
  - **Care Quality** – the effectiveness of diabetes management (Schmittdiel)[13].
  - **Effectiveness** – comparing outcomes for 40,000 patients taking Celebrex versus Vioxx (Graham)[14].

9. See http://www.thepermanentejournal.org/
10. Hillier et al., "Childhood Obesity and Metabolic Imprinting: the Ongoing Effects of Maternal Hyperglycemia". Diabetes Care, September 2007. See https://care.diabetesjournals.org/content/diacare/30/9/2287.full.pdf
11. Raebel et al., "Randomized Trial to Improve Laboratory Safety Monitoring of Ongoing Drug Therapy in Ambulatory Patients". Pharmacotherapy, May 2006. See https://accpjournals.onlinelibrary.wiley.com/doi/abs/10.1592/phco.26.5.619
12. Smith et al., "The Impact of Prescribing Safety Alerts for Elderly Persons in an EMR". Archives of Internal Medicine, May 2006. See https://jamanetwork.com/journals/jamainternalmedicine/article-abstract/410337
13. Schmittdiel et al., "The Effectiveness of Diabetes Care Management in Managed Care". American Journal of Managed Care, May 2009. See https://europepmc.org/article/med/19435397
14. Graham et al,. "Risk of Acute Myocardial Infarction and Sudden Cardiac Death in Patients Treated with Cyclo-oxygenase 2 Selective and Non-selective Non-Steroidal Anti-Inflammatory Drugs". Lancet. Feb 2005. See https://www.sciencedirect.com/science/article/abs/pii/S0140673605178647

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