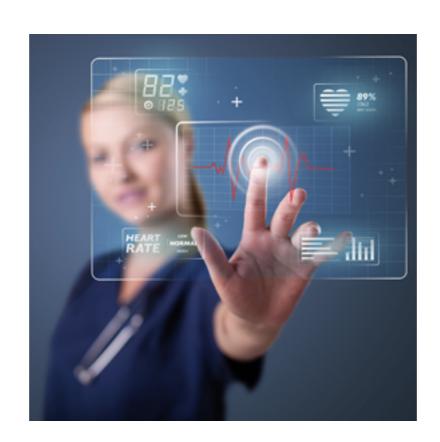
Medicine and the "Internet of Things"



Remote Liquid Biopsy Singapore's A*STAR Technologies



Intraaortic Monitoring Device Remon Medical Technologies

Bradford W. Hesse, PhD
Chief, Health Communication and
Informatics Research Branch

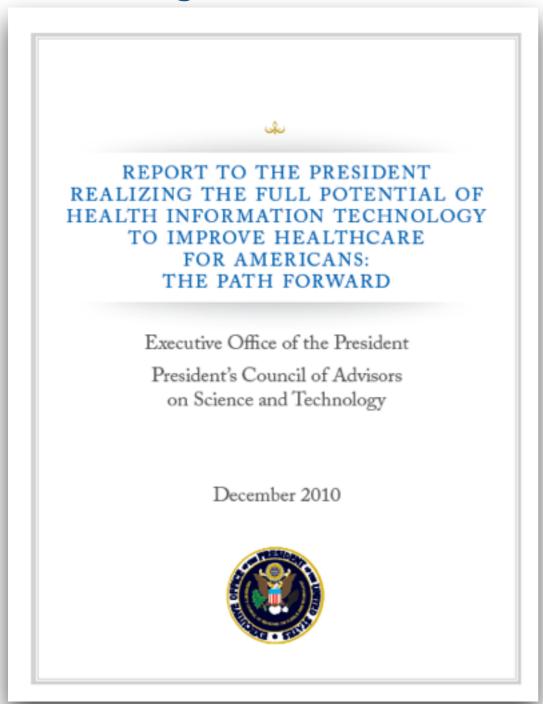


CONSUMER FACING TECHNOLOGY

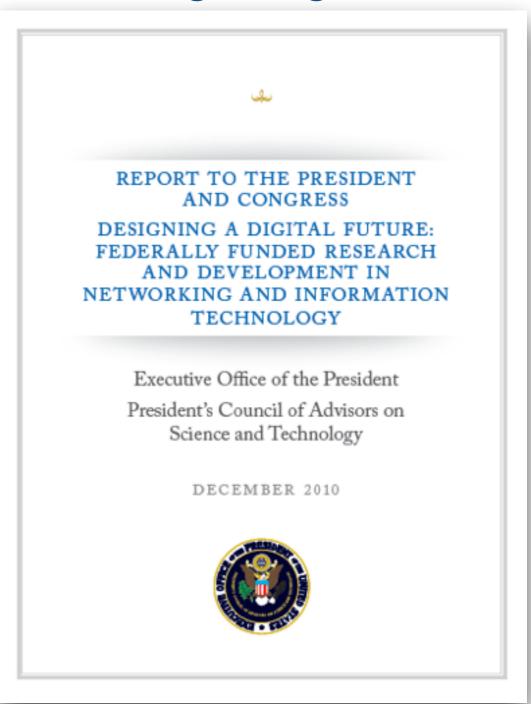
Background

President's Council of Advisors on Science and Technology (Dec 2010)

Realizing Health I.T.

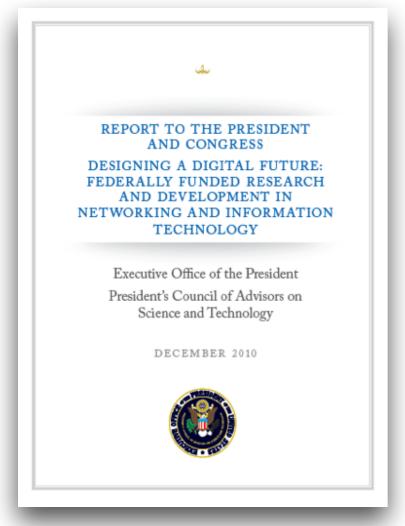


Envisioning a Digital Future



President's Council of Advisors on Science and Technology (Dec 2010)





For the treatment of chronic conditions, including those due to aging, progress in the discovery and development of advanced assistive technologies is essential. Further advances are needed in image analysis, in new kinds of robotics, in non-intrusive monitoring and response technologies, and in all manner of cognitive assistance.



American Medical Informatics Association, *Keynote Address 2011*

"We are only going to succeed if we work closely together -- between those with biological sophistication and those with computational sophistication"



Dr. Francis S. Collins
Director, National Institutes of Health
Oct. 23, 2011





Smart and Connected Health



Wendy Nilsen CISE/IIS



REPORT TO THE PRESIDENT AND CONGRESS

DESIGNING A DIGITAL FUTURE: FEDERALLY FUNDED RESEARCH AND DEVELOPMENT IN NETWORKING AND INFORMATION TECHNOLOGY

> Executive Office of the President President's Council of Advisors on Science and Technology

> > DECEMBER 2010



Smart and Connected Health (SCH)

PROGRAM SOLICITATION
NSF 13-543

REPLACES DOCUMENT(S): NSF 12-512



National Science Foundation

Directorate for Computer & Information Science & Engineering Division of Computing and Communication Foundations Division of Computer and Network Systems Division of Information & Intelligent Systems

Directorate for Engineering

Directorate for Social, Behavioral & Economic Sciences



National Institutes of Health

Eunice Kennedy Shriver National Institute of Child Health and Human Development

National Cancer Institute

National Human Genome Research Institute

National Institute of Biomedical Imaging and Bioengineering

National Institute on Aging

Office of Behavioral and Social Sciences Research





Cyber-Physical Systems



Vinay Pai NIH-NIBIB



REPORT TO THE PRESIDENT AND CONGRESS

DESIGNING A DIGITAL FUTURE: FEDERALLY FUNDED RESEARCH AND DEVELOPMENT IN NETWORKING AND INFORMATION TECHNOLOGY

> Executive Office of the President President's Council of Advisors on Science and Technology

> > DECEMBER 2010



Cyber-Physical Systems (CPS)

PROGRAM SOLICITATION
NSF 15-541

REPLACES DOCUMENT(S): NSF 14-542



National Science Foundation

Directorate for Computer & Information Science & Engineering Division of Computer and Network Systems Division of Computing and Communication Foundations Division of Information & Intelligent Systems Division of Advanced Cyberinfrastructure

Directorate for Engineering

Division of Electrical, Communications and Cyber Systems
Division of Civil, Mechanical and Manufacturing Innovation
Division of Chemical, Bioengineering, Environmental, and Transport Systems



Department of Homeland Security, Science & Technology Directorate



U.S. Department of Transportation, Federal Highway Administration



National Aeronautics and Space Administration



National Institutes of Health

National Institute of Biomedical Imaging and Bioengineering





EPISODIC, REACTIVE FOCUS ON DISEASE



PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

HOSPITAL-CENTRIC



PATIENT-CENTRIC, HOME-BASED

TRAINING & EXPERIENCE BASED



MORE EVIDENCE – BASED DECISION SUPPORT

FRAGMENTED, LOCAL DATA



INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

NAÏVE, PASSIVE, PATIENTS



EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING



PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE - BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE **ANYWHERE, ANYTIME**

EMPOWERED, ENAGAGED, INFORMED, **PARTICIPATING**

Quantified Self



Wifi - Enabled Scale



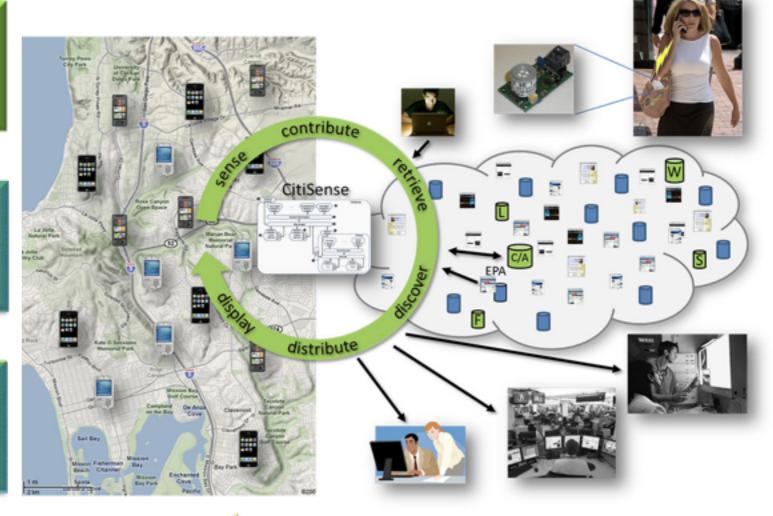




PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT



INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME



Citysense

EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING

This project supported by NSF Cyber-Physical Systems Grant CNS-0932403, with additional support from the NIH and a gift from Qualcomm.





PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING

MD Anderson study finds sensor-based monitoring of cancer patients at home during radiation treatment may identify problems in their early stages

Study followed head and neck cancer patients looking for signs of dehydration, a common and sometimes dangerous side-effect



MD Anderson News Release 01/15/14

MD Anderson researchers may have found a high-tech solution to detect a common side effect of cancer treatment in its early stages, before it becomes a serious problem.

A new feasibility study shows that equipping head and neck cancer patients with home-based sensors to identify potential risks of dehydration during radiation treatment is attainable and acceptable to patients as well as their physicians.

These new findings were published in the Journal of the <u>National Cancer Institute</u> Monographs'special issue, "Cancer Prevention and Control in the Changing Communication Landscape."

"We used sensor-based technology to monitor and evaluate potential signs for dehydration in the patients' home environment," said Susan Peterson, Ph.D., M.P.H., lead investigator on the study and behavioral scientist at The University of Texas MD Anderson Cancer Center.



Susan Peterson, Ph.D., M.P.H.



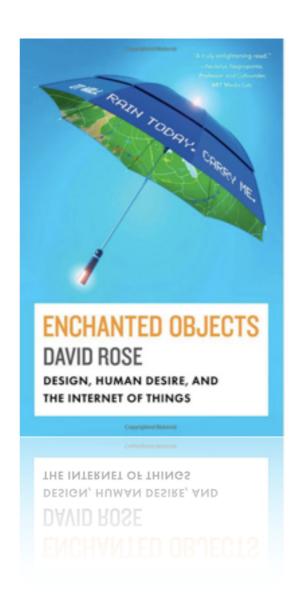
PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING





Smart pill bottles to track adherence



PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

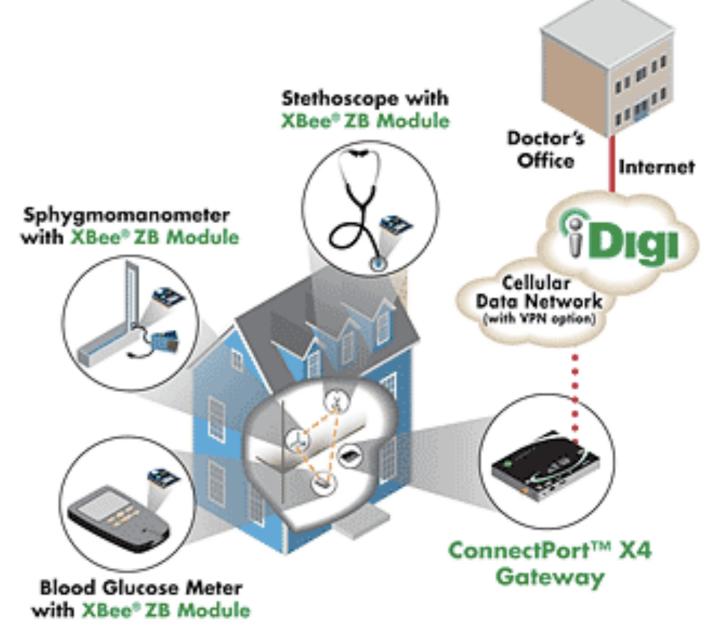
Smart Home for Patients

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING



http://www.digi.com/blog/design/technology-for-connectedart-exhibits-a-model-for-innovative-business/



PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

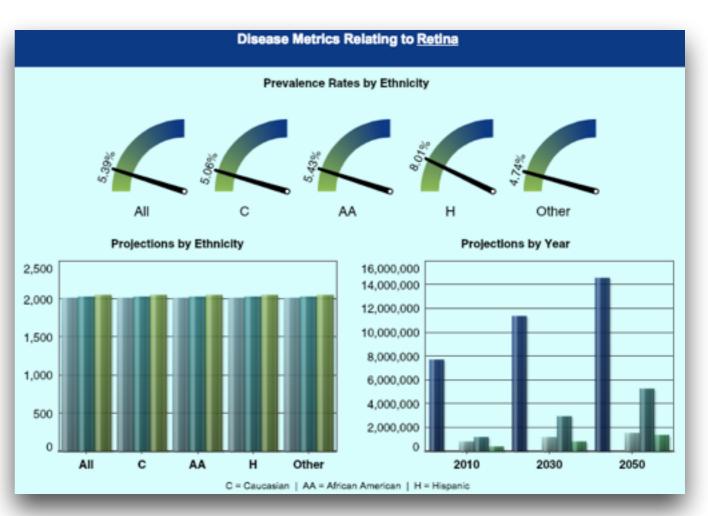
PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING

Data Based
Decisions at
Multiple Levels





PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

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Real Time Update to Decision Support



e.g., Watson, Siri, Google Health



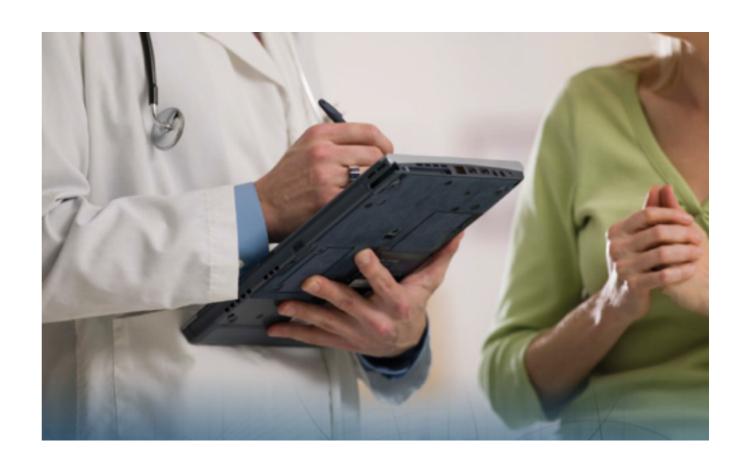
PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

Cloud-Based Mobile Health Records



EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING

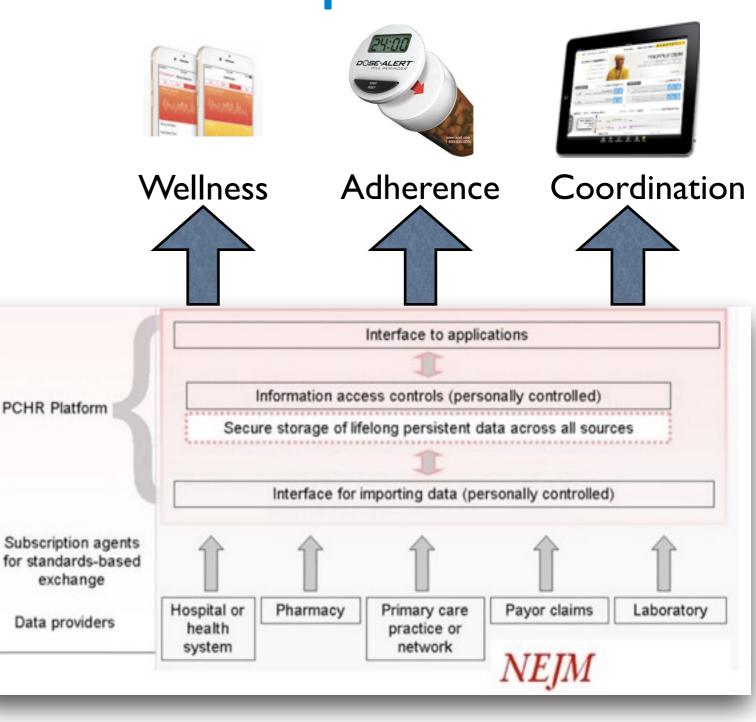


PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME



EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING

Personal Health Information Hub



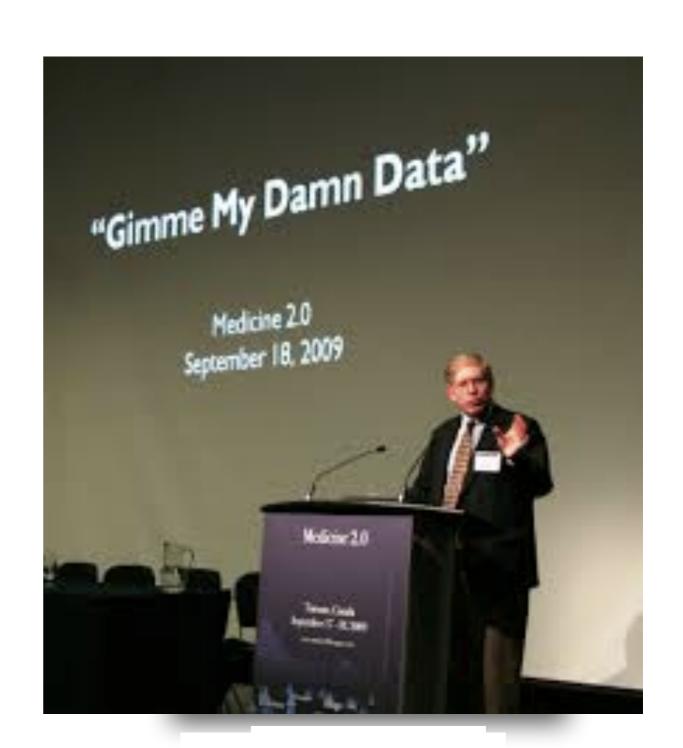
PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING



ePatient Dave





PROACTIVE and PREVENTIVE FOCUS ON WELLBEING QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED DECISION SUPPORT

INTEROPERABLE, EHR AVAILBLE ANYWHERE, ANYTIME

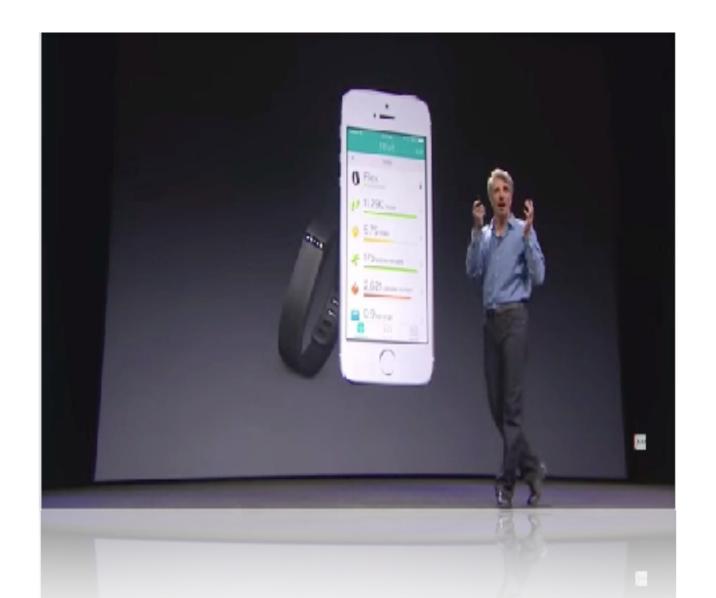
EMPOWERED, ENAGAGED, INFORMED, PARTICIPATING

Health.



An entirely new way to use your health and fitness information.

The new Health app gives you an easy-to-read dashboard of your health and fitness data. And we've created a new tool for developers called HealthKit, which allows all the incredible health and fitness apps to work together, and work harder, for you. It just might be the beginning of a health revolution.



How far have we come?

Changing the Face of Medicine



HITECH Act 2009

TITLE XIII—HEALTH INFORMATION TECHNOLOGY

SEC. 13001. SHORT TITLE; TABLE OF CONTENTS OF TITLE.

- (a) SHORT TITLE.—This title (and title IV of division B) may be cited as the "Health Information Technology for Economic and Clinical Health Act" or the "HITECH Act".
- (b) Table of Contents of Title.—The table of contents of this title is as follows:

Sec. 13001. Short title; table of contents of title.

Key goals*:

- Improve quality, safety, & efficiency
- Engage patients & their families
- Improve care coordination
- Improve population and public health; reduce disparities
- Ensure privacy and security protections

^{*}Adapted from National Priorities Partnership. National Priorities and Goals: Aligning Our Efforts to Transform America's Healthcare. Washington, DC: National Quality Forum; 2008.

HITECH: Meaningful Use as

Building Blocks

Use information to transform

Improve access to information

Data utilized to improve delivery and outcomes

Patient self management

Care coordination

Evidenced based medicine

Registries for disease management

Privacy & security protections

Connect to Public Health Enhanced access and continuity

Data utilized to improve delivery and outcomes

Patient engaged, community resources

Patient centered care coordination

Team based care, case management

Registries to manage patient populations

Privacy & security protections

Connect to Public Health

Utilize technology to gather information

Basic EHR functionality, structured data

Privacy & security protections

Connect to Public Health Care coordination

Patient engaged

Connect to Public Health

Privacy & security protections

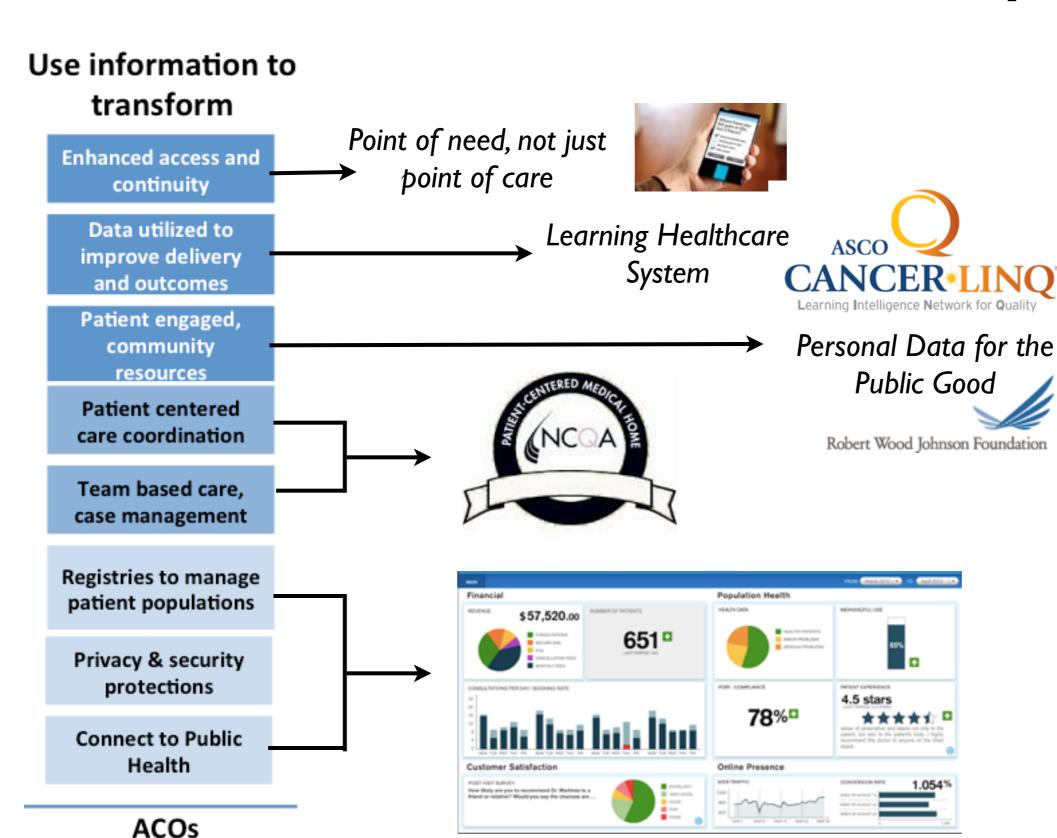
Structured data utilized for Quality Improvement

Stage 1 MU

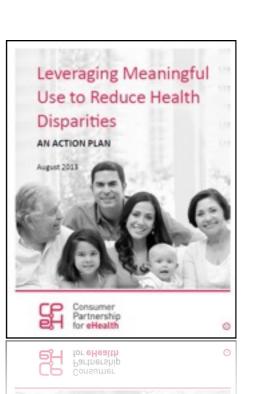
Stage 2 MU

PCMHs 3-Part Aim ACOs Stage 3 MU

A 10 Year Goal for Health Systems



Stage 3 MU



Technology: EHR Adoption

Hospitals receiving incentives for EHR adoption or meaningful use Local Area Trends of EHR Adoption, 2011-2013

Note: Dots denote hospitals that have received Medicare or Medicaid EHR Incentive payments.





Medscape Medical News

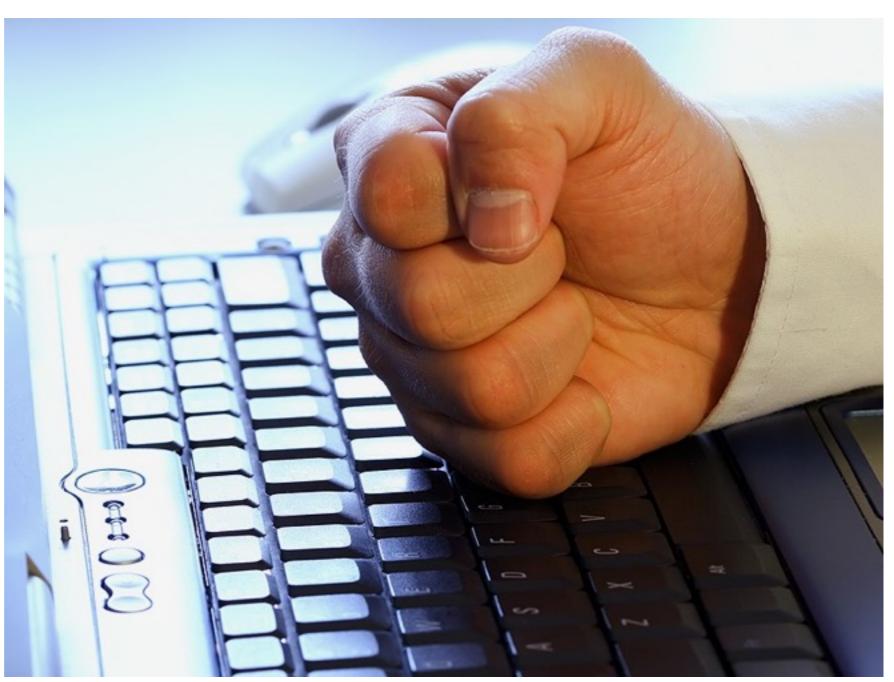
AMA Calls for More User-Friendly EHRs

Ken Terry September 18, 2014

Deficits in:







Must Improve Usability

Modern Healthcare

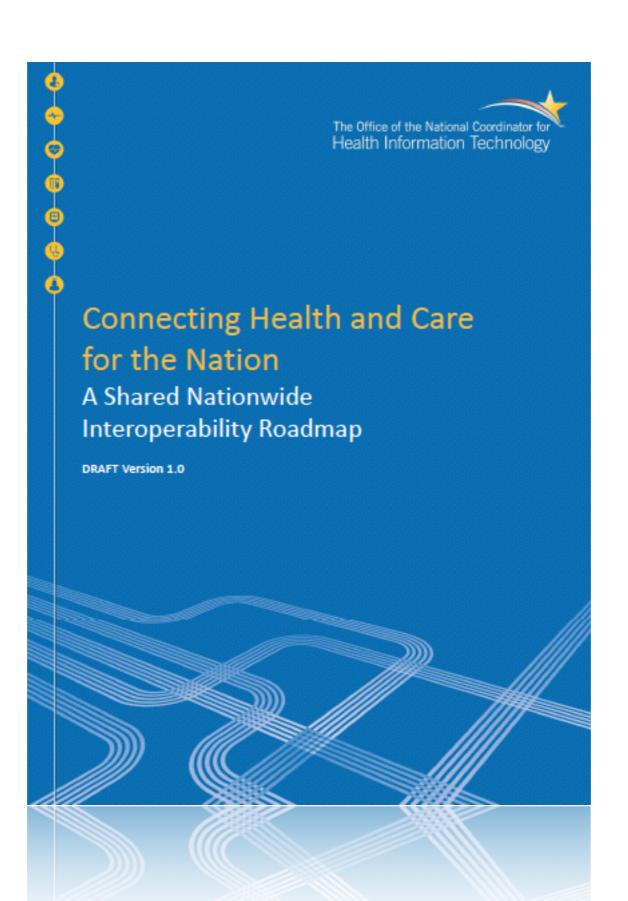
The leader in healthcare business news, research & data



Health IT prevalent among ECRI's top 10 safety concerns

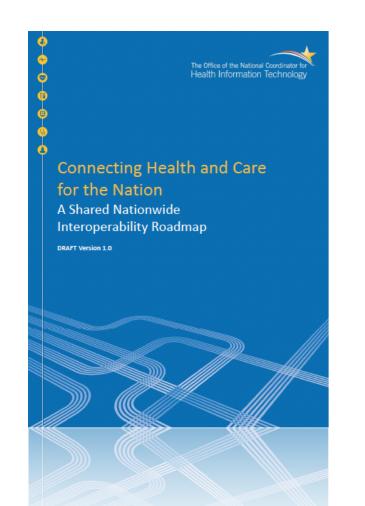
By Sabriya Rice | April 6, 2015

Alarm fatigue, incomplete electronic health-record data and poor carecoordination due to over-reliance on healthcare IT are among the top 10 patientsafety concerns for healthcare organizations, according to a new report from the ECRI Institute. Must Improve Interoperability





- Health care is being transformed to deliver care and services in a person-centered manner and is increasingly provided through community and home-based services that are less costly and more convenient for individuals and caregivers; and
- Most determinants of health status are social and are influenced by actions and encounters that
 occur <u>outside traditional institutional health care delivery settings</u>, such as in employment,
 retail, education and other settings.









AliveCor Launches New App that Automatically Tells Patients When Their ECG Recording is Normal

March 10, 2015

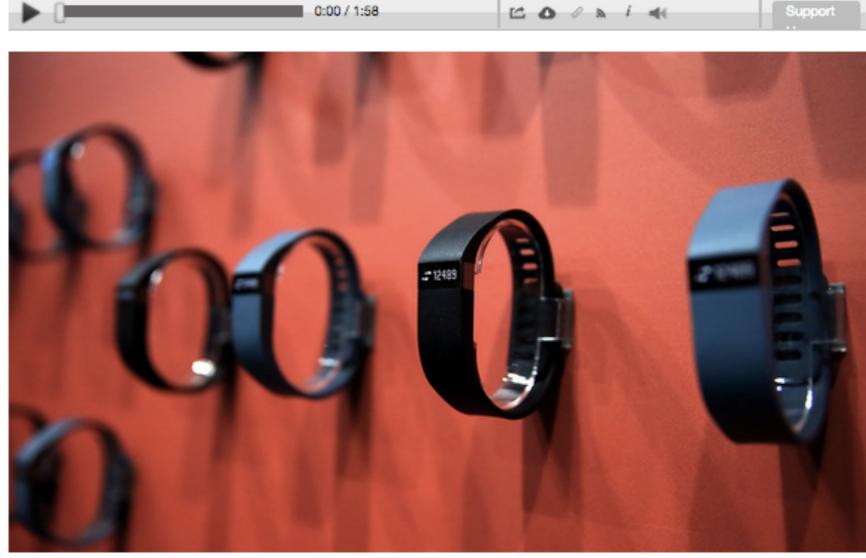


April 8, 2015



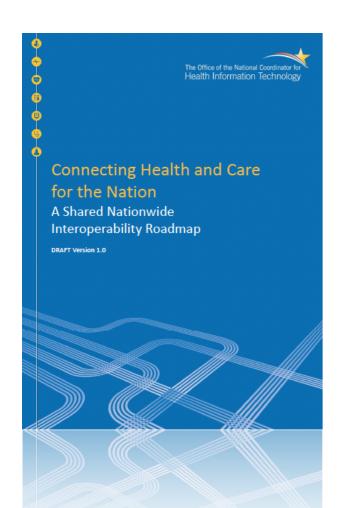
Trading insurance discounts for health data

0:00 / 1:58



Fitbit wearables on display at CES last year in Las Vegas.

by Curt Nickisch Wednesday, April 8, 2015 - 14:11



STORY

Support

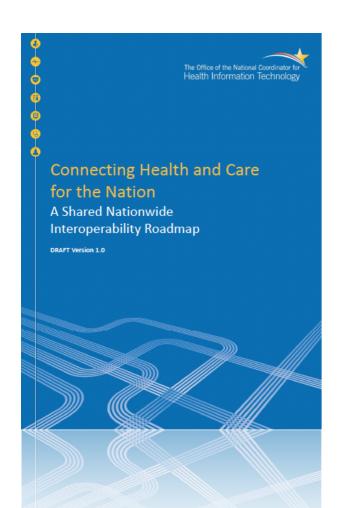
Interoperability: Standards Based

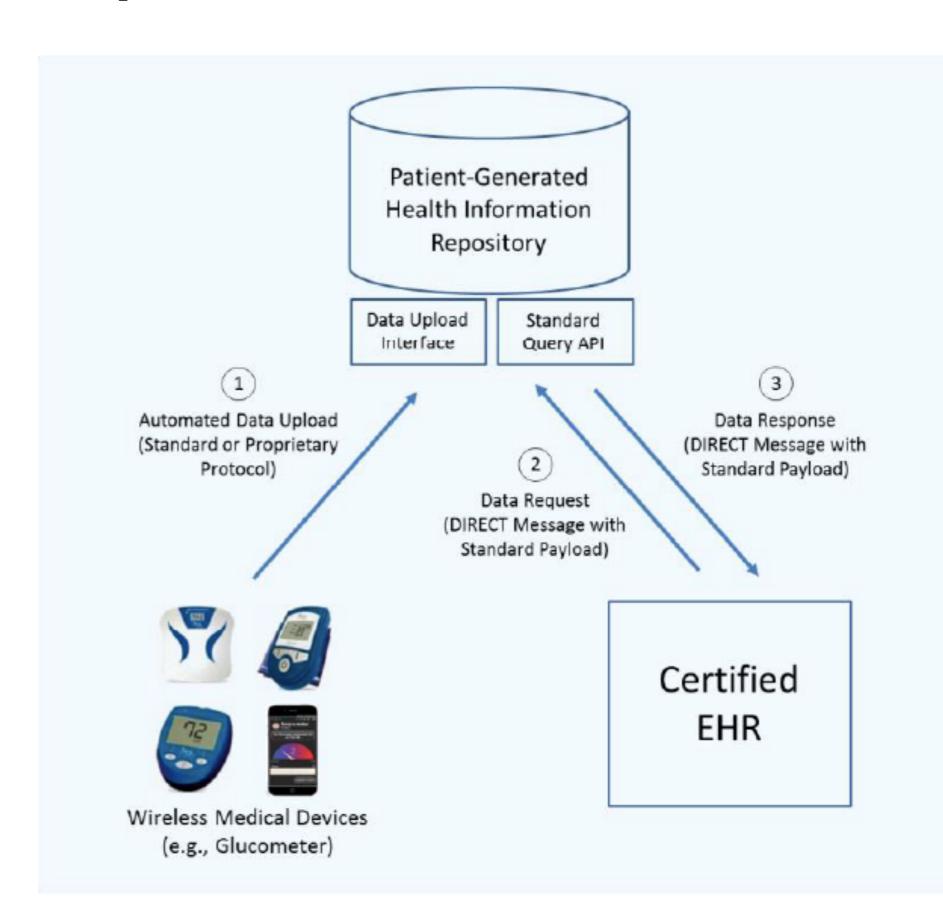
Prepared by

Sujansky & Associates, LLC

On behalf of Project HealthDesign

July 18, 2013

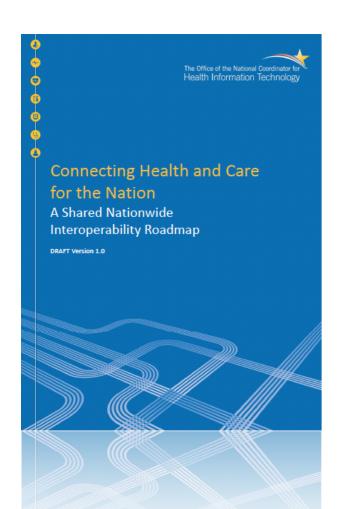




Interoperability: Ontology-based

An ontology-based personalization of health-care knowledge to support clinical decisions for chronically ill patients

David Riaño ^a, Francis Real ^a, Joan Albert López-Vallverdú ^{a,*}, Fabio Campana ^b, Sara Ercolani ^c, Patrizia Mecocci ^c, Roberta Annicchiarico ^d, Carlo Caltagirone ^{d,e}



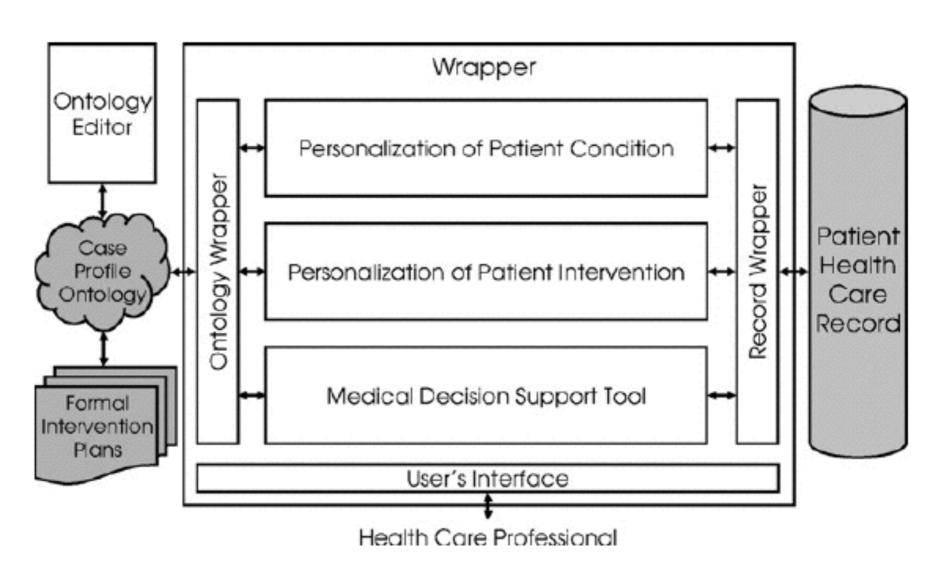


Fig. 1. The wrapper system.

a Research Group on Artificial Intelligence, Universitat Rovira i Virgili, Tarragona, Spain

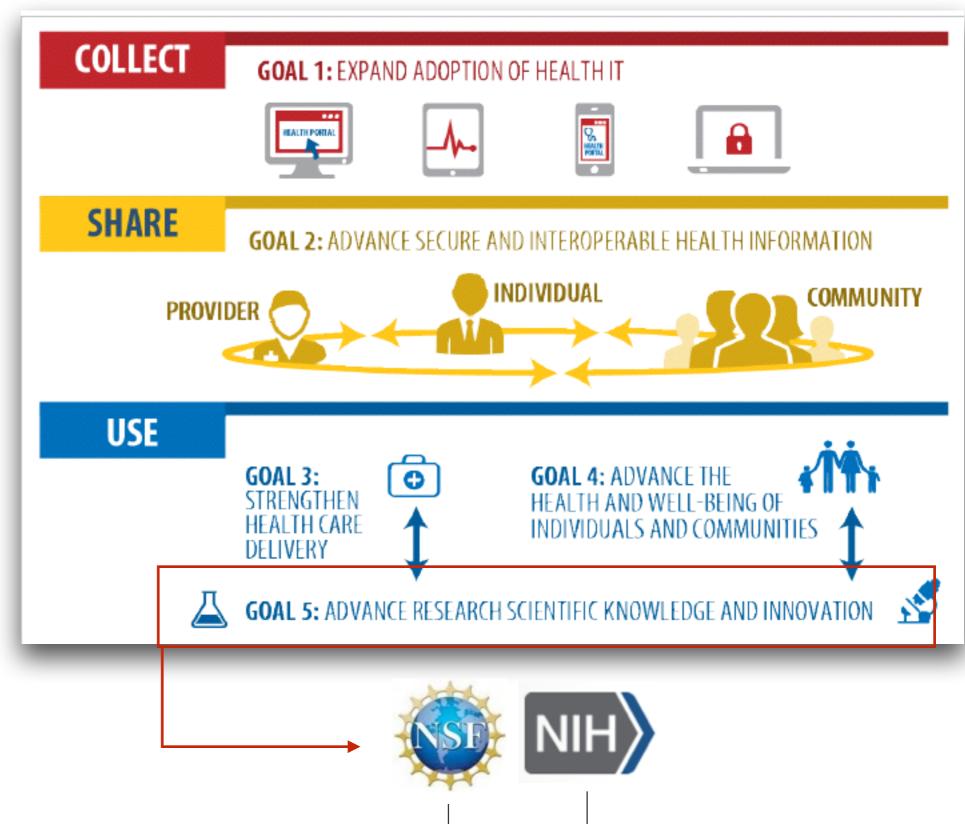
^bCentro di Assistenza Domiciliare, ASL RM B, Roma, Italy

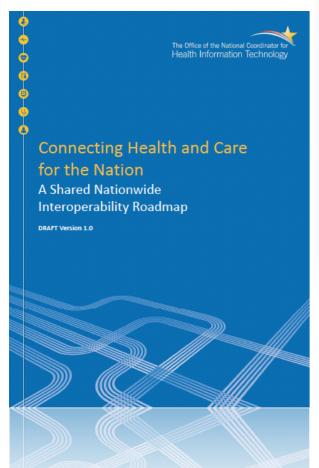
^cUniversity of Perugia, Perugia, Italy

^d IRCCS Fondazione S. Lucia, Roma, Italy

^e University Roma Tor Vergata, Roma, Italy

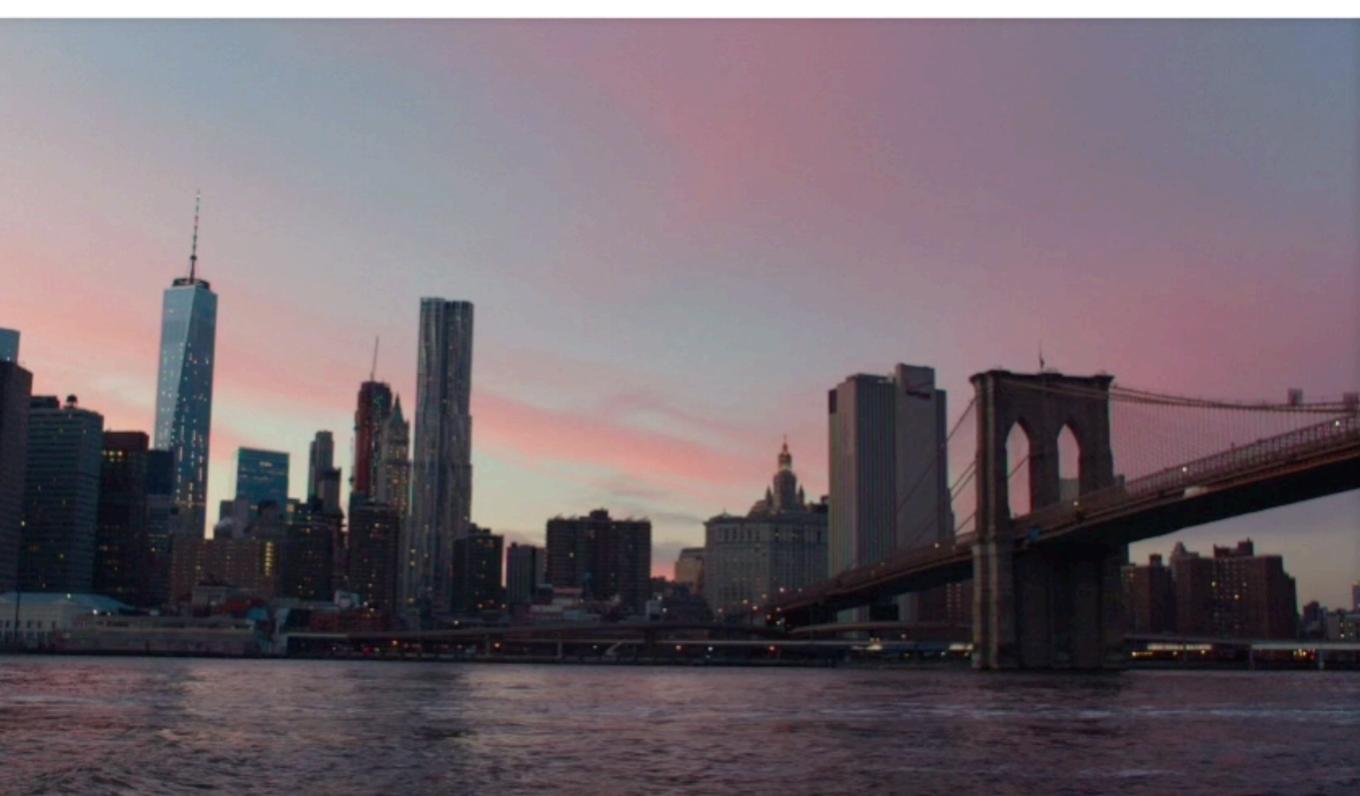
Interoperability: Need for Research







Apple Computer: Citizen Science



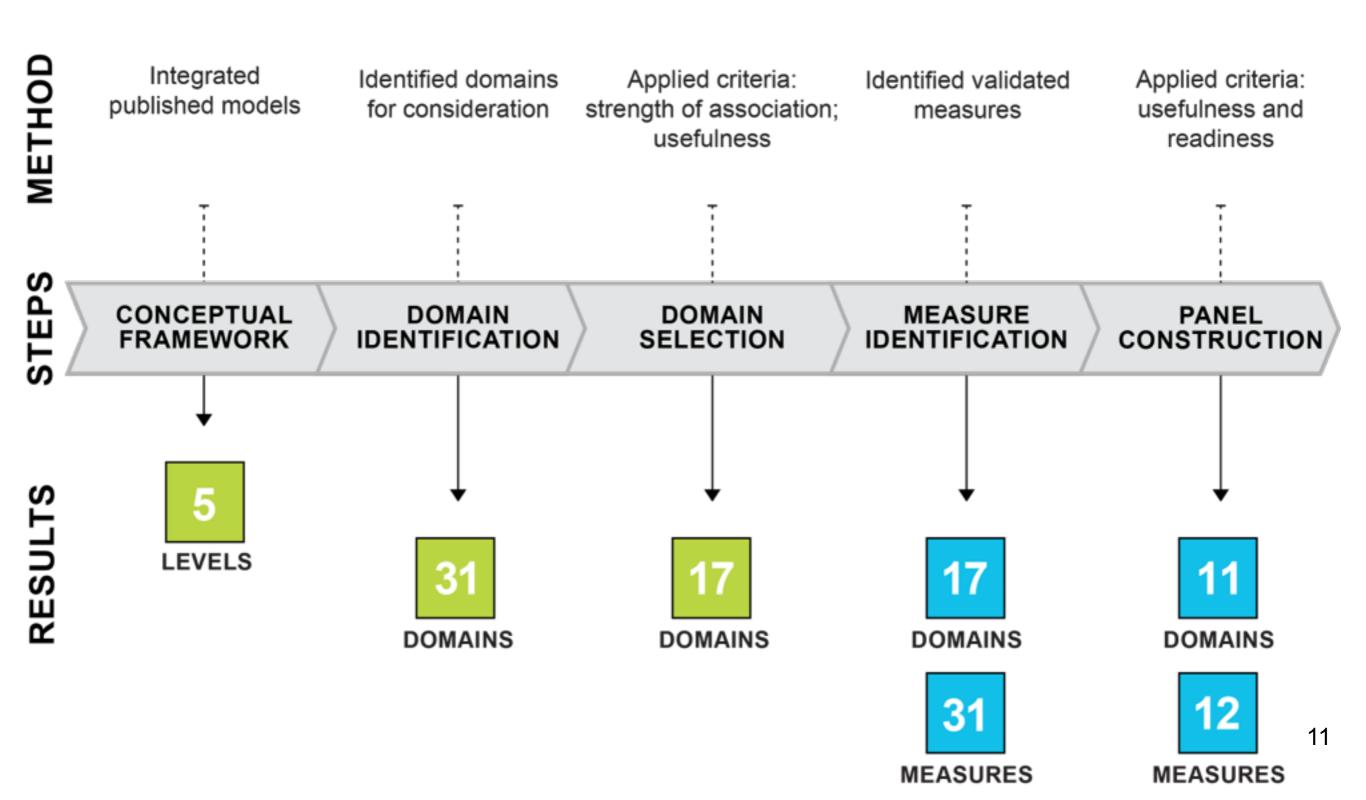
March 24, 2015

CAPTURING SOCIAL & BEHAVIORAL DOMAINS & MEASURES IN ELECTRONIC HEALTH RECORDS: PHASE 2

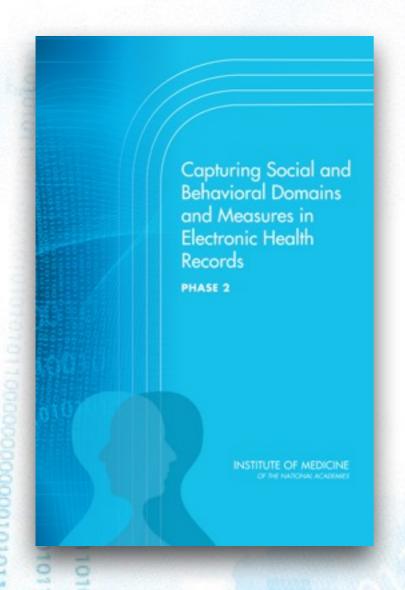
Nancy E. Adler, PhD William W. Stead, MD Committee Co-Chair Committee Co-Chair

Committee on Recommended Social & Behavioral Domains & Measures for Electronic Health Records (EHRs)

IOM Process for Domain Selection



REPORT



THE FULL REPORT IS NOW AVAILABLE FOR FREE DOWNLOAD AT: iom.edu/ehrdomains2

Connected Health

President's Cancer Panel: 2015



The Personal Health Data Revolution, Connected Health, and Cancer

March 26, 2015 • San Francisco, CA Hyatt Regency San Francisco #cHealth4Cancer

Barbara K. Rimer, DrPH Univ. of North Carolina at Chapel Hill

Hill Harper, JD

Cancer Survivor, Actor, and Best-Selling Author

Owen N. Witte, MD

University of California Los Angeles





NIH-NSF Funded "Smart and Connected Health" Project



- □ Traditional navigator programs increase 5-year survival rates for breast cancer patients-- are expensive.
- □ Computer scientists at GA Tech are creating computational model of patient discontinuities with triggers for improving navigation / health outcomes

Smart & Connected Health

8/12/2013 in <u>Biotechnology & Biomedicine</u>, <u>People & Technology</u>, <u>Public Service, Leadership & Policy</u>,

<u>Rotator</u>

Print This Page

MyJourney Compass: National Pilot Project Uses Information to Improve Cancer Treatment

An experimental health information exchange being tested in the north Georgia city of Rome is helping Koren Sinnock keep her travel plans. A breast cancer patient, Sinnock had been reluctant to travel very far from her doctors until the new program promised to provide access to her medical records from anywhere she might happen to be - including the beach.

"It gives me a sense of freedom that I can actually leave town and know that I can have medical information related to my cancer with me," she said. "I'm excited to be part of creating something that other people across the country might use."

· Watch a video describing this project

Providing easy access to medical histories and treatment records is just one aspect of MyJourney Compass, a pilot project designed to help patients navigate the complex cancer treatment process and become more involved their health care decisions. Operated through the Georgia Department of Community Health, the



Koren Sinnock is shown using the Nexus 7 tablet computer provided to patients through the MyJourney Compass pilot project. The computer provides medical information, access to health information records and a symptom tracker for regular communication with physicians. (Click image for high-resolution version. Credit: Rob Felt)



"Patients Lead the Way" in use of "Apps" for Health (NPR report, 6, 2013)



news

arts & life

music

listen

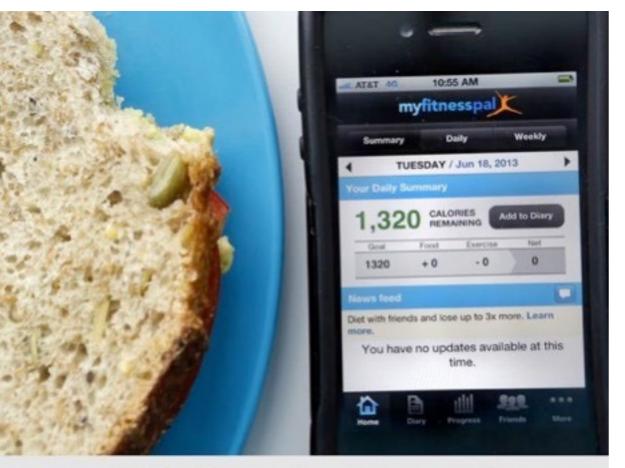
treatments

Patients Lead The Way As Medicine Grapples With Apps

by MARTHA EEBINGER

June 18, 2013 4:49 PM





"The average person looks at their smartphone 150 times a day, so all of a sudden they're able to diagnose if their blood pressure's adequately controlled and what are the circumstances when it's not."

-Eric Topol

How many calories in that bite? My Fitness Pal and other fitness and nutrition apps can



Connecting Health Data to Clinical Systems Through Sensors, Wearables & Other Devices

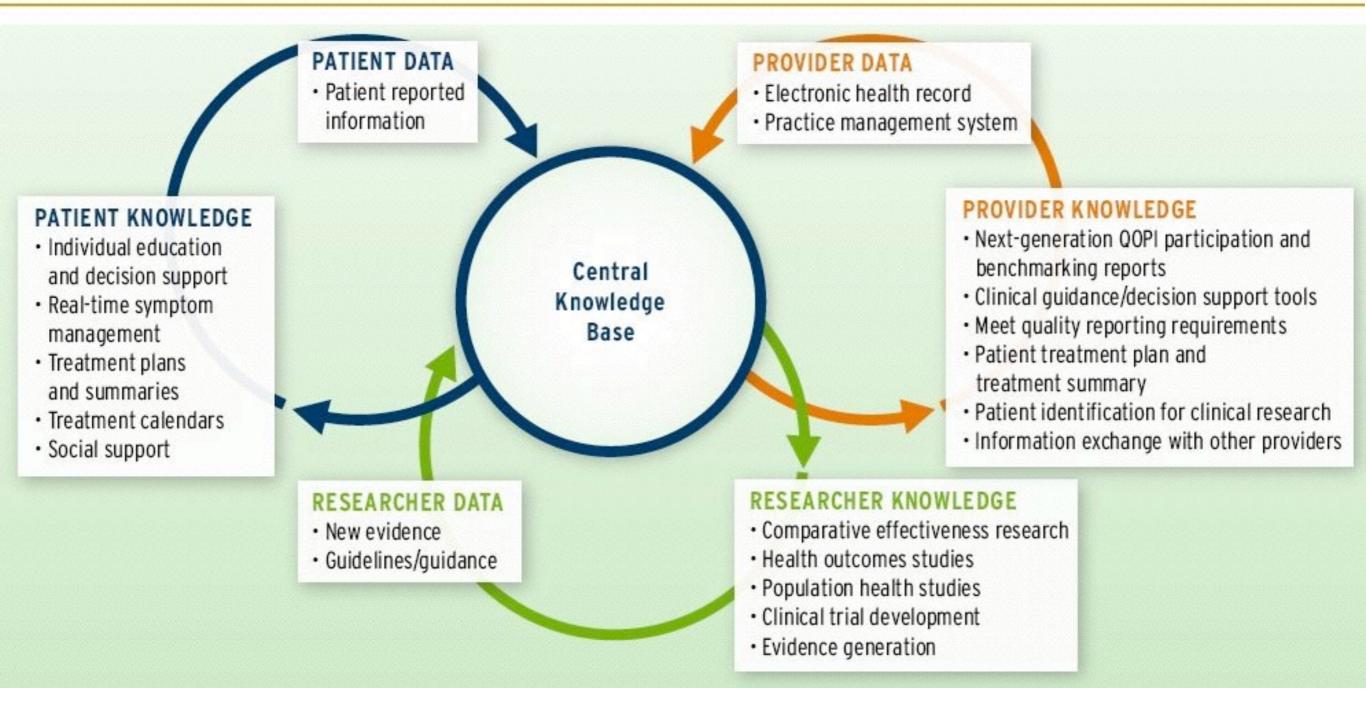
Robert Wood Johnson Foundation: Personal Data for the Public Good (2014)



- "Quantified Self" movement spurs new interest in prevention and healthy behaviors relevant to cancer control.
- "Meaningful Use" incentives to health care providers focus on requirement to demonstrate "patient engagement" through health information technology (Phases 2 & 3).



Integrated data from connected health devices will create a new platform for practice and research





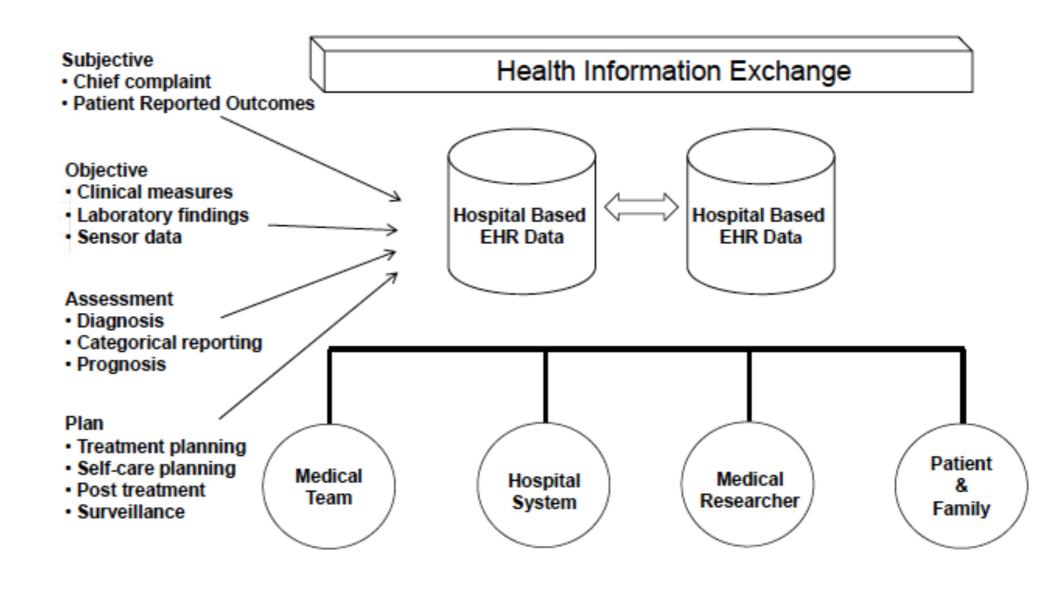
With data-based, precision treatments and monitoring as a result











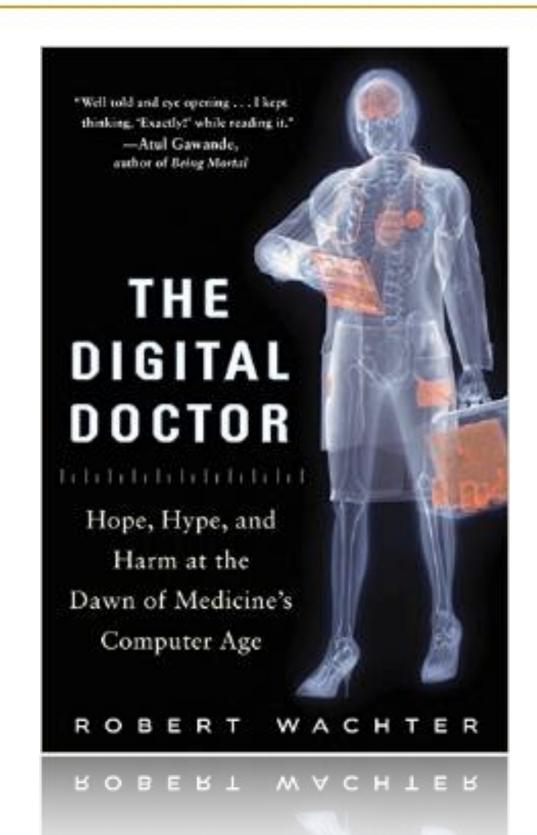
Decision Support Needs

- Risk modeling
- Diagnostic support
- Treatment selection
- Guideline adherence
- Error detection/correction

- Situational awareness
- Population health
- · Continuity of care
- Identify side effects
- · Inform discovery



Ultimately, the goal is to empower patients

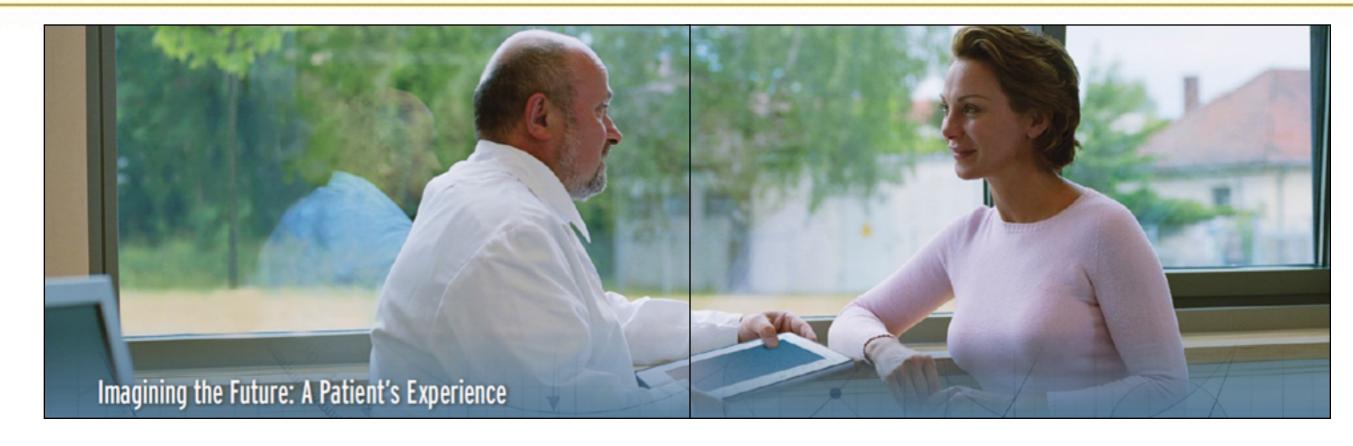


"The real action — and the money — will shift to creating innovative tools to allow patients to stay healthy and manage chronic illness."

- Robert Wachter



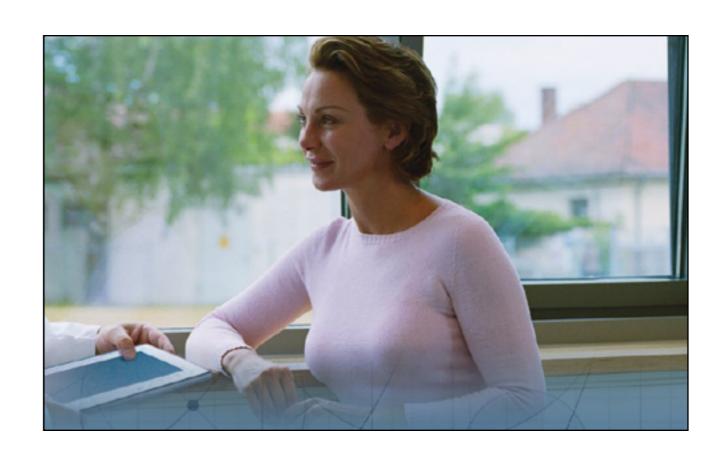
Connecting patients and their care teams through common language and data



- "You will receive a saliva reader that plugs into your smart phone, together with a few mobile applications that allow you to record your symptoms" (p. 3, line 8).
- "Every eight hours, your phone will buzz to remind you to take your medicine and answer a short series of questions about how you are feeling" (p. 3, line 10).

ACCELERATING PROGRESS AGAINST CANCER ASCO'S Blueprint for Transforming Clinical and Translational Cancer Research

Thank you!



Slideshare.nethttp://www.slideshare.net/BradfordHesse