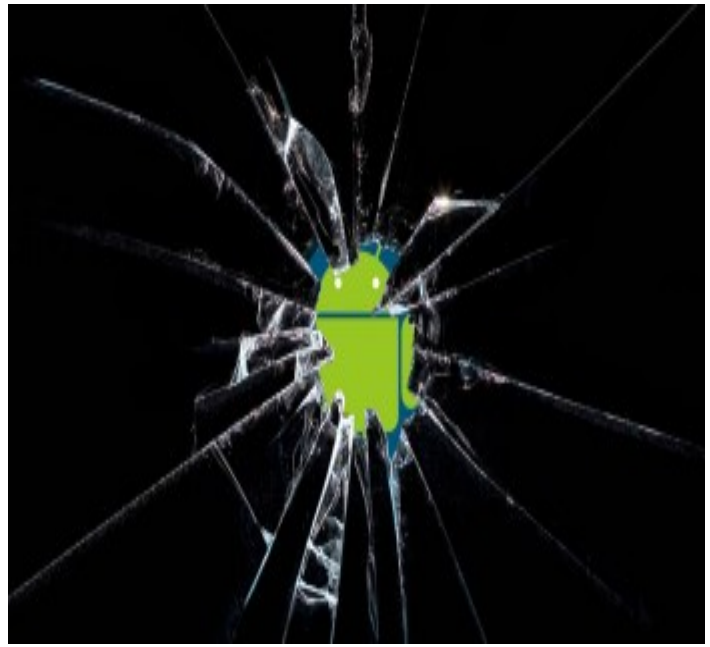
INCOSE Healthcare Working Group

5th Annual Systems Engineering in Healthcare Conference

May 1-2, 2019
Minneapolis, MN

Invited Presentation "The Evils of Healthcare Fragmentation and SE Solutions at KP"



Michael Kanter, M.D., CPPS, Professor of Health System Science and Chair of Clinical Sciences, Kaiser Permanente School of Medicine. Michael.h.kanter@kp.org

Bo Oppenheim, PhD, Professor of Systems Engineering, Director of Healthcare Systems Engineering Program, LMU. boppenheim@lmu.edu

Overarching Philosophy for Healthcare[1]

- **Safe**: Avoiding harm to patients from the care that is intended to help them.
- **Effective**: Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and misuse, respectively).
- **Patient-centered**: Providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.
- **Timely**: Reducing waits and sometimes harmful delays for both those who receive and those who give care.
- **Efficient**: Avoiding waste, including waste of equipment, supplies, ideas, and energy.
- **Equitable**: Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.

(1) Institute of Medicine, Agency for Healthcare Research and Quality, Rockville, MD. "Six Domains of Health Care Quality". Content last reviewed November 2018. http://www.ahrq.gov/talkingquality/measures/six-domains.html

The Evils of Care Fragmentation

- Every year in the U.S., estimated 250,000 people die by combined effects of care fragmentation [1]
- Third leading cause of death behind cancer and heart disease.
- The number of patients harmed but not killed is much larger.
- A study of 23,658 malpractice claims [2] found that:
  - 30% of the cases involved communication errors
  - 1744 of these resulted in death
  - Over 7000 cases were communication failures between clinicians, medical staff, and patients.

Fragmentation= Suboptimization + poor handoffs + lack of feedback/dropped ball + waste

[1] British Medical Journal, May 3, 2017
[2] Hoffman, J., et al "Malpractice Risks in Communication Failures: 2015 Annual Benchmarking Report, CRICO Strategies, The Risk Management Foundation of the Harvard Medical Institutions, Inc., 2015

A short list of Fragmentation Issues

- Healthcare Management stovepiped into disjointed departments, institutions, organization-centered rather than patient centered
- Culture of physician autonomy. True teaming integration in Dx or TX is still in infancy.
- Information overload; massive amounts of quickly changing information for physicians to obtain, correlate with medical knowledge, and analyze.
- Medical records incomplete, poorly organized, not standardized, often not transportable. Lack of National (international?) EHR
- Most of the handoffs are among people with different training, technical knowledge, nomenclature and cultures. Hierarchy gradients frequent.
- Many payment methods do not compensate for analysis, synthesis, care coordination, or quality improvement activities
- Chronic conditions not monitored or acted upon effectively.
- Preventive care often haphazard, lacking longitudinal and functional integration, failure to follow up on abnormal test.

Each item is an opportunity for Healthcare Systems Engineers

A short list of Fragmentation Issues – cont'd

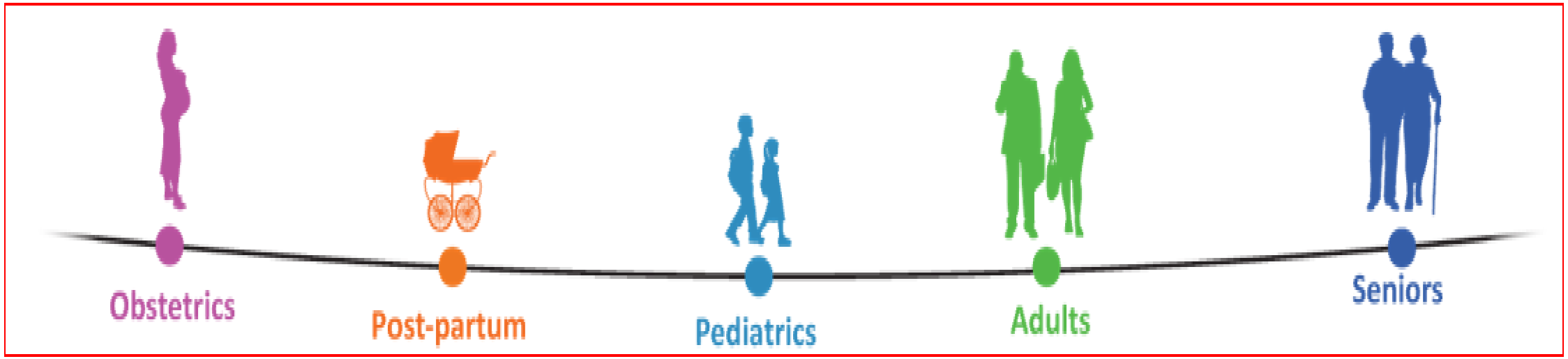
- Incorrect handoffs in handling of medications - (disregard for allergies, drug-drug interactions, drug-disease interactions, drug-age interactions), wrong dose, wrong time, failure to monitor drug effects in patient.
- Patients may have multiple diseases, be on large numbers of medications, and have massive medical records
- Patients deficient at reporting their conditions, and MDs have limited time to extract that knowledge from patients/family/HER
- 38% of Patients change insurance every year (usually employer-caused), with poor transportability of medical records.
- Most physicians operate at a 2 sigma level or less
- 2/3 of physicians admit to not having confidence in how they manage lab results.
- And many more…

Each item is an opportunity for Healthcare Systems Engineers

Traditional Medical Education contributes to Fragmentation

- Mostly based on memorization of large numbers of facts
- 50% of what is taught is incorrect
- 20 million citations in PubMed
- 700,000 new publications in 2010 alone
- 5500 journals in 39 languages
- Lacking systems thinking, especially among specialists

Fragmentation during the life cycle of patients.



The Huge Universe of Care Fragmentation

- The fragmentation issue is too big to address directly in its totality
- So, we focus on the following subsystems:
  1. (Easier, non-medical): Fragmentation of reactive care (patient comes in with a complaint…)
  2. Fragmentation in chronic and preventive care (highly medical)

1. Fragmentation of reactive care (a patient comes in with a non-trivial complaint…)

Except in routine cases, multiple stakeholders may be involved in many handoffs and no clear accountability

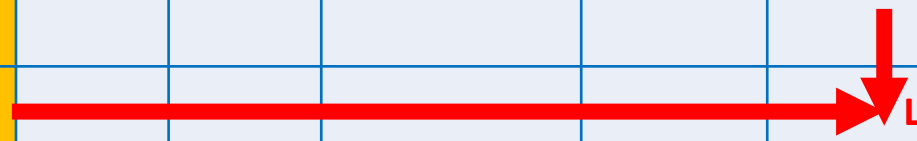
1. Patient
2. Primary care physician (PCP)
3. Specialist(s)
4. Several nurses
5. Clinical lab
6. Imaging lab(s)
7. Pharmacy
8. Electronic Health Records (EHR)
9. In serious cases: hospital (ER, OR, hospitalists and nurses, admin staff…)

- And this is a simplified model; the number of individuals involved is much larger.

Example of the need for Systems Engineering:Fragmentation

Except in routine cases, multiple stakeholders are involved in Dx and Tx

Possible interfaces									
Stakeholder/node	1 Patient	2 PCP	3 Specialist(s)	4 Nurses	5 Clinical lab	6 Imaging lab	7 Pharmacy	8 Electr. H. R.	9 Hospital
1 Patient									
2 PCP									
3 Specialist(s)									
4 Nurses									
5 Clinical lab									
6 Imaging lab									
7 Pharmacy									
8 Electr. H. R.									
9 Hospital									



Opportunities for failed interfaces

Example: Management of the Interface Between PCP and Clinical Lab

Problem	Likelihood	Impact	Mitigation (requirement)
Patient failed to go to the lab	1	5	Positive check with patient and reminder, if necessary
Sample untestable (wrong container, wrong handling, wrong label)	1	5	Contact patient for repeat.
Blood sample lost in transport or in lab	1	5	Contact patient for repeat.
Test performed but not resulted	1	5	Chase the result
Test resulted but no feedback to ordering MD	1	5	Improve EHR to give alarm to provider
Abnormal test not flagged as such	1	5	Implement EHR flags about abnormal test results
Ordering MD received test result but did not follow up	2	5	Automatic reminders to MD about abnormal test

Systems Engineering Approach

- Systematically and carefully evaluate every possible interface in both directions
- Identify potential issues/risks, likelihood and impact, formulate mitigation requirements.
- Implement mitigations to integrate the care seamlessly

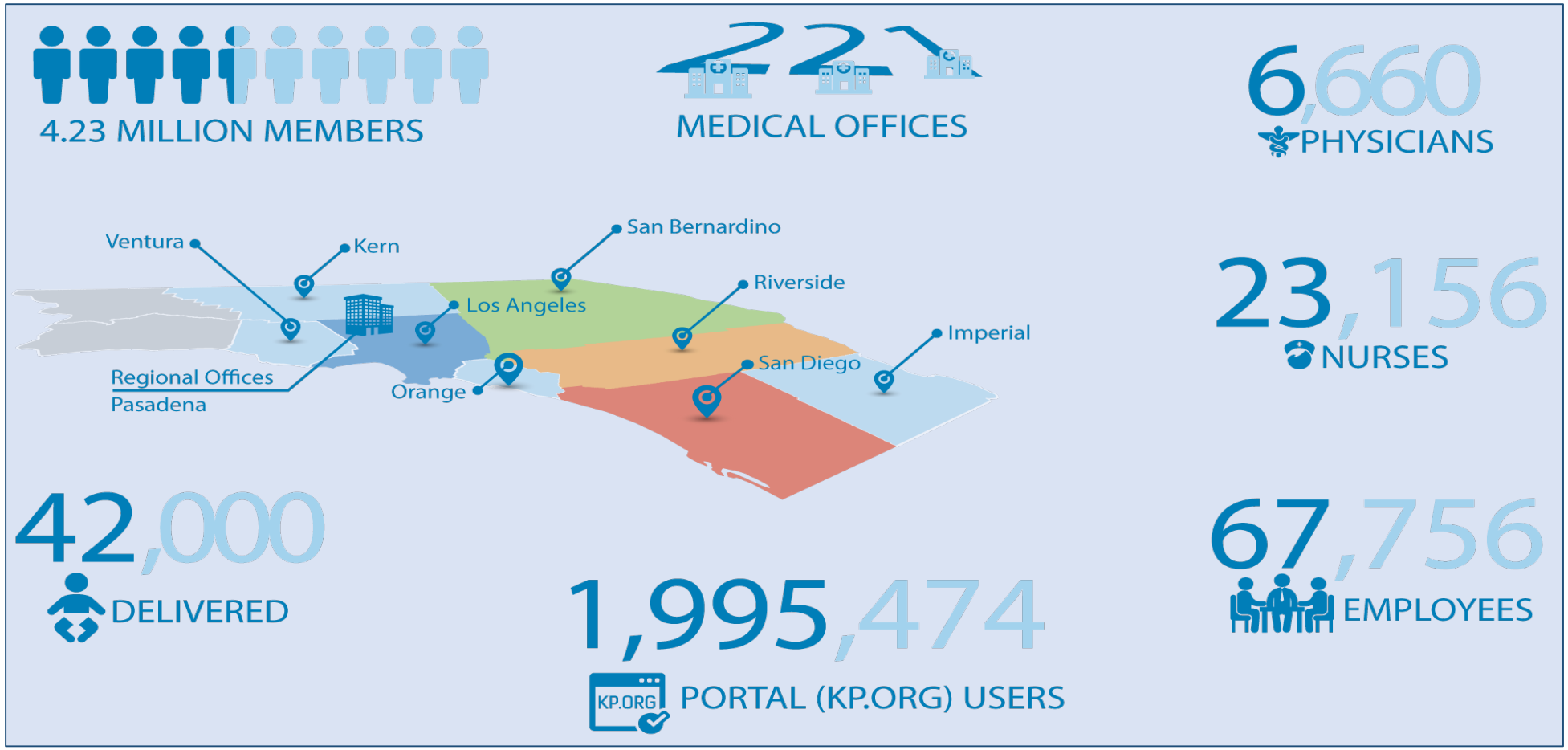
Neither traditional medical education nor traditional management (MBA or MPH) are sufficient.
"Bread and butter" for HSE.

Conclusions From Part 1

- We applied systematic (although abbreviated) SE tools (identification of system, subsystems/stakeholders, interfaces, risks and mitigations) to a relatively simple problem of reactive care (a patient comes with a non-routine complaint…)
- The SE approach comprehensibly identified the reasonable handoff issues and was conducive to identifying mitigation steps.
- This part was easy. Now, moving on to fighting fragmentation in chronic and preventive care for millions of patients….

2. Fighting Fragmentation in Chronic and Preventive Care at KP

Vastly bigger problem given the KP SCAL System Size



A short list of Fragmentation Issues

- All of the items discussed in Part 1 apply here.
- Lack of Follow up on Abnormal Test Result and Ignored Warning Signs
  - 44% of abnormal FOBTs (fecal occult blood testing based on home stool kits to screen for colorectal cancer) are never followed up within 5 years.
  - **52%** lab orders placed for patients with an abnormal creatinine not repeated after 90 days
  - A review of KPSC deaths caused by ruptured Abdominal Aortic Aneurysm revealed that 25% were due to failure to follow up on patients already known to have AAAs.
  - Delays in diagnosis of colorectal cancer due to lack of follow up on presumed Iron Deficiency Anemia with endoscopy
  - Elevated prostate-specific antigen (or PSA) level not evaluated by a urologist within 12 weeks of receiving results
  - Only 50% of evidence based care is actually delivered based on a national survey.
  - Patients live at home; physicians work in their offices.

Top Level Requirements[2] (Part 1)

1. KP shall create standardized infrastructure and evidence-based approach to disease management and preventive care services comprised of integrated systems, programs, and people which come together to help us focus on each person as a whole.

2. The Complete Care shall strive to operate at the best-in-class level.

3. The Complete Care system shall keep adding as many chronic and preventive-care conditions as possible.

4. The Complete Care shall include comprehensive care elements including ambulatory, hospital, online, home and specialized services.

5. The Complete Care shall be applied during the patient entire life cycle from pre-natal to death.

6. The system shall create a patient facing secure portal designed for patients to proactively participate in their care, learn about their conditions and communicate with their care team.

[2] The Complete Care was created without formal use of SE. The present requirements have been added post-factum.

Top Level Requirements[2] (Part 2)

7. A tracking software Sure Net shall be created to identify members who have inadvertent lapses in care, and permit a small, centralized team to intervene before harm reaches the patient. In addition, Sure Net shall track certain abnormal results for all members using automated electronic tools.

8. The system shall create Clinical Guidelines to provide evidence-based care to improve health outcomes, clinical quality and operational efficiency, and to disseminate the best practices among all providers.

9. The system shall have a consistent and systematic delivery of care among different medical centers and clinics within a region.

10. The system shall embed preventive and chronic care needs processes into standard workflows.

11. The system shall utilize information technology tools for identification of patient care gaps.

12. The system shall activate **all** members of the healthcare team in providing a proactive patient care experience.

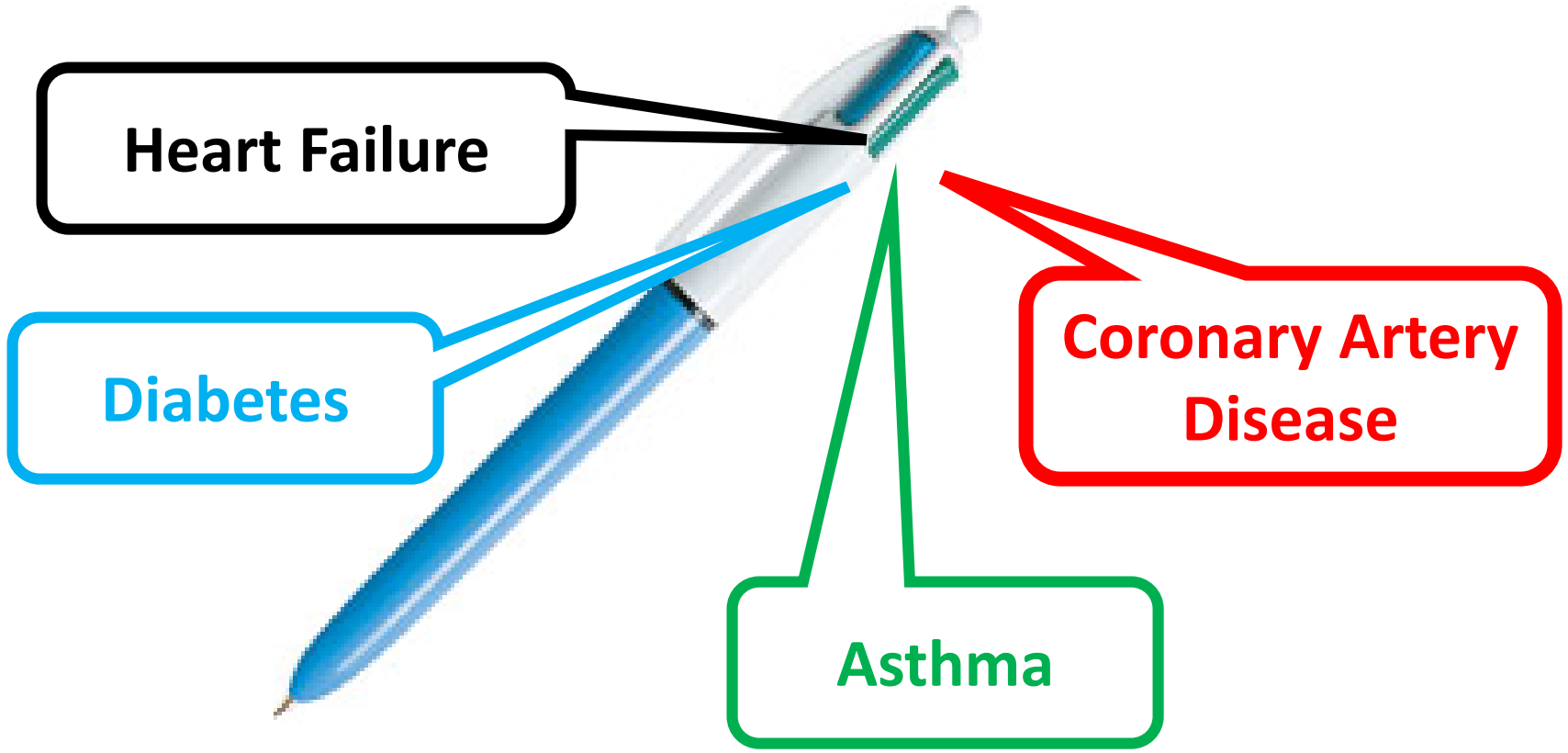
[2] The Complete Care was created without formal use of SE. The present requirements have been added post-factum.

Why is health care like flying a plane?

In the beginning, there were some conditions…

Bic 4 Color Pen. Source: www.officedepot.com

In the beginning, there were some conditions…



As time went by, we added more conditions…

Pentel “Arts” Color Pen Set
Source: www.amazon.com

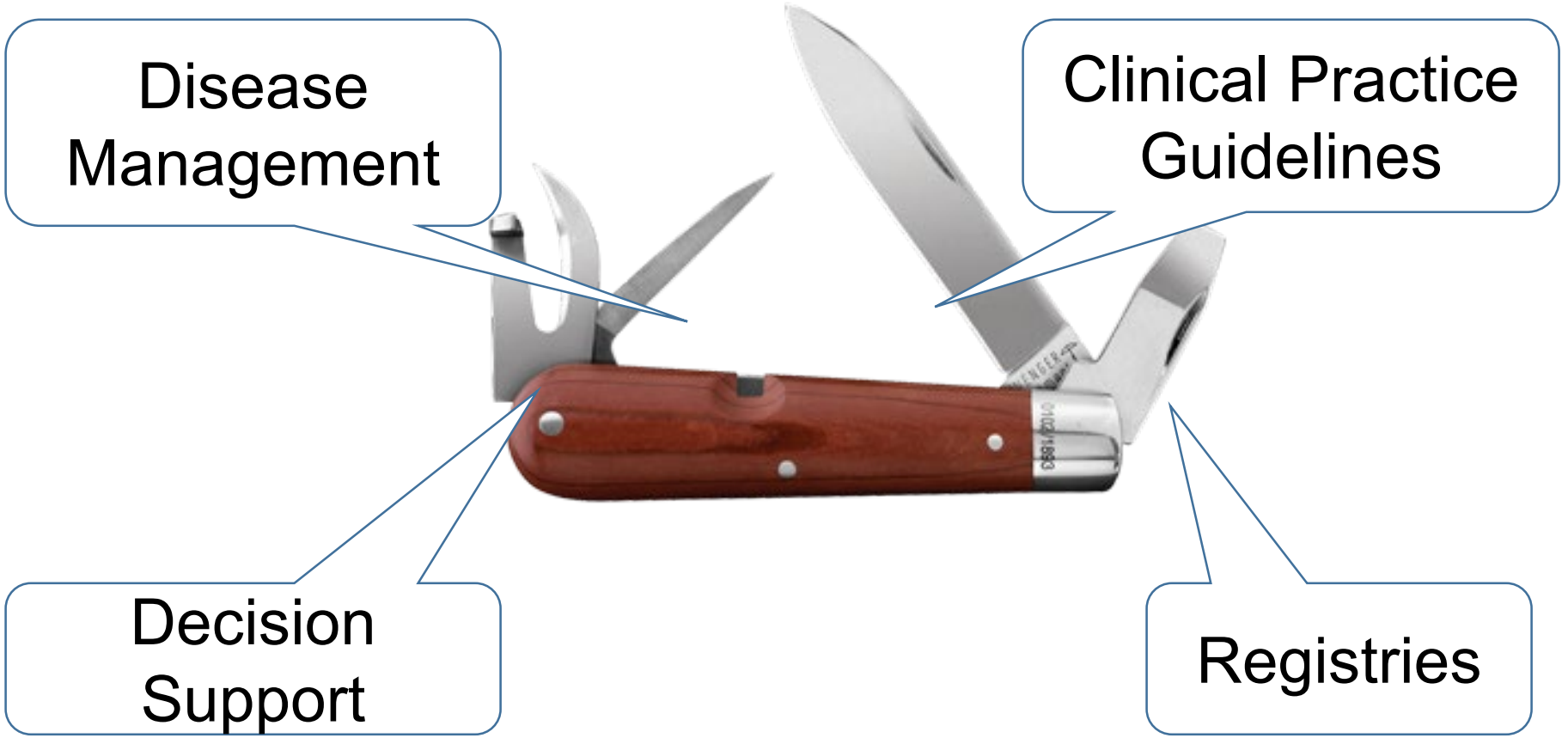
- Alcohol
- Asthma
- Bariatric Surgery
- Breast Cancer
- Cervical Cancer
- Coronary Artery Disease
- Chronic Kidney Disease
- Colorectal Cancer
- COPD
- Cardiovascular Disease
- Depression
- Diabetes
- Exercise
- Geriatrics
- Healthy Bones (Osteoporosis)
- Heart Failure
- HIV
- Hypertension
- Immunizations
- Pain Management
- Rare Diseases
- Tobacco Cessation
- Weight Management

In the beginning, there were some functions…

Wenger 1893 “Heritage” Swiss Army Knife

Source: www.wenger.ch

In the beginning, there were some functions…



Putting Conditions and Functions Together

Functions

Conditions

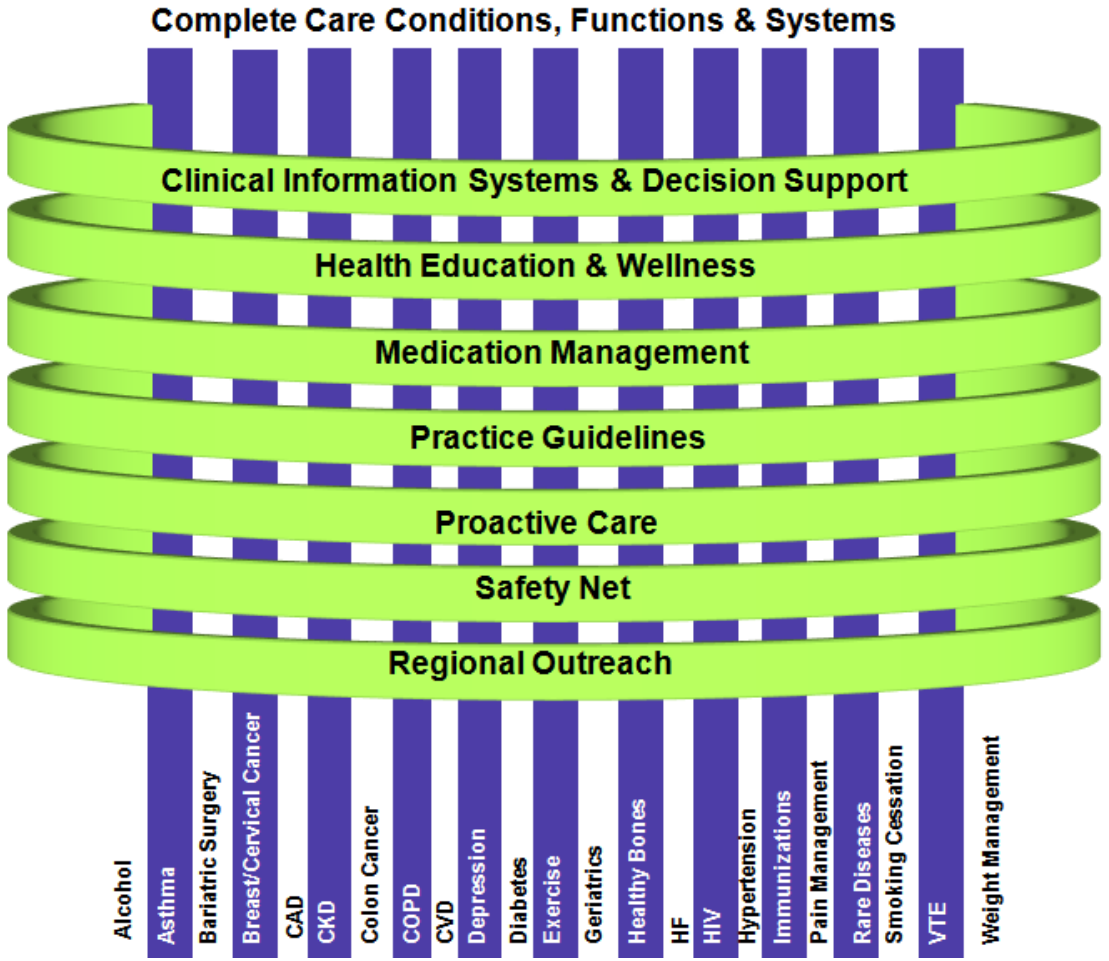
As time went by, we added more functions…

Wenger “Giant” Swiss Army Knife

Source: www.wenger.ch

"The Whiskey Barrel"

"The Whiskey Barrel"



The Joint Commission Journal on Quality and Patient Safety

Organizational Change and Learning

Complete Care at Kaiser Permanente: Transforming Chronic and Preventive Care

Michael H. Kanter, MD; Gail Lindsay, RN, MA; Jim Bellows, PhD; Alide Chase, MS

The Chronic Care Model (CCM) aims to transform care for patients with chronic illnesses through six interrelated system changes: health system, delivery system design, decision support, clinical information systems, self-management support, and community resources.[1–3] It has stimulated innovative models

Article-at-a-Glance

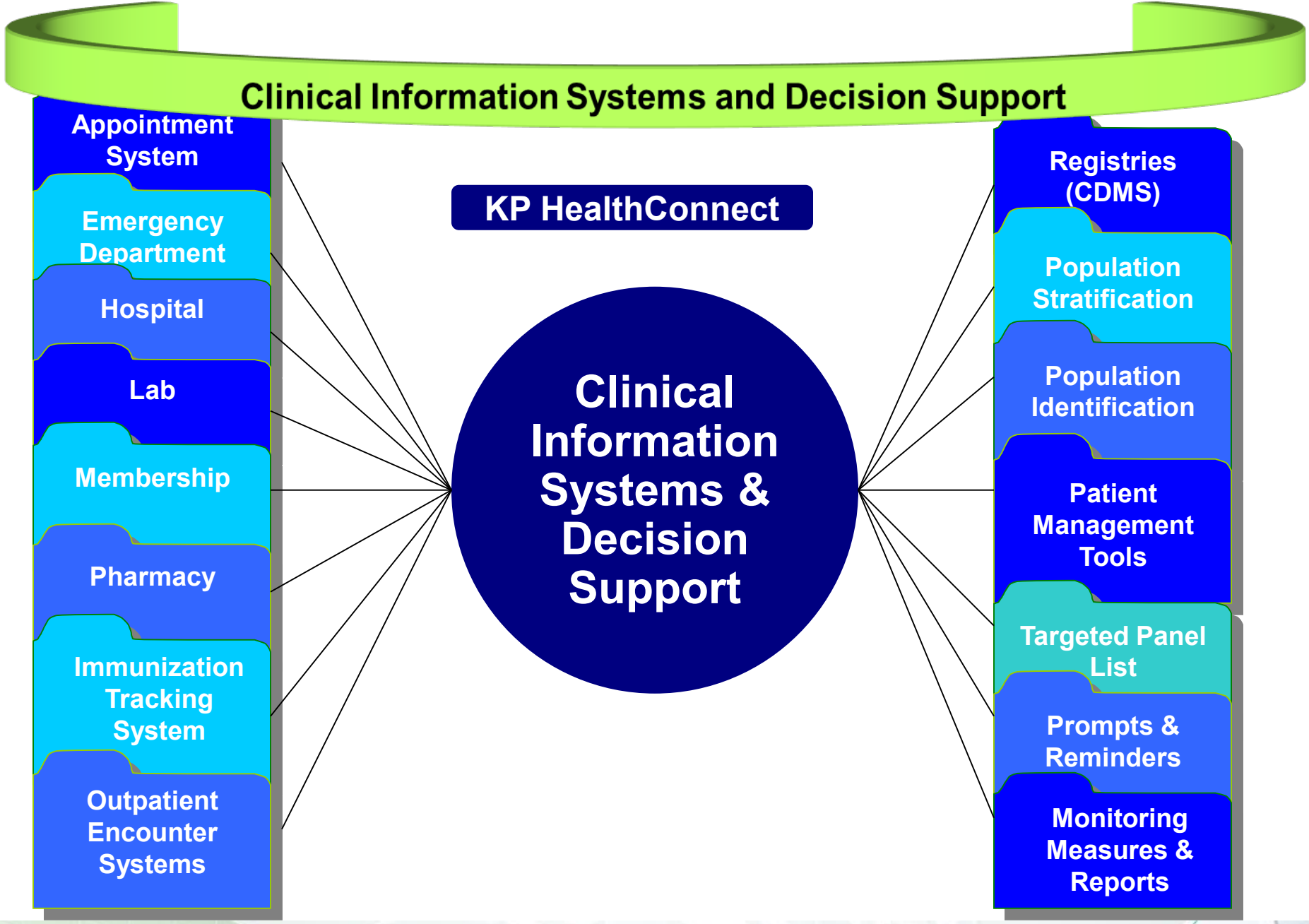
Background: In 2004 Kaiser Permanente Southern California (KPSC) recognized the potential to improve the quality of care. Healthcare Effectiveness Data and Information

Joint Commission Journal on Quality & Patient Safet, November 2013; 39(11):484-494

HEDIS Results

Results	Commercial	Medicare
Total measures	25	26
Above US 90th percentile at baseline	10 (40%)	11 (42%)
Above US 90th percentile by 2012	19 (76%)	22 (85%)
Average KPSC improvement, baseline to 2012	13.3%	12.8%
Average improvement in US median, baseline to 2012	5.6%	5.4%

KPSC improvement was 2-3 times greater than median US health plans


Clinical Information Systems and Decision Support
Appointment System
Emergency Department
Hospital
Lab
Membership
Pharmacy
Immunization Tracking System
Outpatient Encounter Systems
KP HealthConnect
Clinical Information Systems & Decision Support
Registries (CDMS)
Population Stratification
Population Identification
Patient Management Tools
Targeted Panel List
Prompts & Reminders
Monitoring Measures & Reports

Clinical Practice Guidelines

Institute for Health Policy

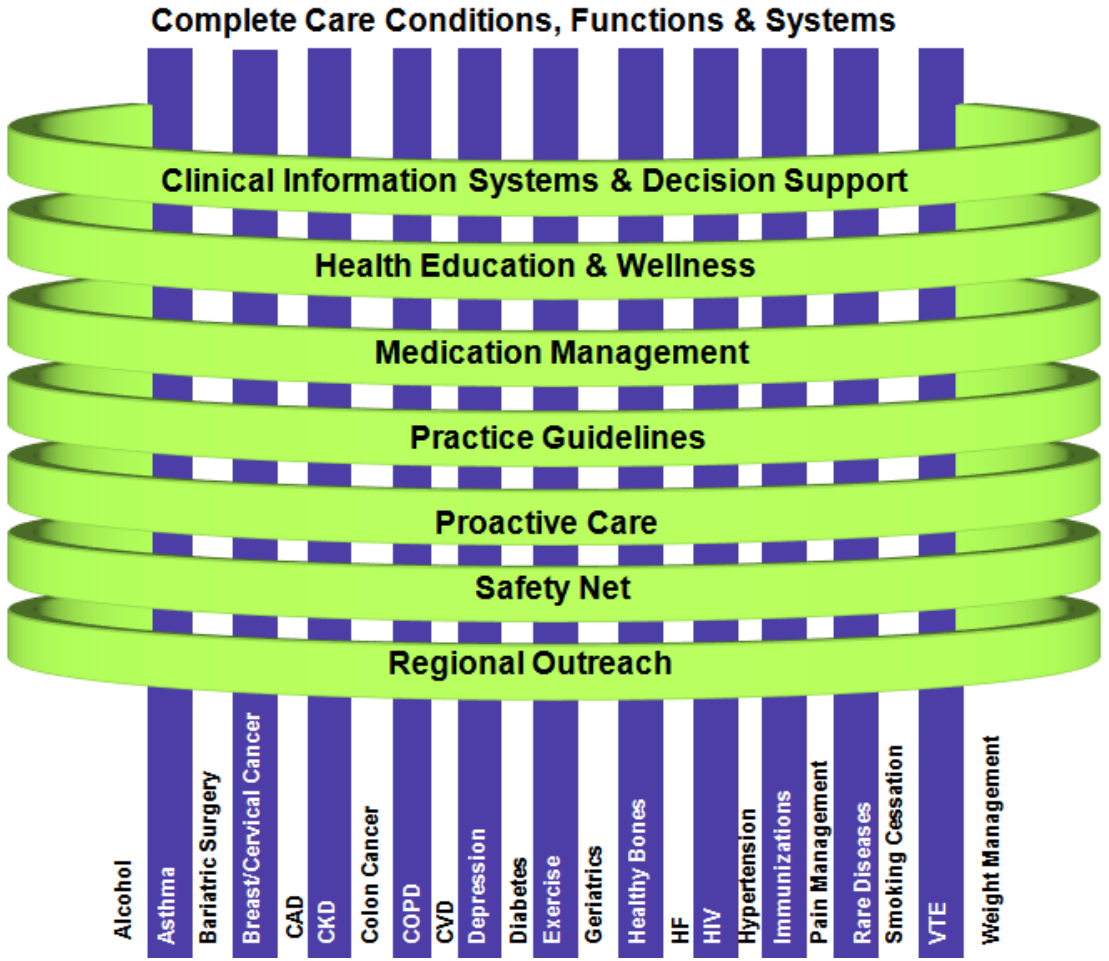
Evidence Based or Consensus Based

Kaiser Permanente Policy Story, V2, No. 2

Foundation of Evidence: Clinical Guideline Development at Kaiser Permanente

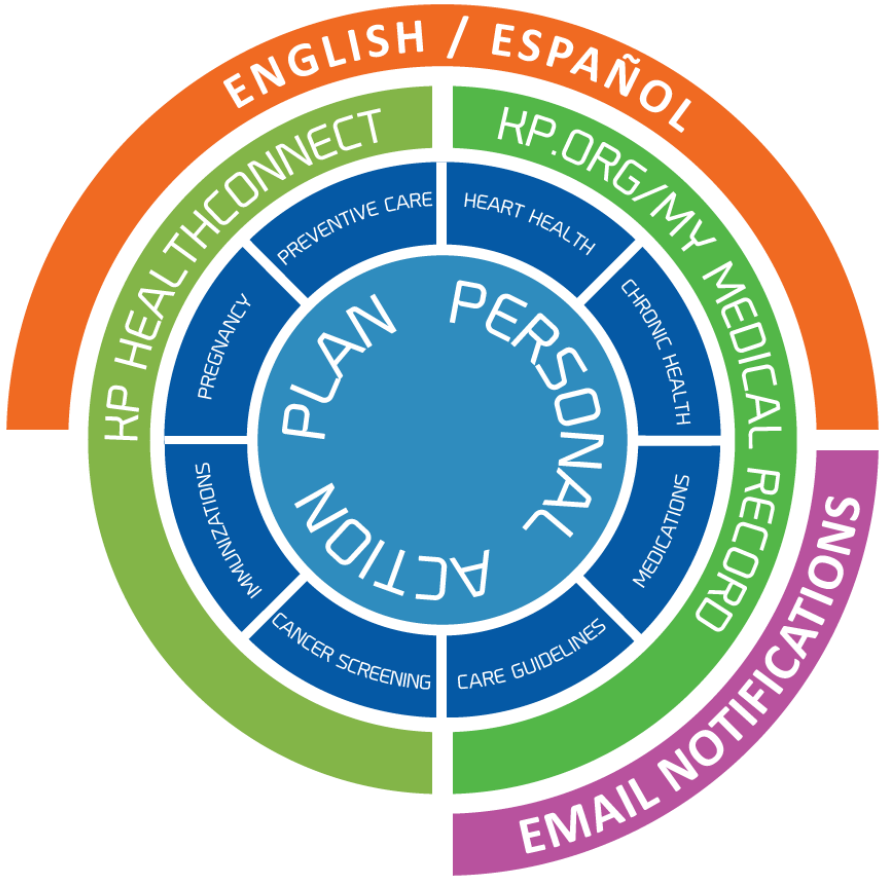
- In the U.S. and worldwide, patients with similar health problems often undergo very different courses of treatment. Sometimes this is due to gaps in physician knowledge about which medical interventions are most effective, based on research evidence.
- Public and private payers are moving toward paying physicians based on quality—rather than quantity—of care, and the need for clear evidence regarding clinical effectiveness has become even more pronounced.
- Kaiser Permanente has been a pioneer in evidence-based medicine for decades. In the early 1990s, we moved to reengineer our processes for developing clinical practice guidelines based on research evidence.
- Kaiser Permanente's guideline development and evidence services capacity has grown increasingly sophisticated. Our National Guidelines Program applies rigorous process and evidentiary standards to develop a core set of guidelines. We share our expertise with organizations around the world and have helped to advance the science of guideline development.

"The Whiskey Barrel"



Regional Outreach

Online Personal Action Plan



The Online Personal Action Plan is a fully featured and integrated personal care gap monitoring system.

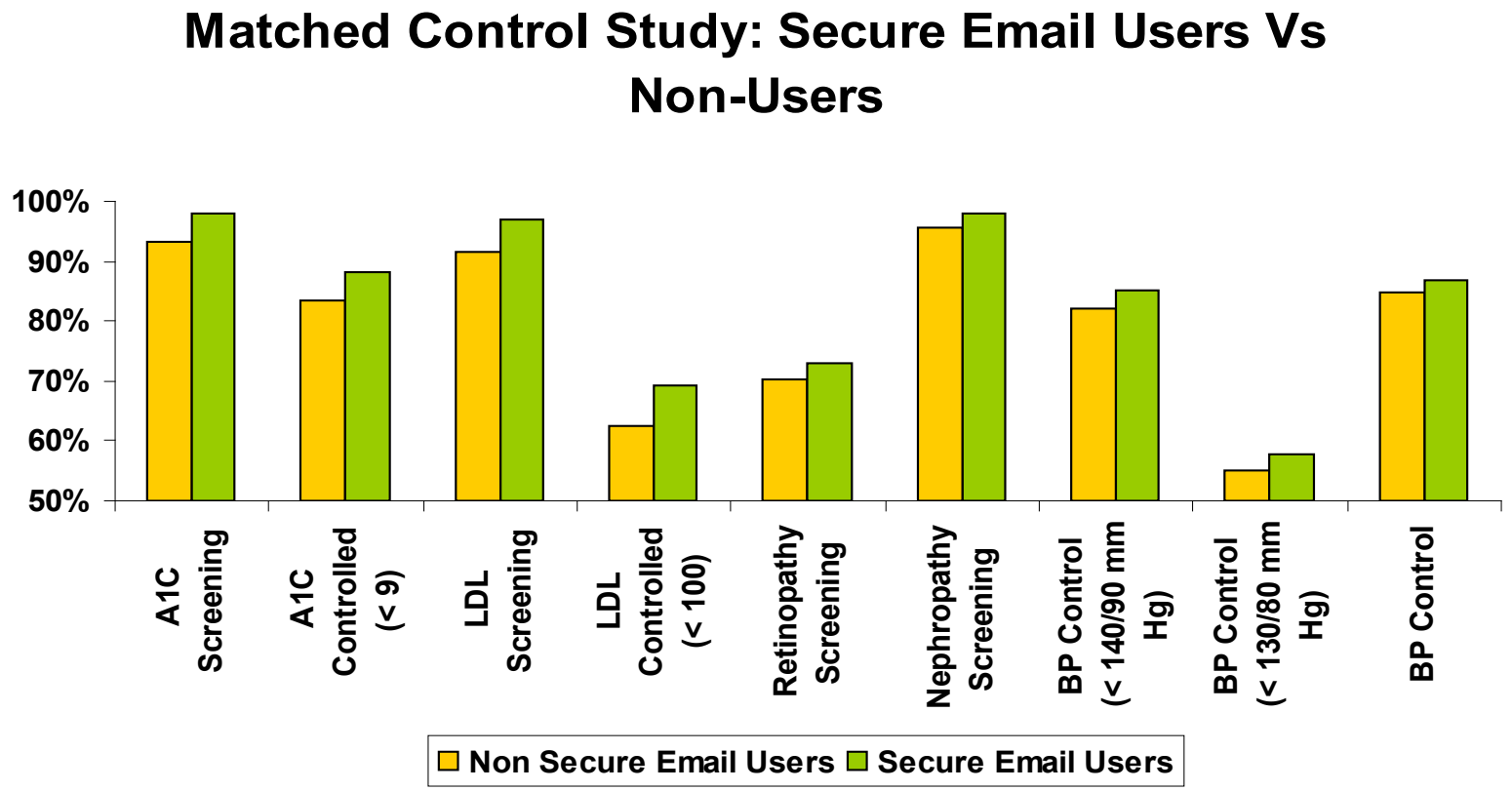
Available in both English & Spanish, it explains clearly what is needed to take action on, why it is important and how to take the necessary action.

The system monitors care gaps and automatically notifies the patient when a new gap arises.

Available at kp.org and within KP HealthConnect™

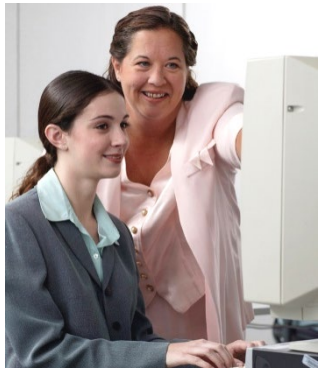
Improvement and patient portal -Secure Email

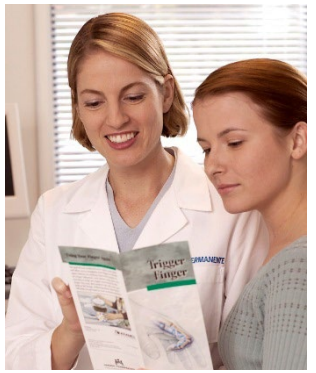
Health Affairs 2010;29(7):1370-1375



Proactive Care

Proactive Office Encounter (POE)





Pre Visit	Visit	Post Visit
Proactive Identification • Identify missing labs (A1c, LDL, microalbumin), screening procedures, access management, KP.org status, etc. • Provide member instructions prior to visit • Contact member and document encounter in HealthConnect™	Office Encounter • Pre-encounter follow-up • Vital sign, history, social, demographics, medication review • Identify and flag alerts for provider for screening and uncontrolled chronic conditions • Room and prepare patient for necessary exams	Immediate: • After visit summary, after care instructions, follow-up appointments, health ed materials, how to access info on KP.org Future: • Follow up contact & appointments per provider

Proactive Office Encounter

- Adult primary care
- Pediatrics
- Obstetrics
- Post natal care
- Specialty care

Making the Business Case for Specialty POE

Opportunities for Breast Cancer and Diabetes Management in Adult Primary Care

Test	Total	Seen in Primary Care	%
Needing Mammogram	**47,294**	**18,222**	**38%**
Needing A1c test	**10,530**	**3,911**	**37%**

Approximately 60% of members seen in Specialty Care

Specialty care POE and HTN

- Does anyone care about the identification of HTN as much as the control rate?
- 18% of newly identified HTN cases occurred in specialty care
- 14% of pts with a BP > 180/110 were identified in specialty care

Hander J, Mohan J, Kanter MH. J Clin Hypertension 2015:1-9

Successful Opportunities Target Met < 30 Days

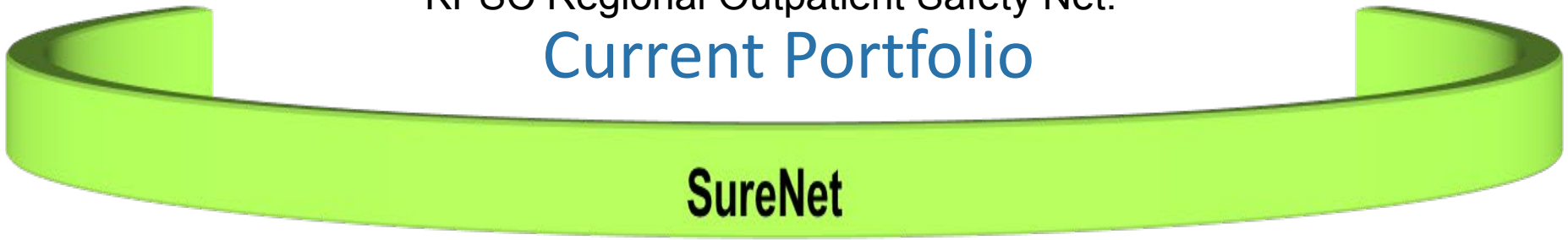
0	AV	Bel	BPK	FON	KC	LA	OC	PC	RVS	SB	SD	WH	WLA
% A1c	55	58	58	61	70	64	56	55	57	57	56	57	56
% Microalbumin	36	45	50	46	44	55	45	46	47	48	45	48	44
% LDL	41	54	57	51	69	58	51	47	55	50	50	48	48
% Mammo	36	38	37	36	34	39	38	34	40	37	28	31	41
% Pap	43	46	49	43	39	48	46	46	46	55	40	46	50
% Dexa	14	19	20	21	21	22	20	25	14	24	16	15	18
% Pneumovax	12	19	19	17	16	21	20	19	14	17	16	17	12
% Flu	4	3	14	9	9	14	13	12	10	12	8	13	15
% Retinal screening	28	20	29	21	15	33	30	27	23	21	15	29	25
% BMI	85	80	83	70	84	85	80	76	76	82	75	76	70
% Smoking	88	86	88	87	84	88	91	84	85	88	83	85	88
% Chlamydia	41	41	42	38	52	46	40	38	37	43	40	40	38
% DM Health	13	13	13	12	14	13	11	12	15	16	13	16	12
% Lead	22	12	15	14	0	14	18	13	17	12	13	8	14
% Asthma Quesr	58	59	68	64	77	74	60	55	45	64	65	61	39

Proactive Panel Support

- Panel Manager
  - PharmD, RN, RNP, PA
  - 1:10 – Panel Manager : Physician
- Support Coordinator
  - Clerk, LVN, MA
  - 1:2 – Support Coordinator : Panel Manager
- Scheduled Physician Time
  - 20 to 60 minutes per month

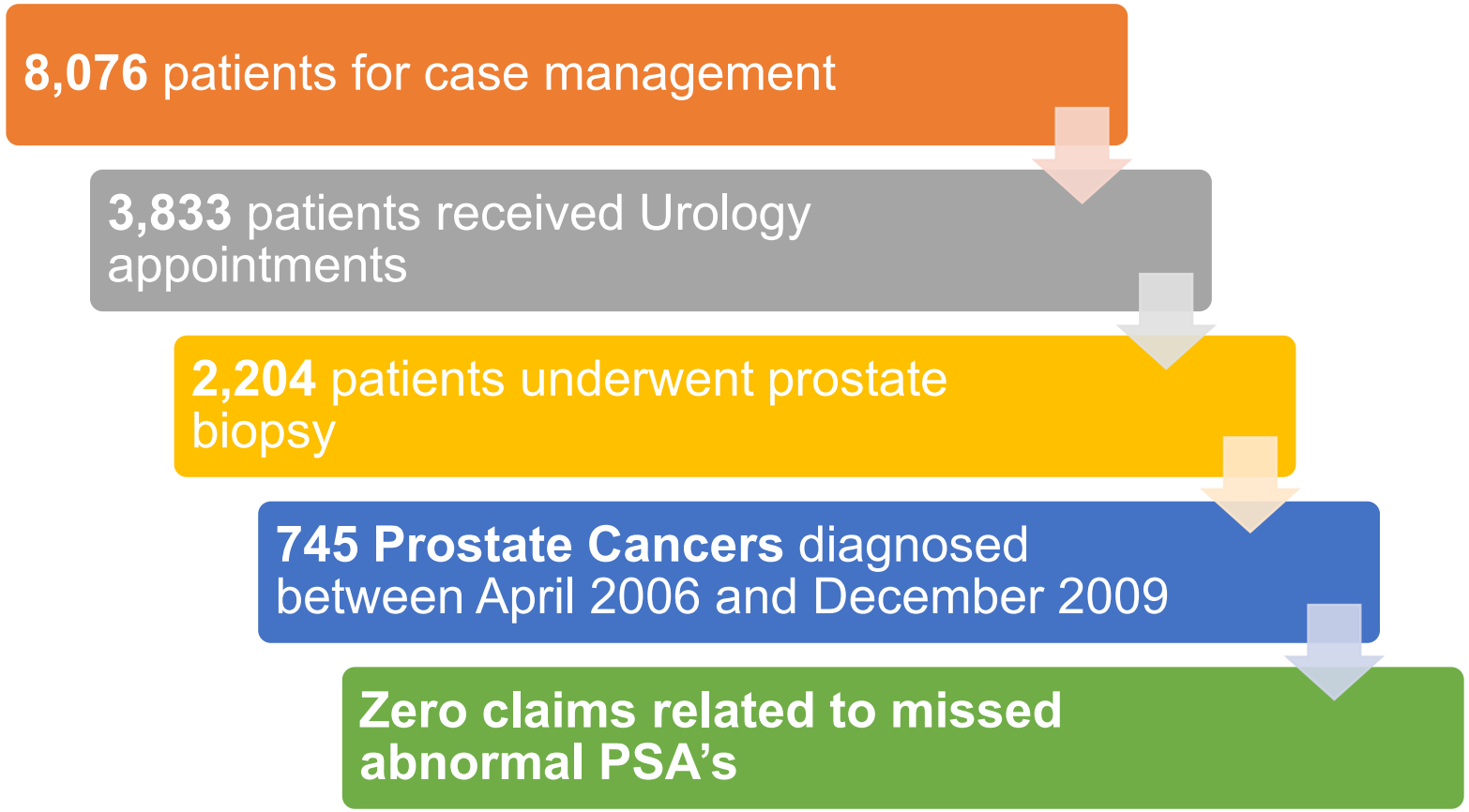
KPSC Regional Outpatient Safety Net:

Current Portfolio

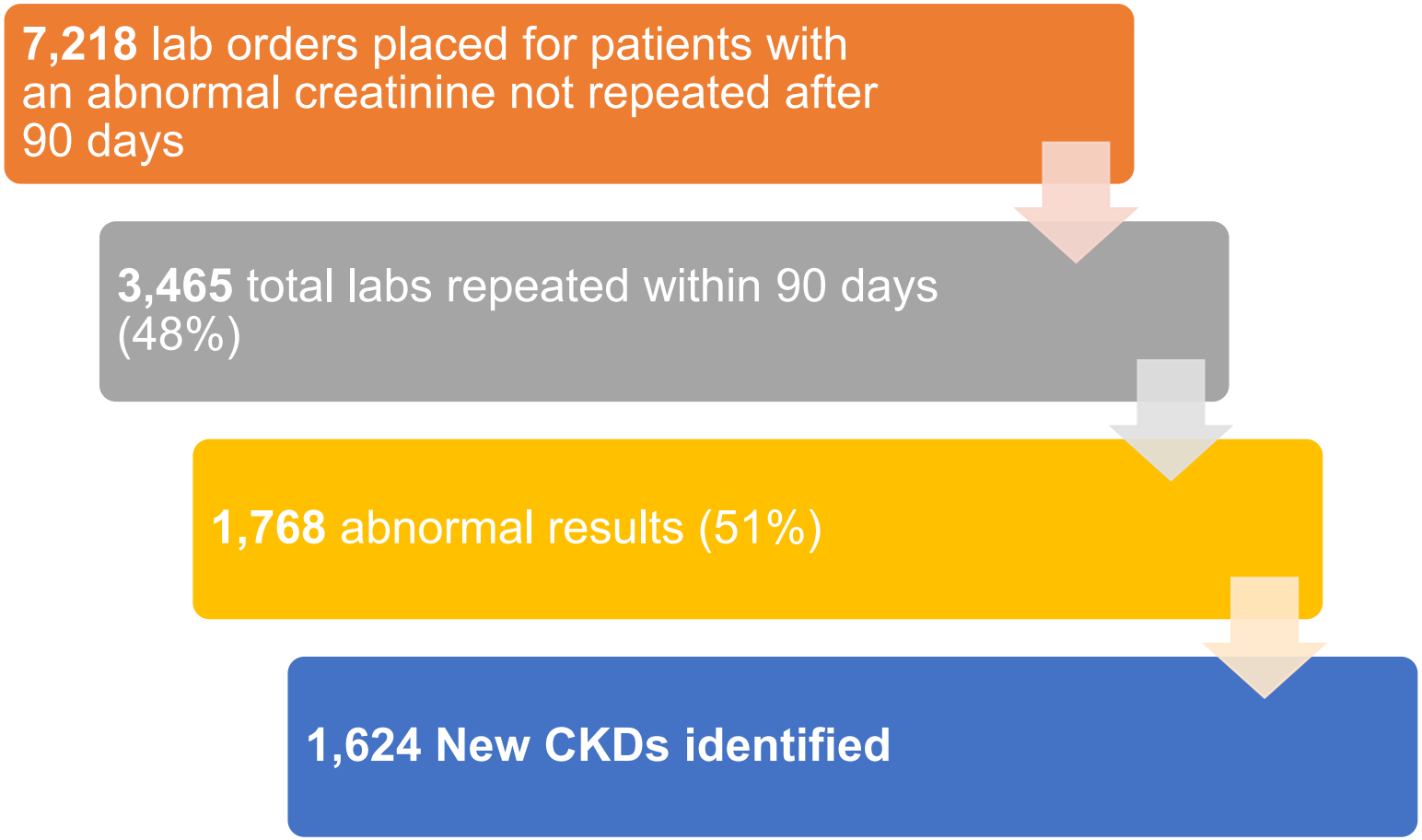


Diagnosis Detection/Follow UP	Diagnosis Detection/Follow Up
• PSA Electronic Safety Net • +FIT Electronic Safety Net • Abnormal Pap Electronic Safety Net • Kidney Disease (Repeat Creatinine) • Colon Cancer (Iron Deficiency Anemia + No colonoscopy) • Colon Cancer (Rectal Bleeding+ No colonoscopy) • Abdominal Aortic Aneurysm Tracking • Post Splenectomy Immunizations • Positive Chlamydia Follow up • Down Syndrome Care Coordination • Sickle Cell Care Coordination • Hepatitis C (+Antibody + No confirmatory test) • Newborn Hearing Screening • Lung Nodules • Unintended Pregnancy Follow up	• Annual Lab Monitoring: Digoxin (K+, level and SCr), Diuretics (K+ and SCr) • Amiodarone (Preventive monitoring plan) • Acetaminophen Overuse • Elderly Care Drug-Disease (Falls) • Elderly Care Drug-Disease (Dementia) • Elderly Care High Dose Digoxin Conversion • Interacting Statin Combinations (Gemfibrozil and/or Amiodarone) • Diuretic Medication Induced Hyponatremia • Medication Induced Hyperkalemia • NSAIDs in CKD 4-5, Dialysis, Kidney Transplant • INH ALT monitoring • Monitoring Plaquenil Eye Monitoring • Metformin b12 monitoring • Ethambutal eye monitoring

Diagnosis Detection and Follow Up: PSA Safety Net Results



Diagnosis Detection and Follow Up: Unrepeated Creatinine



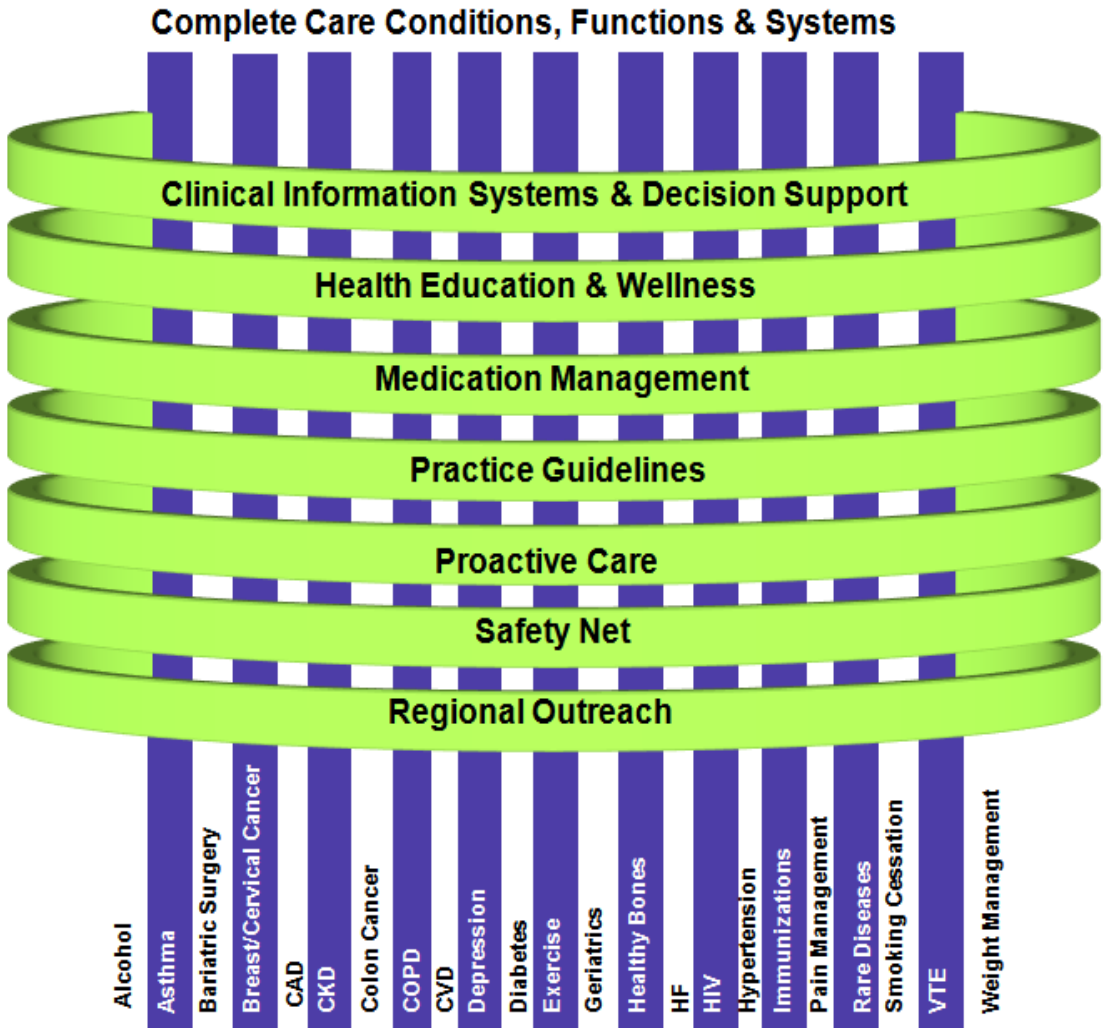
Medication Safety: Falls or Dementia + TCAs

8,310 patients with a history of fall or dementia and taking a TCA or sleep medication

5,548 conversions facilitated through pharmacist led interventions

70% reduction in potential outpatient safety risk

"The Whiskey Barrel"



Alcohol

Domestic Violence

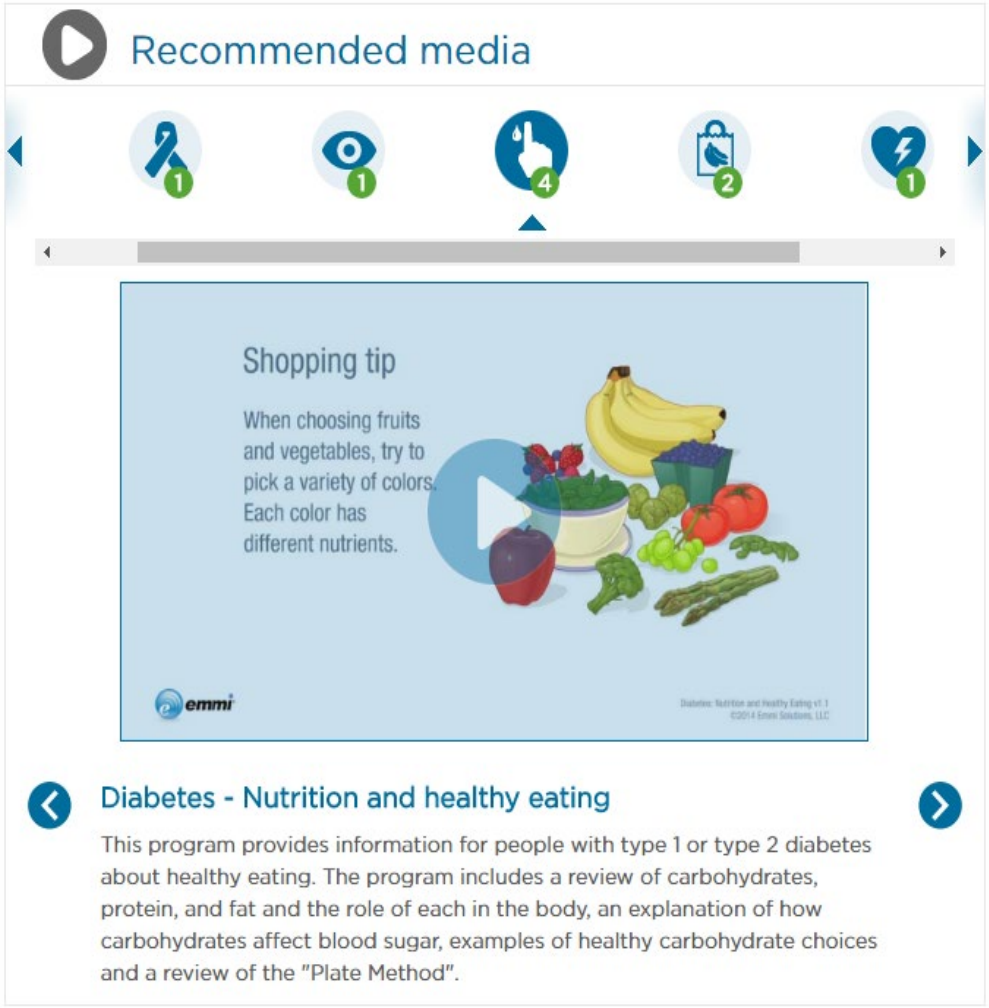
Immunizations

Physical Activity

Smoking Cessation

Weight Management

Personalized Education

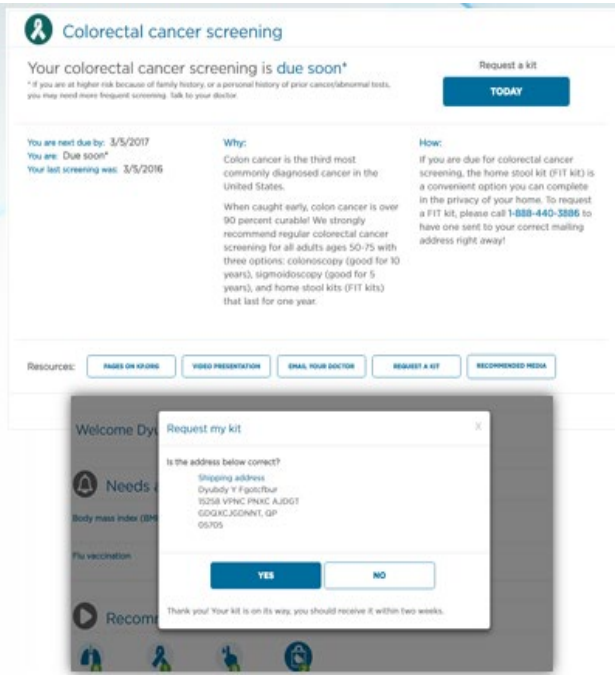


Interactive Colon Cancer Screening

Patients are able to request a FIT kit to be sent to them at the touch of a button

This allows the patient to take control at the moment of opportunity

Early results have shown a much higher return rate vs when KP pushes the kit out to the patient through Outreach



E-Scope

Featured in... NEJM Catalyst

Evidence Scanning for Clinical, Operational, & Practice Efficiencies

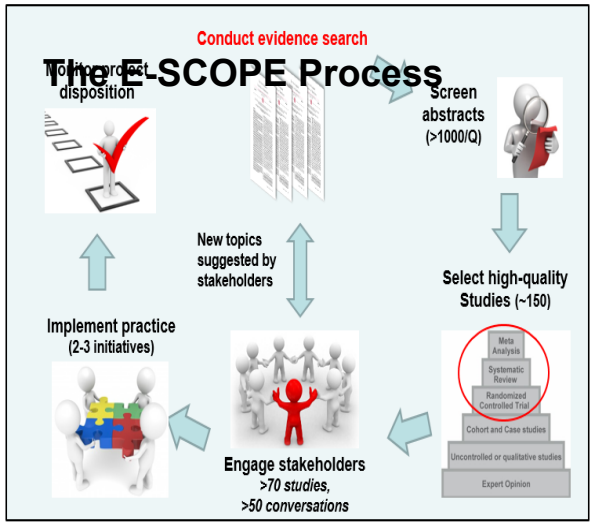
Michael Kanter, MD; Joanne Schottinger, MD & SCPMG Evidence-Based Medicine (EBM) Services Unit

40,000+ new clinical trials published annually; 17 years for findings to reach clinical practice

…E-SCOPE shortens the gap between research and clinical implementation

Goals/Objectives

- Proactively identify new or underutilized evidence-based interventions to improve health outcomes, clinical quality and operational efficiency
- Ensure awareness of effective clinical interventions, implement beneficial practices, de-implement non-beneficial practices
- Reduce time between research and implementation



*Stakeholders may include: SCPMG Executive Team, Chiefs of Service, PICs, MD champions, Clinical Committees, Operational Committees, Regional task force leaders, AMDs, Joint Session, Area Medical Directors, other regional departments (Complete Care, Consulting & Implementation, etc.)

Accomplishments

- 17 evidence-based interventions launched since 2014
- Examples of initiatives in various stages of implementation:
  - ✓ Epley Maneuver Outreach for Vertigo
  - ✓ Exercise-based cardiac rehabilitation for heart failure
  - ✓ At-home exercise for stroke patients
  - ✓ Vaginal washing prior to C-section
  - ✓ Shut off idle steam sterilizers to reduce energy costs
  - ✓ Probiotics for preterm infants in NICU
  - ✓ Weight management to reduce psoriasis severity
  - ✓ Undeployment of continuous passive motion after total-knee arthroscopy
  - ✓ Scaling up use of Kangaroo Care in the NICU setting

Conclusions

- The power of Healthcare Systems Engineering in care integration (de-fragmentation) has been demonstrated
- It is possible to improve medical care by creating integrated systems of care
  - that identify and close the gaps in care
  - minimize unwarranted variation
  - create reliability
  - recognize human cognitive limitations
  - are patient centric
  - and make providers' work more satisfying.

Thank you for attending!

Share your experiences at #HWGSEC