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
Recommendation: The Federal Government, under the leadership of NSF and Health and Human Services (NIH, ONC, AHRQ) should invest in a national, long-term, multi-agency research initiative on NIT for health that goes well beyond the current national program to adopt electronic health records. 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.
“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

DECEMBER 2010

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

NIH

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
From traditional medicine to smart health

NSF + NIH Combined Perspective

- 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 AVAILABLE ANYWHERE, ANYTIME
- NAÏVE, PASSIVE, PATIENTS → EMPOWERED, ENGAGED, INFORMED, PARTICIPATING
From traditional medicine to smart health
NSF + NIH Combined Perspective

PROACTIVE and PREVENTIVE
FOCUS ON WELLBEING
QUALITY OF LIFE

PATIENT-CENTRIC, HOME-BASED

MORE EVIDENCE – BASED
DECISION SUPPORT

INTEROPERABLE, EHR AVAILABLE
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PARTICIPATING

Quantified Self

Wifi - Enabled Scale
From traditional medicine to smart health
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Citysense

This project supported by NSF Cyber-Physical Systems
Grant CNS-0932403, with additional support from the NIH
and a gift from Qualcomm.
From traditional medicine to smart health
NSF + NIH Combined Perspective

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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 National Cancer Institute Monographs’s 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.
From traditional medicine to smart health
NSF + NIH Combined Perspective

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Smart pill bottles to track adherence
From traditional medicine to smart health

NSF + NIH Combined Perspective

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PARTICIPATING

Smart Home for Patients

http://www.digi.com/blog/design/technology-for-connected-art-exhibits-a-model-for-innovative-business/
From traditional medicine to smart health
NSF + NIH Combined Perspective

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PARTICIPATING

Data Based
Decisions at
Multiple Levels

Disease Metrics Relating to Retina
Prevalence Rates by Ethnicity

Projections by Ethnicity

Projections by Year

C = Caucasian | AA = African American | H = Hispanic
From traditional medicine to smart health
NSF + NIH Combined Perspective

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Real Time Update to
Decision Support

e.g., Watson, Siri, Google Health
From traditional medicine to smart health

NSF + NIH Combined Perspective

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Cloud-Based Mobile Health Records
From traditional medicine to smart health
NSF + NIH Combined Perspective

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PARTICIPATING

Wellness
Adherence
Coordination

Personal Health
Information Hub
From traditional medicine to smart health

NSF + NIH Combined Perspective

PROACTIVE and PREVENTIVE
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QUALITY OF LIFE

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PARTICIPATING

“Gimme My Damn Data”

Medicine 2.0
September 18, 2009

ePatient Dave
From traditional medicine to smart health
NSF + NIH Combined Perspective

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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

HITECH: Meaningful Use as Building Blocks

Use information to transform
- Enhanced access and continuity
- Data utilized to improve delivery and outcomes
- Patient engaged, community resources
- Patient self management
- Patient centered care coordination
- Team based care, case management
- Registries to manage patient populations
- Privacy & security protections
- Privacy & security protections
- Structured data utilized for Quality Improvement

Utilize technology to gather information
- Basic EHR functionality, structured data
- Connect to Public Health
- Privacy & security protections
- Structured data utilized for Quality Improvement

Improve access to information
- Care coordination
- Patient engaged
- Evidenced based medicine
- Registries for disease management
- Connect to Public Health

Stage 1 MU | Stage 2 MU | PCMHs 3-Part Aim | ACOs Stage 3 MU
A 10 Year Goal for Health Systems

Use information to transform

- 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

Point of need, not just point of care

Learning Healthcare System

Personal Data for the Public Good

ACOs
Stage 3 MU
Technology: EHR Adoption

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

92% of Hospitals achieve Meaningful Use of Electronic Health Records (2014-01)

20,000+ Health Care Professionals are ready to transform health care with health IT.

84% of Surveyed American Adults agree that health care providers have appropriate

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

- Usability
- Interoperability
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 care-coordination due to over-reliance on healthcare IT are among the top 10 patient-safety concerns for healthcare organizations, according to a new report from the ECRI Institute.
Must Improve Interoperability
1. 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

2. Most determinants of health status are social and are influenced by actions and encounters that occur **outside traditional institutional health care delivery settings**, such as in employment, retail, education and other settings.

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

*March 10, 2015*
Trading insurance discounts for health data

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

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

Prepared by
Sujansky & Associates, LLC
On behalf of
Project HealthDesign
July 18, 2013

[Diagram showing patient-generated health information repository, automated data upload, standard query API, data response, wireless medical devices, and certified EHR]
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

a Research Group on Artificial Intelligence, Universitat Rovira i Virgili, Tarragona, Spain
b Centro di Assistenza Domiciliare, ASL RM B, Roma, Italy
c University of Perugia, Perugia, Italy
d IRCCS Fondazione S. Lucia, Roma, Italy
e University Roma Tor Vergata, Roma, Italy

Fig. 1. The wrapper system.
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

**Method**
- Integrated published models
- Identified domains for consideration
- Applied criteria: strength of association; usefulness
- Identified validated measures
- Applied criteria: usefulness and readiness

**Steps**
- Conceptual Framework
- Domain Identification
- Domain Selection
- Measure Identification
- Panel Construction

**Results**
- 5 Levels
- 31 Domains
- 17 Domains
- 17 Domains
- 11 Domains
- 31 Measures
- 12 Measures
REPORT

THE FULL REPORT IS NOW AVAILABLE FOR FREE DOWNLOAD AT: iom.edu/ehrdomains2
Connected Health
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
"Patients Lead the Way" in use of “Apps” for Health (NPR report, 6, 2013)

"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
“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.

- **Patient Data**: Patient reported information
- **Provider Data**: Electronic health record, Practice management system
- **Patient Knowledge**: Individual education and decision support, Real-time symptom management, Treatment plans and summaries, Treatment calendars, Social support
- **Provider Knowledge**: Next-generation QOPI participation and benchmarking reports, Clinical guidance/decision support tools, Meet quality reporting requirements, Patient treatment plan and treatment summary, Patient identification for clinical research, Information exchange with other providers
- **Researcher Data**: New evidence, Guidelines/guidance
- **Researcher Knowledge**: Comparative effectiveness research, Health outcomes studies, Population health studies, Clinical trial development, Evidence generation
With data-based, precision treatments and monitoring as a result.
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
“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).
Thank you!

Slideshare.net [http://www.slideshare.net/BradfordHesse]