INTRODUCTION TO CLINICAL INFORMATICS

David M. Schlossman, M.D., Ph.D., FACP, MMI, CPHIMS

INFORMATION OVERLOAD

- Biomedical knowledge and information have grown explosively over the last 50 years.
- *"The complexity of modern medicine exceeds the inherent limitations of the unaided human mind."*
  - David Eddy, M.D., Ph.D. *JAMA 263*(9): 1265-1275, March 2, 1990
- How do we store, manage and utilize it all that information to improve the quality, safety, and cost efficiency of health care?

COULD TECHNOLOGY HELP?

OPERATIONAL BENEFITS OF ELECTRONIC HEALTH RECORDS

- Better access, especially remote access
- No lost charts (well, almost…)
- Legibility
- Simultaneous access by multiple users
- Ability to process and reformat data to support clinical decision making
- Ability to aggregate and integrate data across time periods and sites of care to improve population health

HEALTH INFORMATION MANAGEMENT

How Information is

- Stored
- Organized
- Analyzed
- Retrieved
- Transmitted
- Protected

A NEW MEDICAL SUBSPECIALTY

VIEWPOINT

Clinical Informatics
Prospects for a New Medical Subspecialty

Don E. Detmer, MD
University of Virginia, Charlottesville.

Edward H. Shortliffe, MD, PhD
Arizona State University, Phoenix.

Only a few years ago, the mention of informatics in clinical circles generated questions regarding the rigor or relevance of the field. With the expanding interest and investment in health information technology by hospitals, health systems, and practitioners, however, interest in and acceptance of clinical informatics has increased substantially. Since 1972, the National Institutes of Health, principally through the National Library of Medicine (NLM), has supported a number of centers of excellence that focus on workforce education in computer applications and the underlying science. Additional efforts to help ensure a supply of competently trained individuals capable of maintaining progress with respect to applied clinical informatics are a recent development.

Among the current challenges for clinical informatics is the relative lack of understanding throughout the medical profession about the distinction between informatics and information technology. Biomedical informatics is a scientific discipline focused on the effective use of knowledge and information in patient care, public tools that allow better learning from the huge amount of information that is generated every day in health care environments.

> Biomedical informatics is a scientific discipline focused on the effective use of knowledge and information in patient care, public health, and biomedicine.

Clinical Informatics as a Subspecialty

The American Medical Informatics Association (AMIA) serves as the scientific association and professional home for clinical informaticians and for others involved with biomedical informatics. Since 1988, members of AMIA and its college, the American College of Medical Informatics, have developed a code of ethics and sponsored meetings, education, policy, and research programs. The creation of the clinical informatics subspecialty followed a process that began in 2007 when AMIA was elected to full membership in the Council of Medical Specialty Societies (CMSS), the umbrella organization composed of organizations that offer board certification through the American Board of Medical Specialties (ABMS). At the time of its election, AMIA was the sole member not having this distinction of board certification, although CMSS leadership was aware that AMIA was pursuing formal designation of clinical informatics as a subspecialty for physicians.

Following creation of 2 substantial documents, (1) a summary of the core content of clinical informatics[1] and (2) a description of formal fellowship training requirements,[2] the American Board of Preventive Medicine, with cosponsorship by the American Board of Pathology, agreed to assume responsibility for

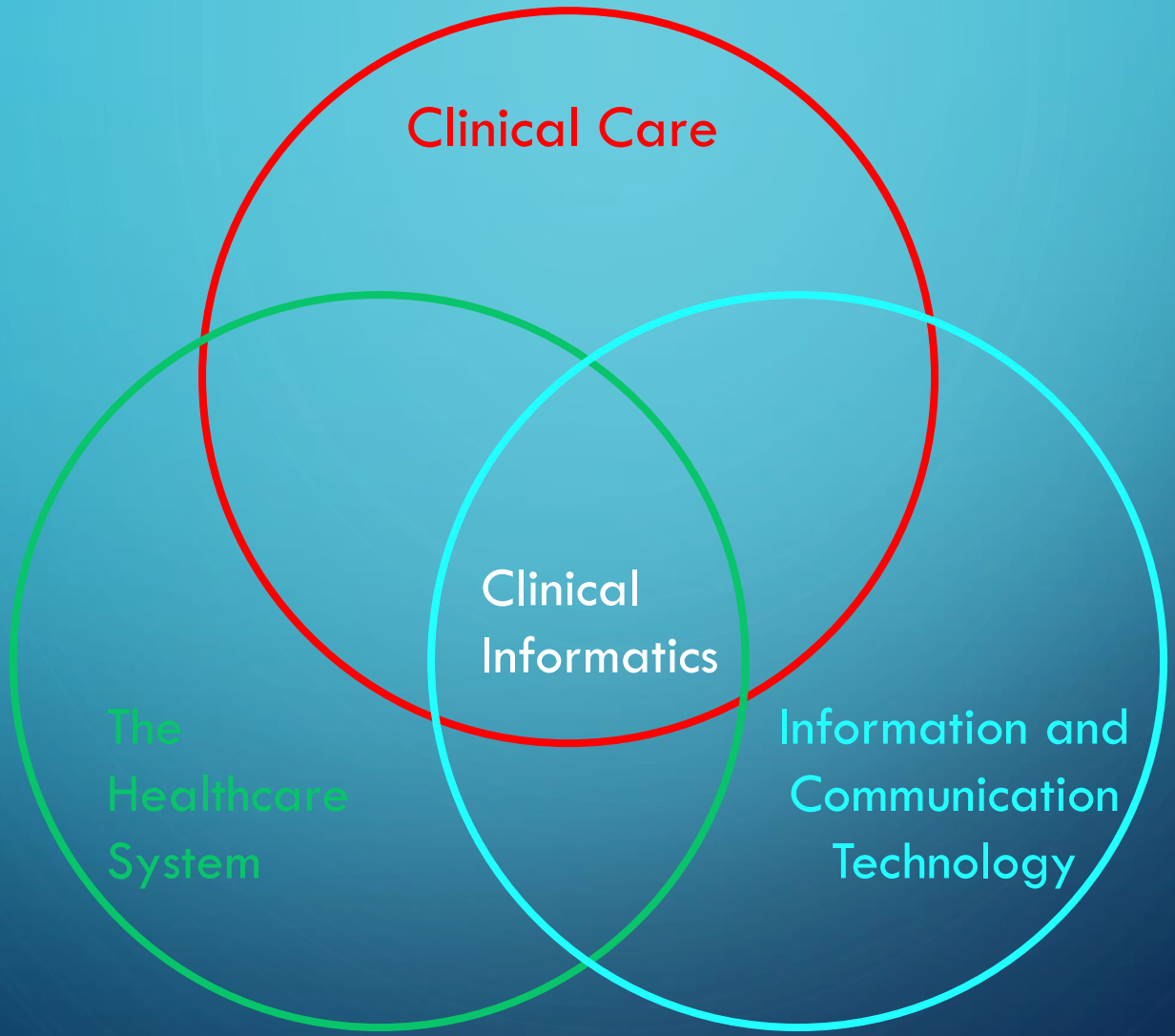
Detmer, D. and Shortliffe, E.H. (2014) JAMA 311(20): 2067-68

DEFINITION OF CLINICAL INFORMATICS

- The patient care and health foci of biomedical informatics
- More than just “computers in medicine”
- The body of knowledge, methods, and theories that deal with the effective use of knowledge and information to improve the quality, safety, and cost effectiveness of patient care, improve the health outcomes of both individuals and populations, and strengthen clinician-patient relationships
- Depends on analyzing, designing, implementing, and evaluating electronic digital information and communication systems

Detmer, D. and Shortliffe, E.H. (2014) JAMA 311(20): 2067-68

CLINICAL INFORMATICS EXISTS AT THE INTERSECTION OF THREE DOMAINS



Gardner, R.M. et al. (2009) *JAMIA 16*(2): 153-157

CORE COMPETENCIES OF CLINICAL INFORMATICS

- Fundamentals: Shared knowledge base, vocabulary, and understanding of informaticians' working environment
- Clinical Decision Support: Use of IT to support clinical decision making by healthcare professionals and improve clinical care processes
- Health Information Systems: Development, analysis, selection, and implementation
- Change Management: Leading and managing the changes associated with the adoption and use of clinical information systems

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FUNDAMENTALS

- Understand the practice of medicine and how to apply informatics methods, tools and concepts to improve that practice
- Understand the stakeholders, structures, and processes which constitute the health system
- Understand the flow of data, information, and knowledge among the domains of the health system
- Understand the technology which provides the basis for information storage, processing, and communication.

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THE CENTRAL IDEA OF CLINICAL INFORMATICS

Clinical Decision Support (CDS)

Systems designed to assemble a precisely calibrated mix of patient data and scientific information organized and displayed in a format which optimizes clinical decision making

Friedman, C.P. (2013) *JAMIA 20*: 224-226

SURGERY CLINICAL DECISION SUPPORT

CDS INTERVENTION FORMATS

- Critiques and warnings (drug-allergy or drug-drug interaction alerts)
- Standard order sets, care plans, and protocols,
- Relevant data summaries and dashboards
- Parameter and calculation guidance
- Filtered reference information and knowledge sources
- Expert workup and management systems (clinical pathways

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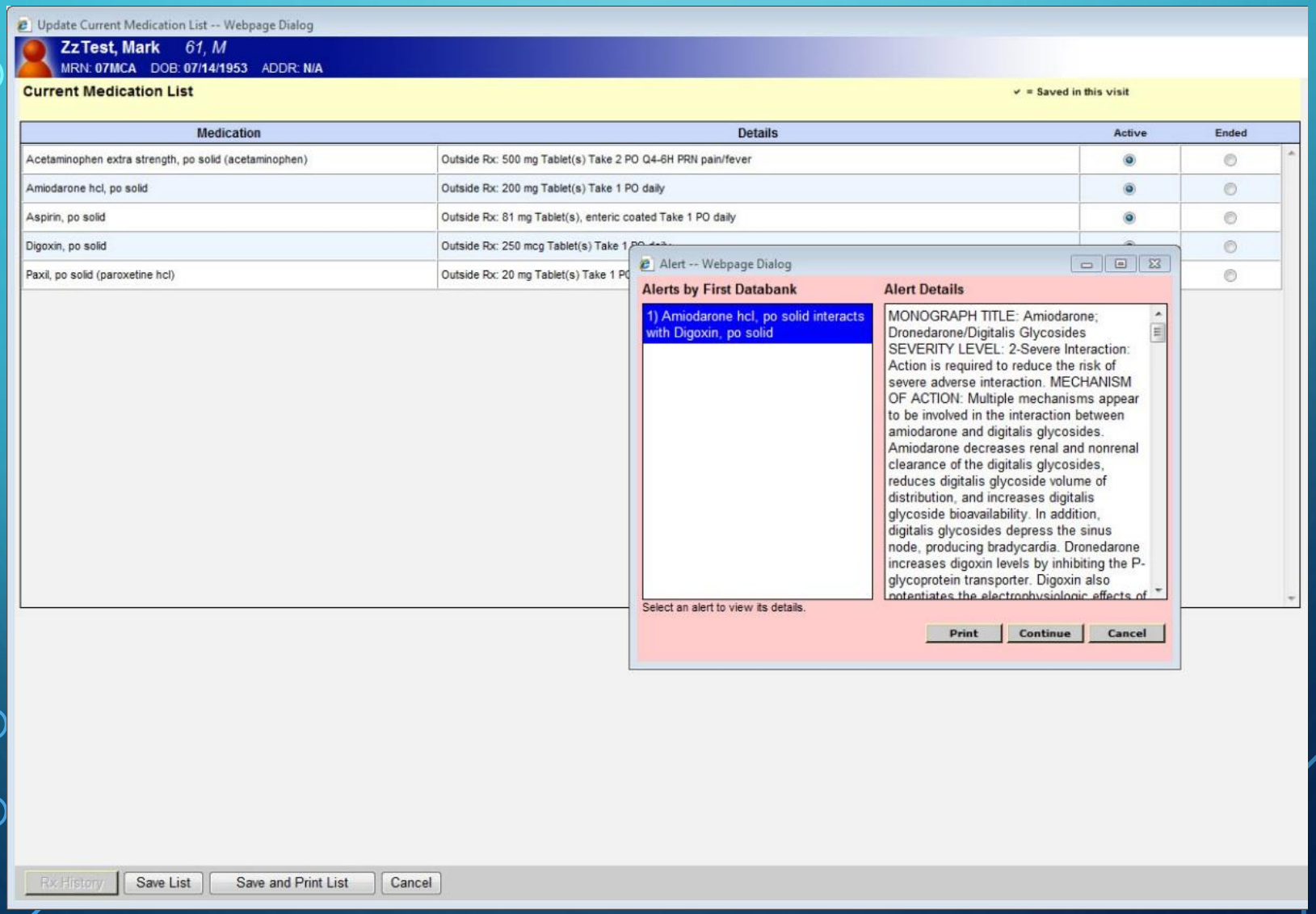
DRUG-DRUG INTERACTION WARNING



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DIABETES DASHBOARD

Medscape

DIABETES MELLITUS TYPE II

- Problem List

- Diabetes mellitus type 2 (250.00)
- Esophageal reflux (530.81)
- Hyperlipidemia (272.4)
- Hypertension (401.1)
- Insomnia (780.52)
- Osteoarthritis, generalized (715.00)

- Allergies

NKA

- Home Medications

- chlorthalidone 25 mg: Daily
- lisinopril 5 mg: Daily
- meloxicam 15 mg: Daily
- metformin 1000 mg: Twice daily
- omeprazole 20 mg oral enteric coated capsule: Daily
- Other: OneTouch Ultra II Twice daily
- Other: Lancets Twice daily
- simvastatin 40 mg: Daily

- Endocrine Events

BP:	114/65 mmHg	(02/18/10)	130/66 mmHg	(02/03/10)
Wt:	94.200 kg/207 lbs	(02/18/10)	96.400 kg/212 lbs	(02/03/10)
BMI:	0	(02/18/10)	0	(02/03/10)
Smoking Hx:	Non Smoker	(02/18/10)	Non Smoker	(01/13/09)
K+:	4.1 mmol/L	(01/16/09)		
Cr:	0.7 mg/dL	(01/16/09)		
MicroAlb/Cr:	6.2 mcg/mg Creat	(01/16/09)		
GFR (AA):	109.95 mL/min	(01/16/09)		
GFR (non AA):	90.72 mL/min	(01/16/09)		
Glu:	H 134 mg/dL	(01/16/09)		
HbA1c:	H 7.1 %	(01/16/09)		
Total Chol:	176 mg/dL	(01/16/09)	159 mg/dL	(01/11/08)
HDL:	45 mg/dL	(01/16/09)	43 mg/dL	(01/11/08)
Chol/HDL:	3.9	(01/16/09)	3.7	(01/11/08)
LDL:	H 104 mg/dL	(01/16/09)	98 mg/dL	(01/11/08)
Eye Exam:	1/31/2009		5/1/2009	
Foot Exam:	Done	(02/03/10)	Done	(01/13/09)

- Diabetes Mellitus PQRI Performance Measures

This Patient	Measure
●	1: Annual HbA1c
◎	2: HbA1c < 9.0%
○	3: BP < 140/90
●	4: Annual LDL Cholesterol
◎	5: LDL Cholesterol < 130
●	6: Annual Microalbumin
●	7: Eye Exam
○	8: Annual Foot Exam

Source: Ann Fam Med © 2011 Annals of Family Medicine, Inc.

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BREAST CANCER RISK CALCULATOR

- Adjuvant! Home
- Messages
- Breast Cancer
- Colon Cancer
- Lung Cancer
- MetResect
- Downloads
- Online Resources
- Personal Info
- Logout
- Intended Use
- FAQs
- Contact Us

Adjuvant! Online

Decision making tools for health care professionals

Adjuvant! for Breast Cancer (Version 8.0)

Patient Information

Age:	60
Comorbidity:	Minor Problems
ER Status:	Undefined
Tumor Grade:	Undefined
Tumor Size:	0.1 - 1.0 cm
Positive Nodes:	0
Calculate For:	Mortality
10 Year Risk:	4 Prognostic

Adjuvant Therapy Effectiveness

Horm:	Tamoxifen (Overview 2000)
Chemo:	CMF-Like (Overview 2000)
Hormonal Therapy:	23
Chemotherapy:	10
Combined Therapy:	31

No additional therapy:

87.8 alive in 10 years.
3.8 die of cancer.
8.4 die of other causes.

With hormonal therapy: Benefit = 0.8 alive.

With chemotherapy: Benefit = 0.3 alive.

With combined therapy: Benefit = 1.1 alive.

Print Results PDF | Access Help and Clinical Evidence | Images for Consultations

If the breast cancer tool does not appear after a few moments and the only thing visible is a gray box, you may need to download the latest version of Java. You can get it by going to www.java.com

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CLINICAL PRACTICE GUIDELINE

NCCN National Comprehensive Cancer Network®

NCCN Guidelines Version 3.2014
Invasive Breast Cancer

NCCN Guidelines Index
Breast Cancer Table of Contents
Discussion

HISTOLOGY	HORMONE RECEPTOR STATUS	HER2 STATUS	SYSTEMIC ADJUVANT TREATMENT
• Ductal[t] • Lobular • Mixed • Metaplastic	ER positive and/or PR positive	HER2-positive[b]	See Systemic Adjuvant Treatment - Hormone Receptor Positive - HER2-Positive Disease (BINV-5)
		HER2-negative[b]	See Systemic Adjuvant Treatment - Hormone Receptor Positive - HER2-Negative Disease (BINV-6)
	ER negative and PR negative	HER2-positive[b]	See Systemic Adjuvant Treatment - Hormone Receptor Negative - HER2-Positive Disease (BINV-7)
		HER2-negative[b]	See Systemic Adjuvant Treatment - Hormone Receptor Negative - HER2-Negative Disease (BINV-8)
• Tubular • Mucinous	ER positive and/or PR positive		See Systemic Adjuvant Treatment - Favorable Histologies (BINV-9)
	ER negative and PR negative		

[b] See Principles of HER2 Testing (BINV-A).
[t] This includes medullary and micropapillary subtypes.

Note: All recommendations are category 2A unless otherwise indicated.
Clinical Trials: NCCN believes that the best management of any cancer patient is in a clinical trial. Participation in clinical trials is especially encouraged.

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HEALTH INFORMATION SYSTEMS

- Assess advantages and disadvantages of different technological approaches to managing clinical information
- Select the best fit for a particular clinical environment and clinical staff
- Support clinicians during implementation and operation of clinical information systems
- Evaluate the effectiveness of systems in meeting clinical needs and collaborate with information technology personnel to optimize local configuration
- Confirm the quality and reliability of clinical data

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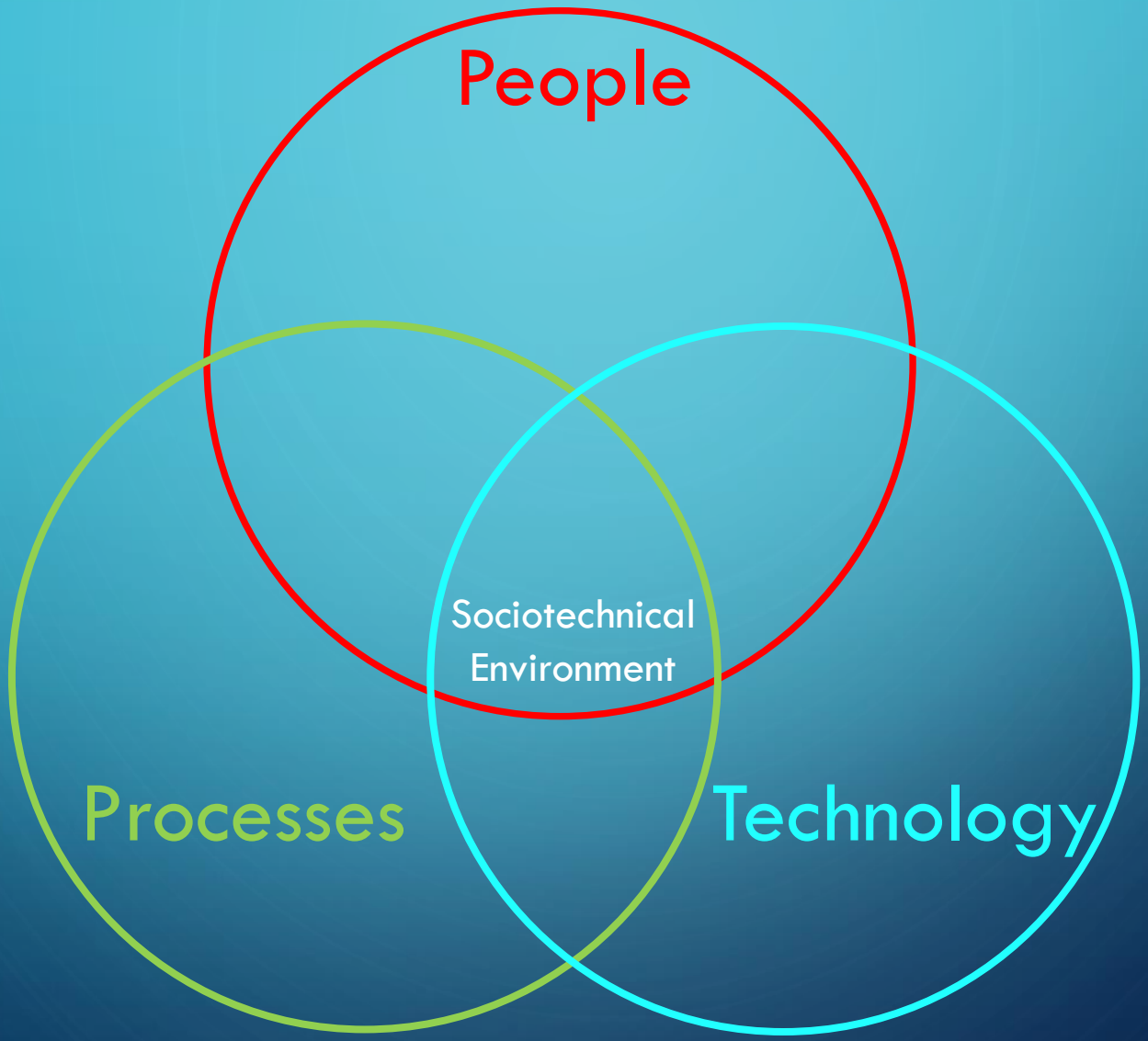
CHANGE MANAGEMENT



LEADING AND MANAGING CHANGE

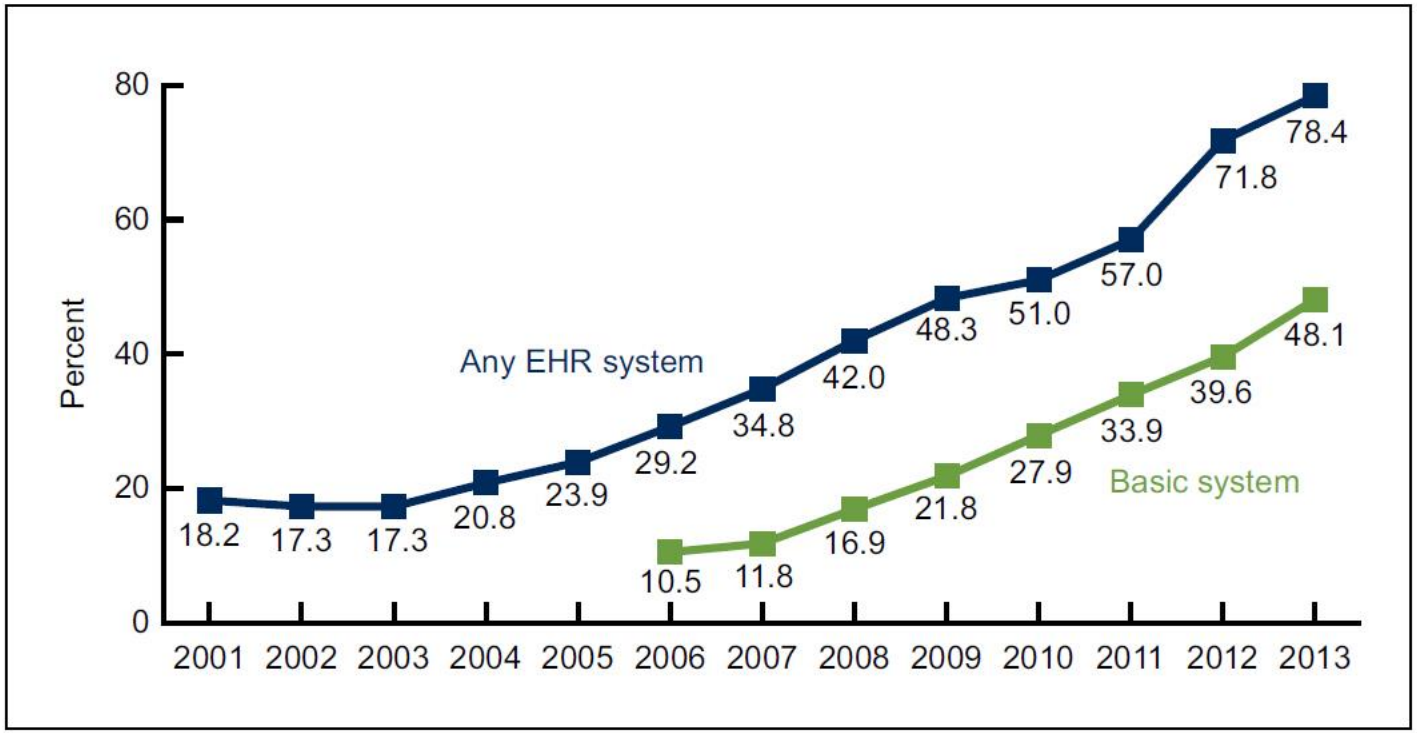
- Understand organizational culture and plan organizational change
- Build and work in effective multidisciplinary teams
- Listen actively, understand needs, articulate plans, explain rationales, inform constituents
- Report results and foster collaboration
- Relate information systems needs and plans to larger organizational strategic goals

CLINICAL INFORMATICS CHALLENGES

EFFECT OF FEDERAL INCENTIVES ON EHR ADOPTION

Adoption of basic EHR systems by office-based physicians increased 21% between 2012 and 2013.

Figure 1. Percentage of office-based physicians with EHR systems: United States, 2001–2013

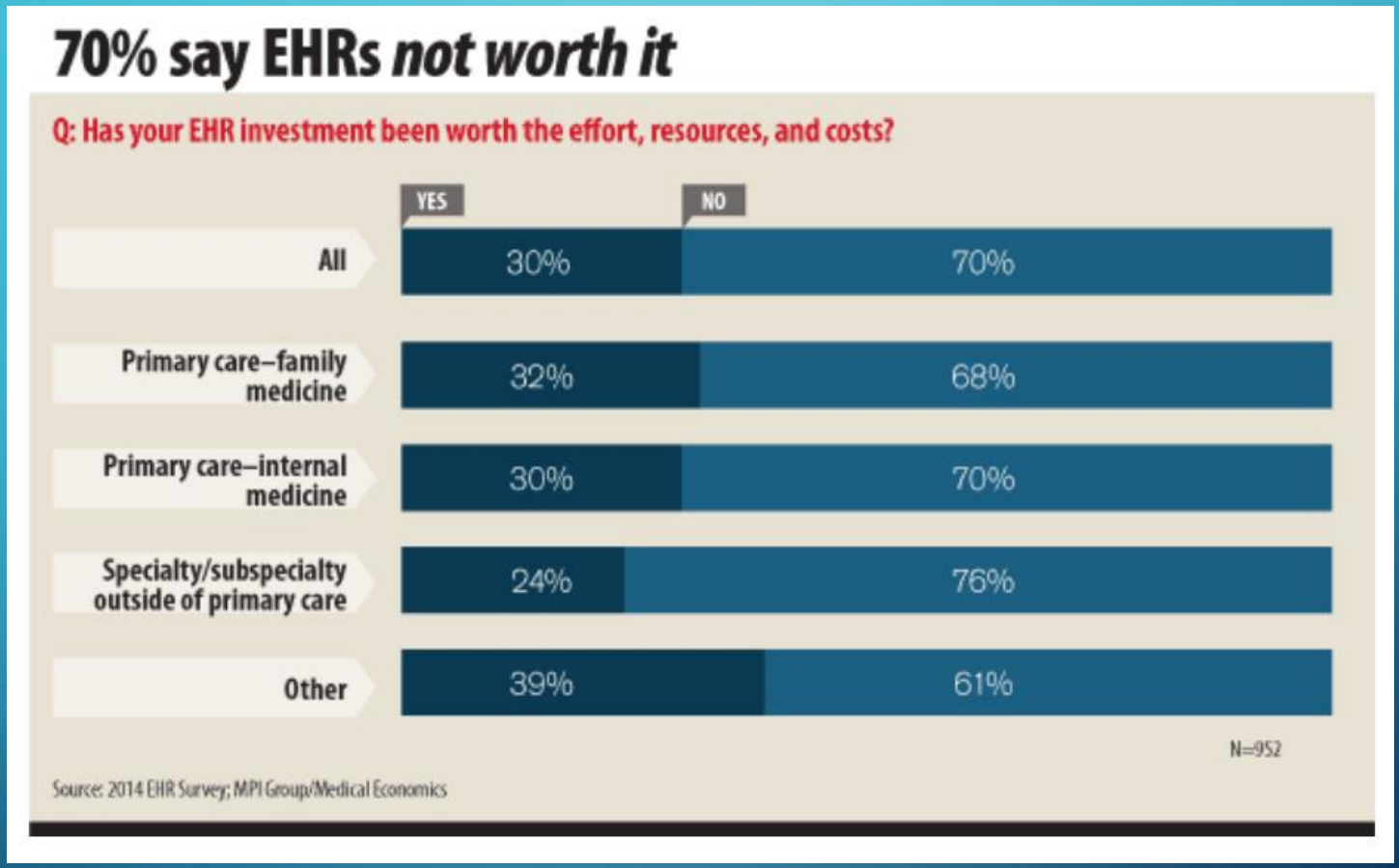


Hsiao C-J, Hing E. Use and characteristics of electronic health record systems among office-based physician practices: United States, 2001–2013. NCHS data brief, no 143. Hyattsville, MD: National Center for Health Statistics. 2014.

HEALTHCARE PROVIDERS' USER EXPERIENCE

- Products not developed with provider-patient workflow in mind
- Information not formatted to fit physician cognitive models or support clinical decision making
- Extra steps added in common clinical tasks
- Increased cognitive and physical workload in clinical practice

MEDICAL ECONOMICS/MPI PROVIDER SURVEY



Verdon, D.R. (2014). Physician outcry on EHR functionality, cost will shake the health information technology sector. *Medical Economics 91*(3): 18-27 (Similar results found in the 2013 AMA/RAND Corporation Physician Satisfaction Study and the 2014 Physician Foundation/Merritt Hawkins Survey of American Physicians)

COGNITIVE LOAD

- Working memory can only hold a limited number of items for short periods of time
- Managing and manipulating items within working memory requires focused thinking and significant effort termed “cognitive load”
- EHRs only work effectively when information is obtained, organized, and presented in a way which decreases cognitive load

THE FIVE RIGHTS OF CLINICAL DECISION SUPPORT

- The right information
- To the right person
- In the right CDS intervention format
- Through the right channel
- At the right point in workflow

Osheroff, J.A., Teich, J.M., Levick, D. et al. (2012). Improving Outcomes with Clinical Decision Support: An Implementers Guide. Healthcare Information and Management Systems Society, Chicago, IL

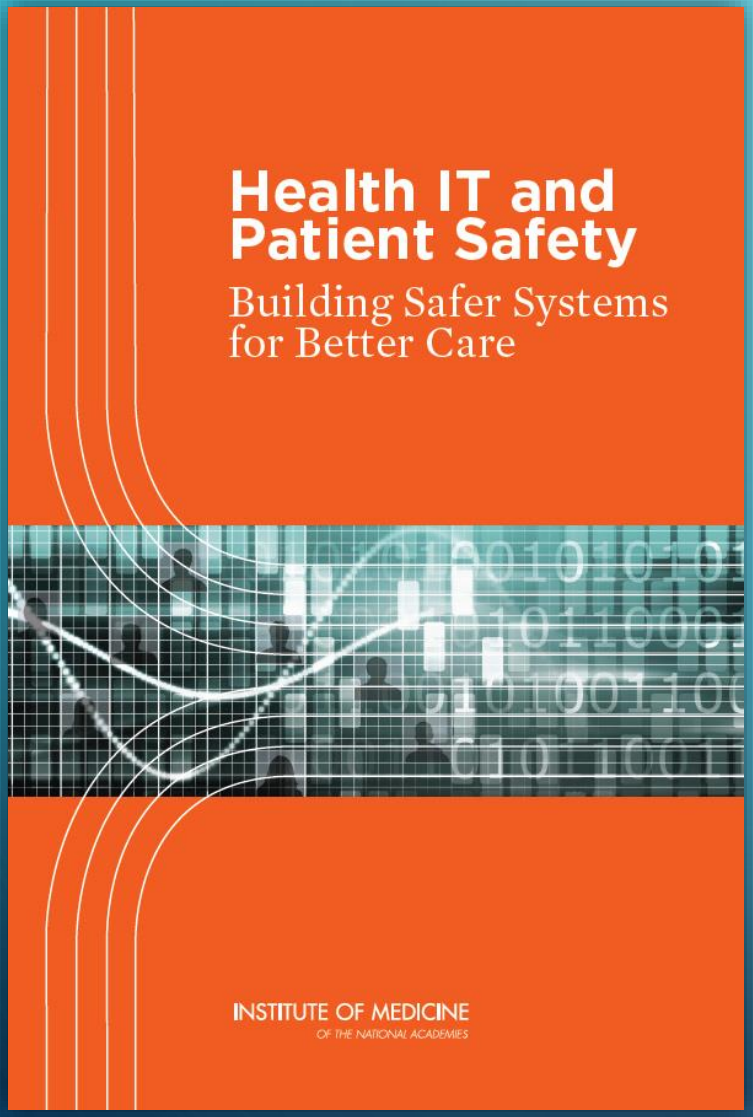
VIOLATING THE FIVE RIGHTS

- Can't properly retrieve and summarize patient information in a usable form or apply that information to properly prioritize and filter recommendations to the user
- Interruptive and fails to integrate key pieces of data and knowledge into the context of workflow
- Overloads the user's capacity to absorb information which then hinders rather than helps the decision-making process

PHYSICIAN CONCERNS ABOUT EHRs

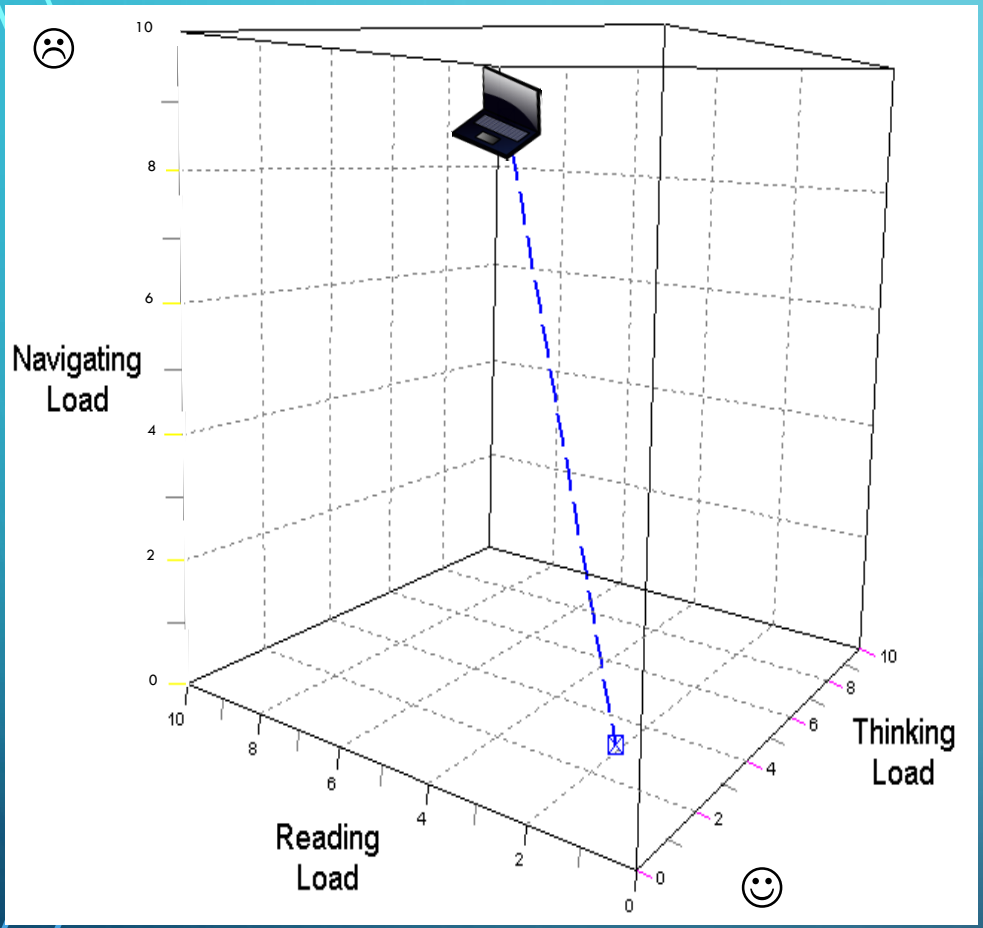
- Navigation Burden: Important data are difficult to locate in context of workflow. Too many clicks
- Data Entry Burden: Entering structured data into EHR distracts attention from the patient being examined
- Documentation Burden: Structured data unable to adequately represent the complex details of patient history or clinician reasoning
- Reconciliation Burden: Tools to verify the accuracy and completeness of information at the time of care transitions are poorly executed
- Interoperability Burden: Transfer of data from one EHR to another in a form usable by the receiving clinician remains an elusive goal

EHR USABILITY AFFECTS PATIENT SAFETY



- Designed and applied inappropriately, health IT can add an additional layer of complexity to the already complex delivery of health care, which can lead to unintended adverse consequences…
- The committee believes poor user-interface design, poor workflow, and complex data interfaces are threats to patient safety.

EHRS SHOULD LIGHTEN "LOADS"



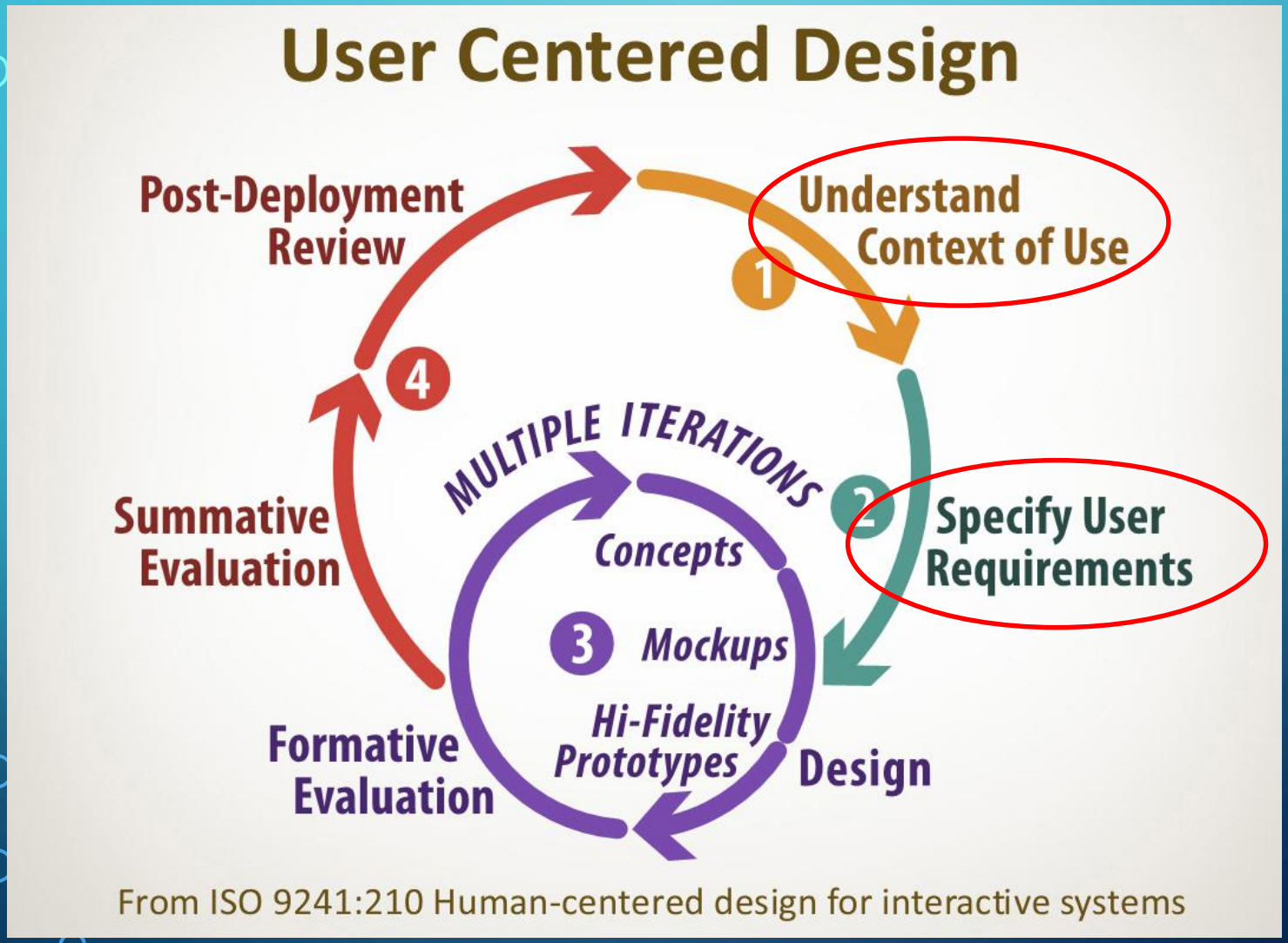
- Navigation
  - Clicks, scrolls, keystrokes, mouse movements
- Reading
  - Legibility, signal to noise ratio, layout, emphasis, eye tracking
- Thinking
  - Icon meaning, recall vs. recognition, cognitive load
- Text Entry
  - Typing, pick lists, dictation
- Emotional Factors
  - Task stress, situational awareness, dissonance

BETTER EHRs ARE A SHARED RESPONSIBILITY

"The clinical systems of today are great advances from what were available a decade ago but are still imperfect. Progress depends on further research, a vibrant vendor community that collaborates well with academia to enhance features such as interoperability and usability, and highly trained applied informaticians, many of whom are also practicing clinicians."

Detmer, D.E. and Shortliffe, E.H. (2014). Clinical Informatics: Prospects for a New Medical Subspecialty. *Journal of the American Medical Association 311* (20): 2067-2068.

USER CENTERED DESIGN (UCD)



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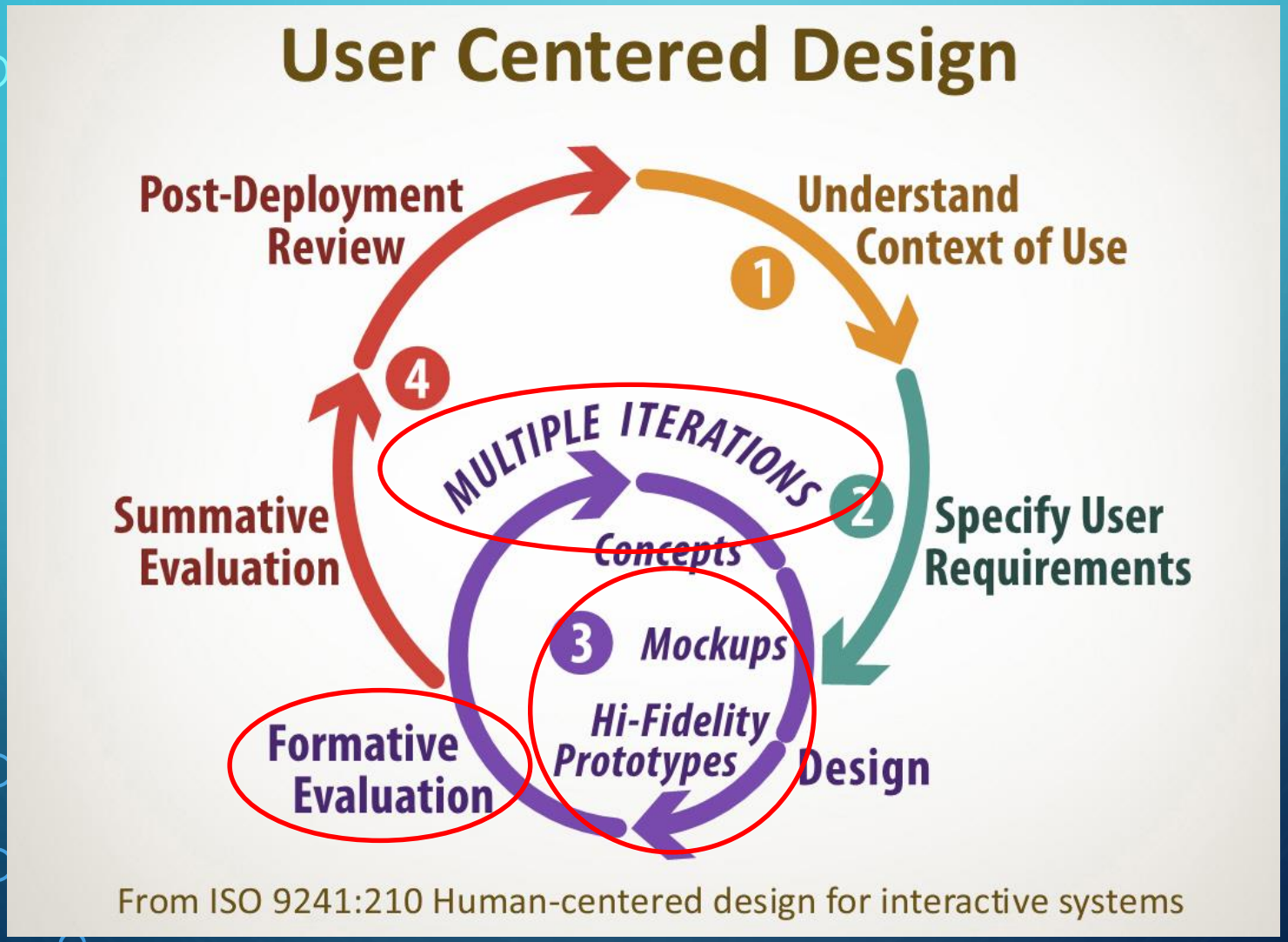

A SLIDE FROM THE EPIC OVERVIEW COURSE

Physician Leaders

- Sponsor
- Physician Champion
- Physician Analyst
- Physician Advocates

Physician leaders need:

- Time
- Support
- Accountability

This is not a hobby!

A LEARNING HEALTHCARE SYSTEM

Electronic Health Records

Biomedical and Clinical Research

Regional and National Public Health and Disease Registries

Standards for Prevention and Treatment

Creation of Protocols, Guidelines, and Educational Materials

Information, Decision-Support, and Order-Entry Systems

Providers Caring for Patients

COMMENTS AND QUESTIONS?