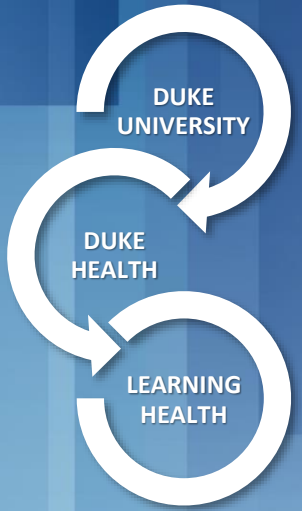
Getting to a Learning Health System through Learning Health Units: Opportunities and Challenges

Adrian F. Hernandez, MD
Vice Dean for Clinical Research

DukeHealth



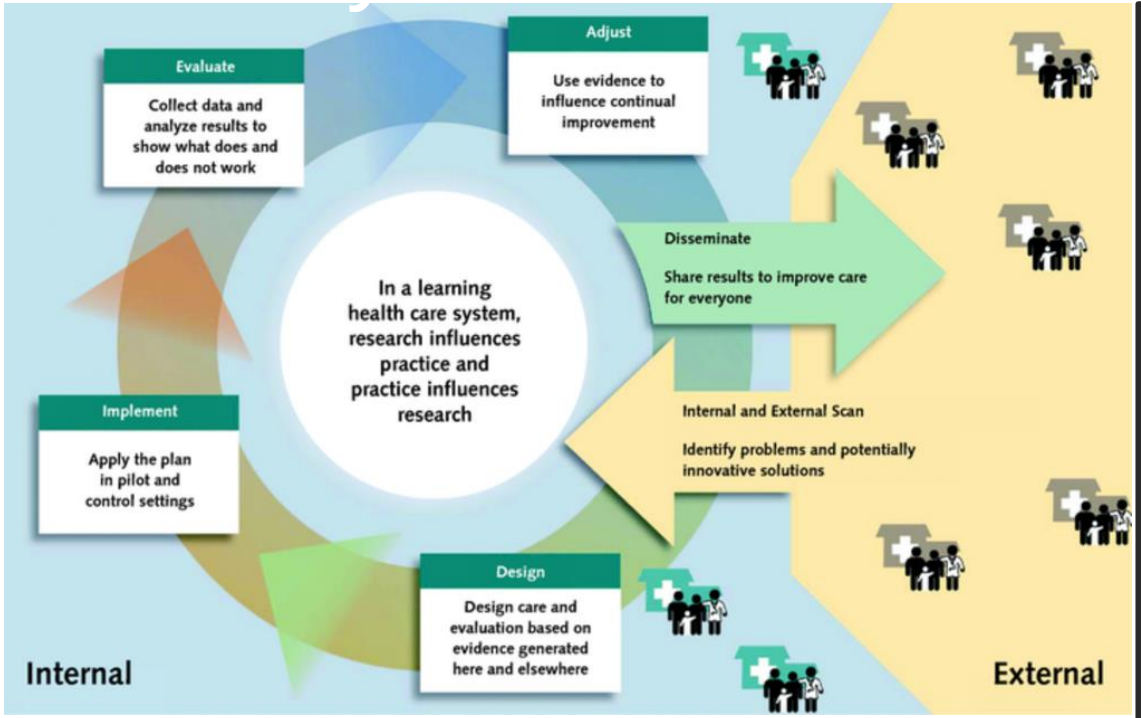
Key questions:

- Are we achieving our goals of a learning health system?
- Based on your experience so far, what are the key attributes for a learning health system?
- If you wanted to get real, high quality results, really fast…how would you design it?

Agenda

- Origins of the learning health system
- Getting answers:
  - The patient?
  - The clinician?
  - The data scientist?
- Designing a learning health unit

Revisiting the concept of a learning



Courtesy: Eric Larson

Aspiration: bring timely, accurate, and current clinical information to the point of care to help patients and clinicians make optimal healthcare choices

Evidence is iteratively applied *and* developed as a natural part of the care delivery process

Entails engagement of a range of stakeholders: health system leaders, front line clinical practitioners, patients, payers, policymakers

Deep reliance on data, rapid analytics, and supportive culture

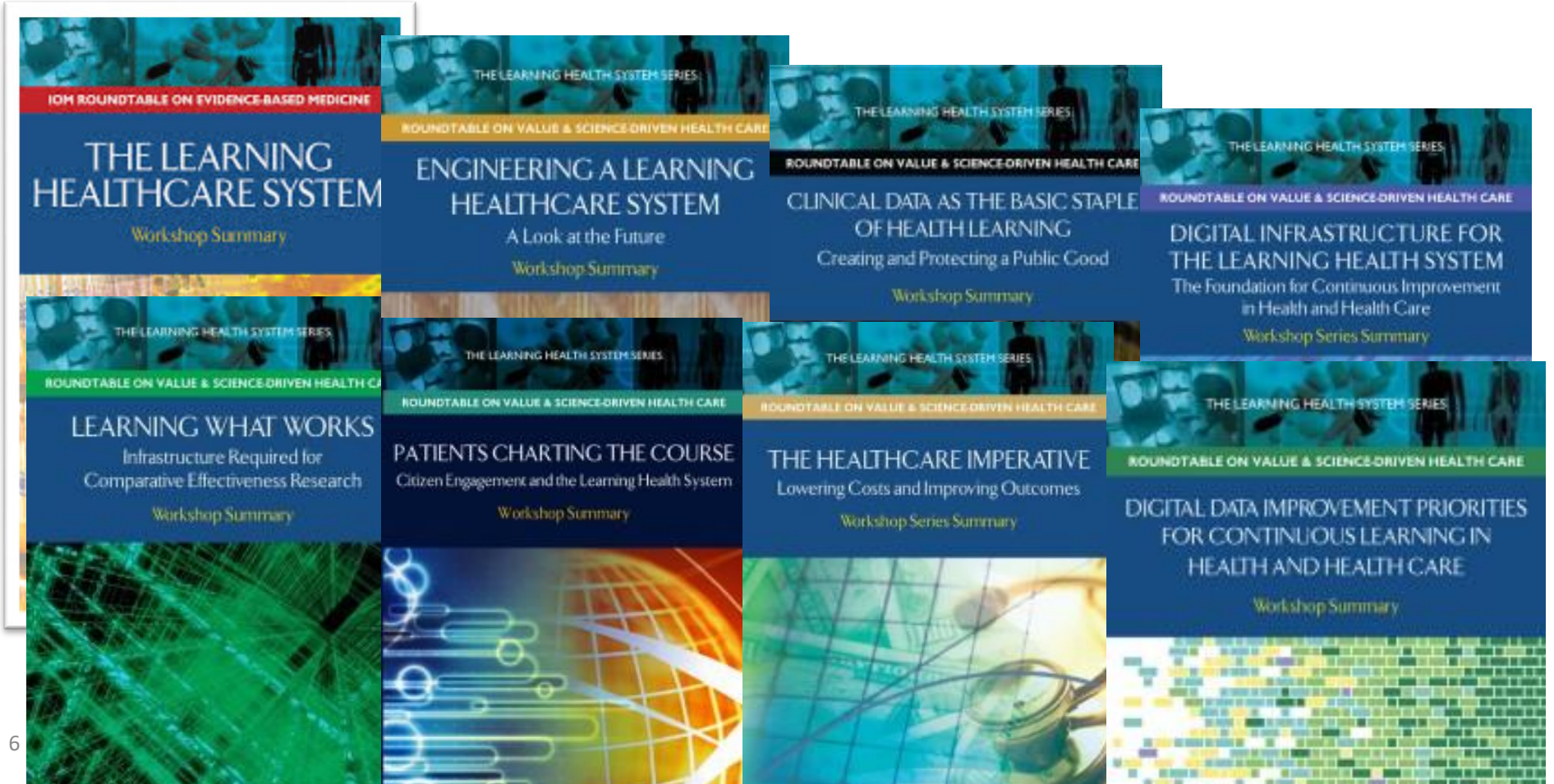
Remember when….

‘By the year 2020, ninety percent of clinical decisions will be supported by accurate, timely, and up-to-date clinical information, and will reflect the best available evidence.”

Charter

IOM Roundtable on Value & Science-Driven Health Care

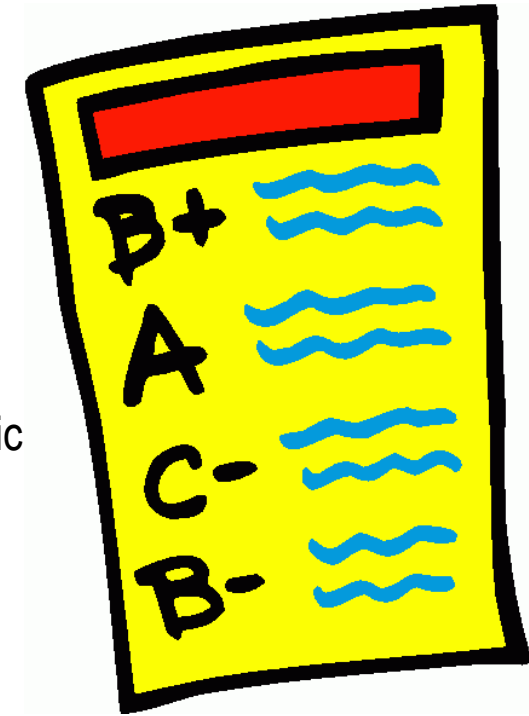
Enormous ideas…



Giving an honest grade on achieving the vision…

The Institute of Medicine's (NAM) vision:

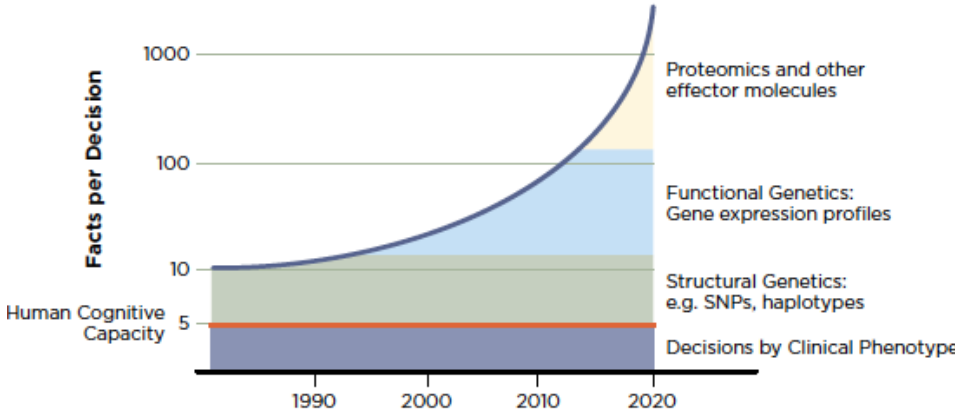
- Research happens closer to clinical practice than in traditional university settings.
- Scientists, clinicians, and administrators work together.
- Studies occur in everyday practice settings.
- Electronic medical records are linked and mined for research.
- Recognition that clinical and health system data exist for the public good.



Summary: Evidence informs practice and practice informs evidence.

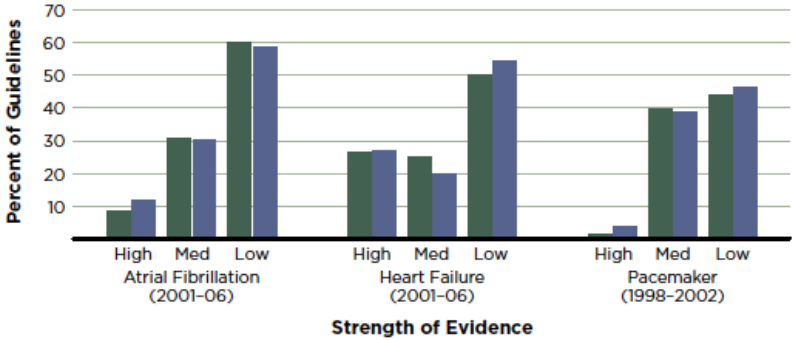
Selective Reflections

Medical decisions becoming more complex



William Stead, IOM Meeting, 8 October 2007. Growth in facts affecting provider decisions versus human cognitive capacity.

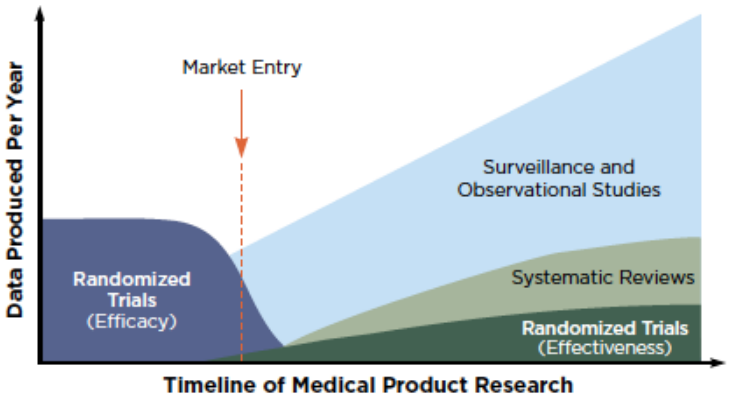
Inadequate evidence to guide care



Robert Califf, IOM Meeting, 12 December 2007. Less than 20% of AHA/ACC heart disease management guidelines are based on a high level of evidence and over 40% are based on the lowest level of evidence. Furthemore, the proportion of guidelines with high evidence levels has not increased over time (green vs. blue).

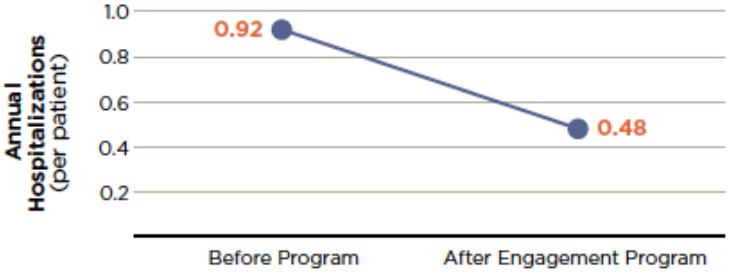
Selective Reflections

Expanded capacity for new knowledge



Redesigning the Clinical Effectiveness Research Paradigm, 2010. Evidence development in the learning health system.

Patient engagement for better outcomes



Joseph Kvedar, IOM Meeting 1 April 2010. Effect of enrollment in Partners HealthCare's Connected Cardiac Care Program (CCCP) program on heart failure hospitalization. Enrollment in the CCCP program, with health IT-facilitated self-monitoring and patient-clinician communication, reduced the rate of hospitalization for heart failure.

Agenda

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If you had a health question, what would you do?

Google chest pain

All Images News Shopping Videos More Settings Tools

About 6,370,000 results (0.68 seconds)

Why does my chest hurt? 26 Causes of Chest Pain & Tightness in Chest
https://www.webmd.com/pain-management/guide/whats-causing-my-chest-pain
Sep 11, 2016 - **Chest pain**. The first thing you may think of is heart attack. Certainly **chest pain** is not something to ignore. But you should know that it has many possible causes. In fact, as much as a quarter of the U.S. population experiences **chest pain** that is not related to the heart. **Chest pain** may also be caused by ...
Burns and Pain · Angina · Pericarditis · Surprising Reasons You're

Chest pain - Symptoms and causes - Mayo Clinic
https://www.mayoclinic.org/diseases-conditions/chest-pain/symptoms.../syc-20370838
Dec 8, 2017 - **Chest pain** has many possible causes — and some of them are serious. Here's why it's so important to see your doctor about **chest pain**.

People also ask

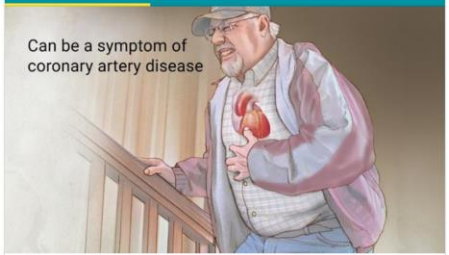
What could cause chest pain?
What can cause chest pains?
Where do you feel chest pain during a heart attack?
What do you do when you have chest pain?

Feedback

Angina (Chest Pain) - American Heart Association
www.heart.org/HEARTORG/.../Angina-Chest-Pain_UCM_450308_Article.jsp
Dec 14, 2017 - Angina is **chest pain** or discomfort caused when your heart muscle doesn't get enough

Angina
Also called: ischemic chest pain

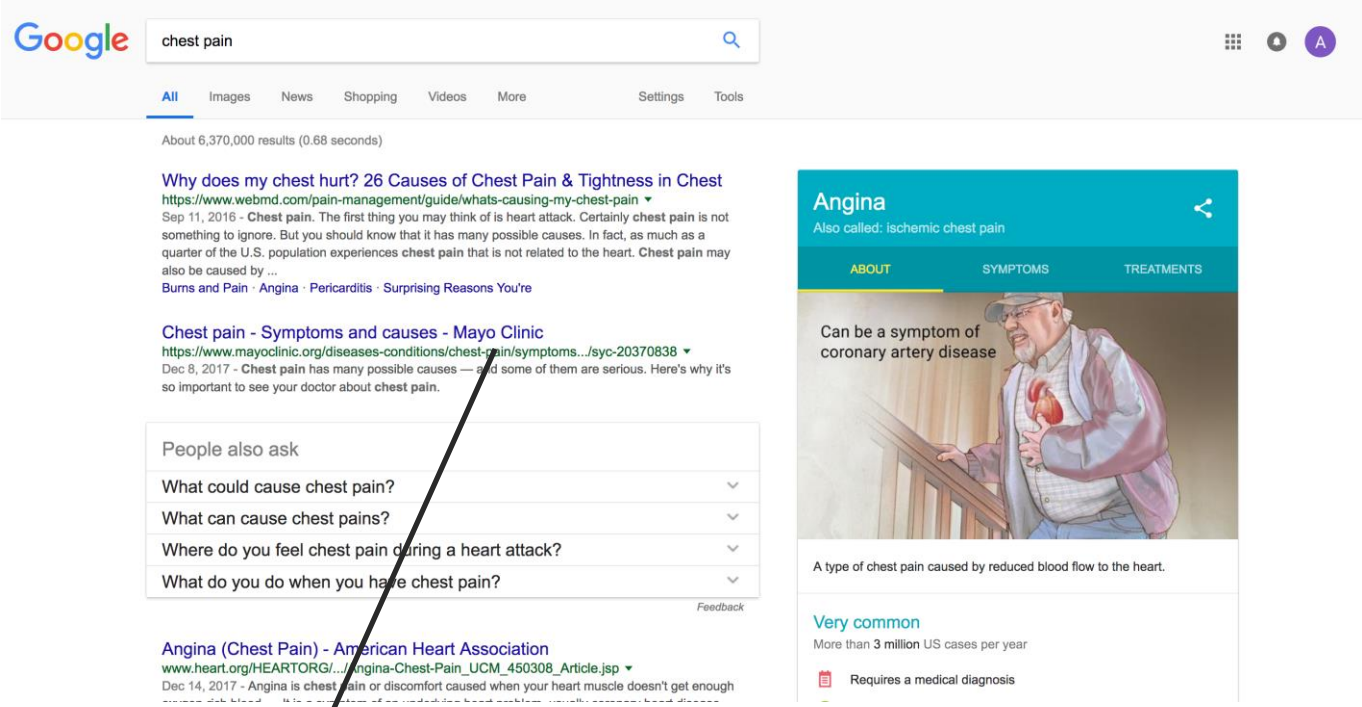
ABOUT SYMPTOMS TREATMENTS



A type of chest pain caused by reduced blood flow to the heart.

Very common
More than 3 million US cases per year

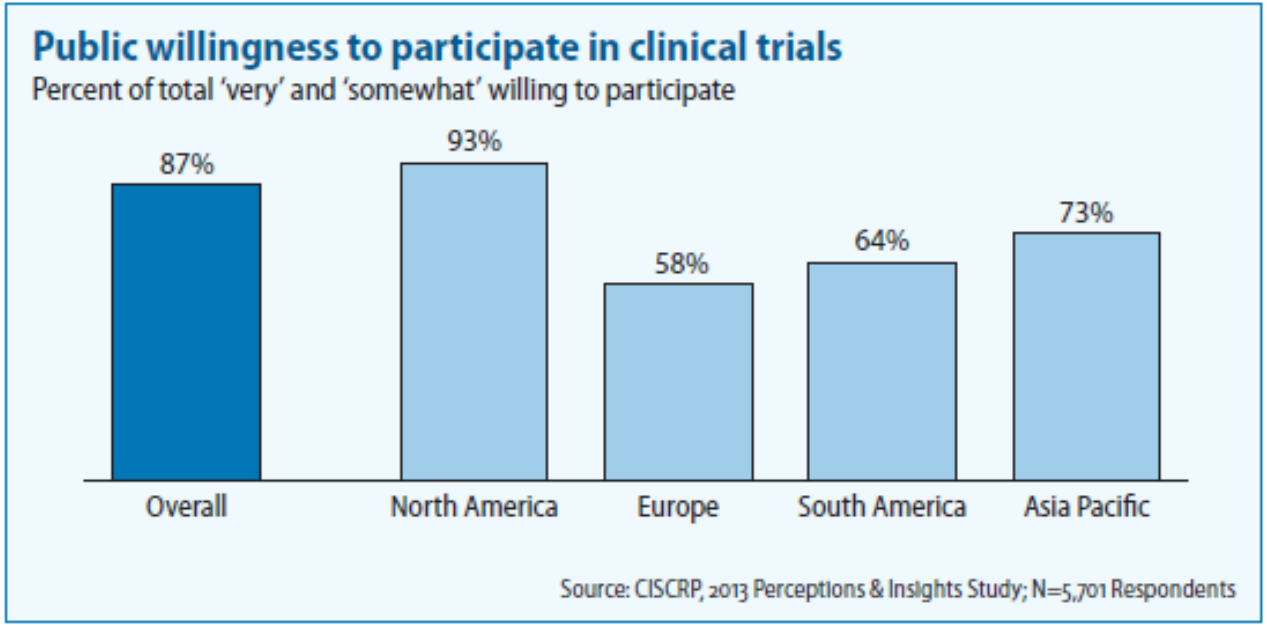
Requires a medical diagnosis



MAYO (& NOT DUKE) ??

Willingness to join learning health systems

Surveys say…



Reality is…

2-3%

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  - The clinician?
  - The data scientist?
- Designing a learning health unit

What would a clinician want?

- **ZDoggMD http://zdoggmd.com/ehr-state-of-mind/**

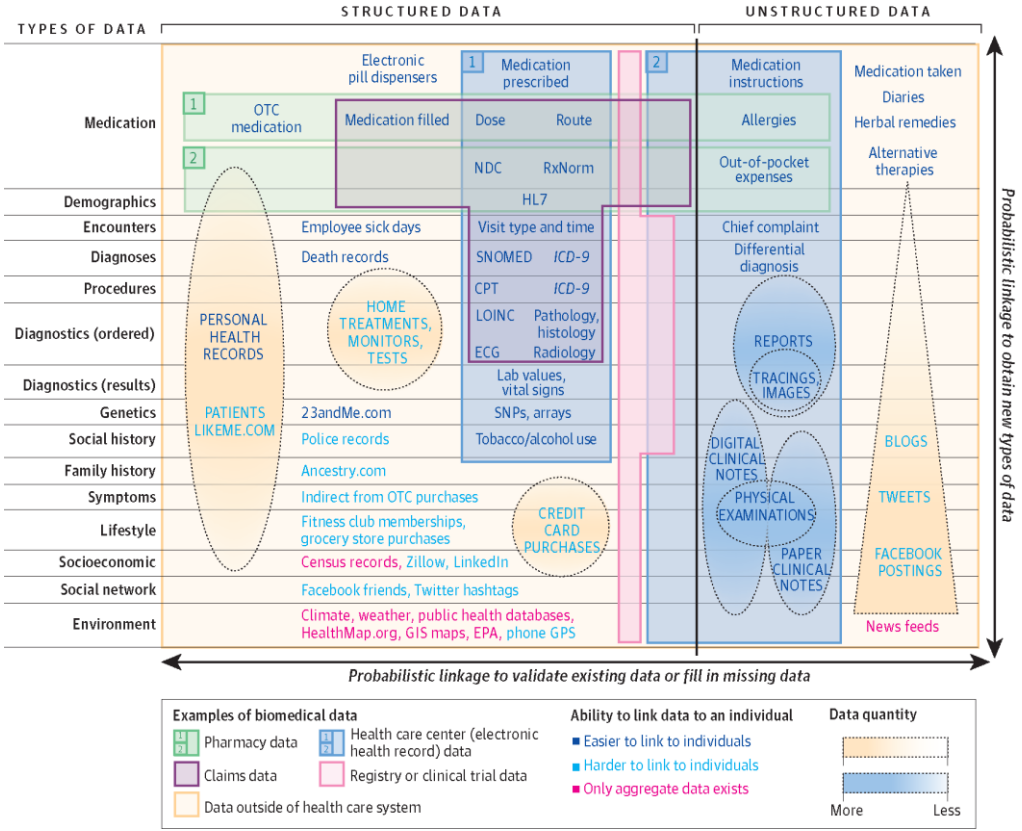
REPORT TO THE PRESIDENT REALIZING THE FULL POTENTIAL OF HEALTH INFORMATION TECHNOLOGY TO IMPROVE HEALTHCARE FOR AMERICANS: THE PATH FORWARD

Executive Office of the President

President's Council of Advisors on Science and Technology

December 2010

Evolving Health Data EcoSystem



Setting:
- Individual
- Health system
- National

Type:
- Biological
- Clinical
- Behavioral
- Social
- Environmental

Solutions:
- Integration
- Cultural
- Regulatory
- Legal

JAMA. 2014;311(24):2479-2480.
doi:10.1001/jama.2014.4228

Data are necessary but not always sufficient

Patient….. EMR.....Big Data.... Big Answers

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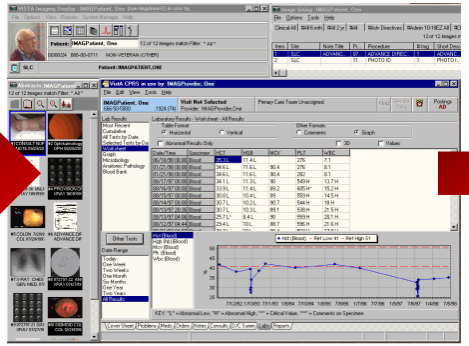
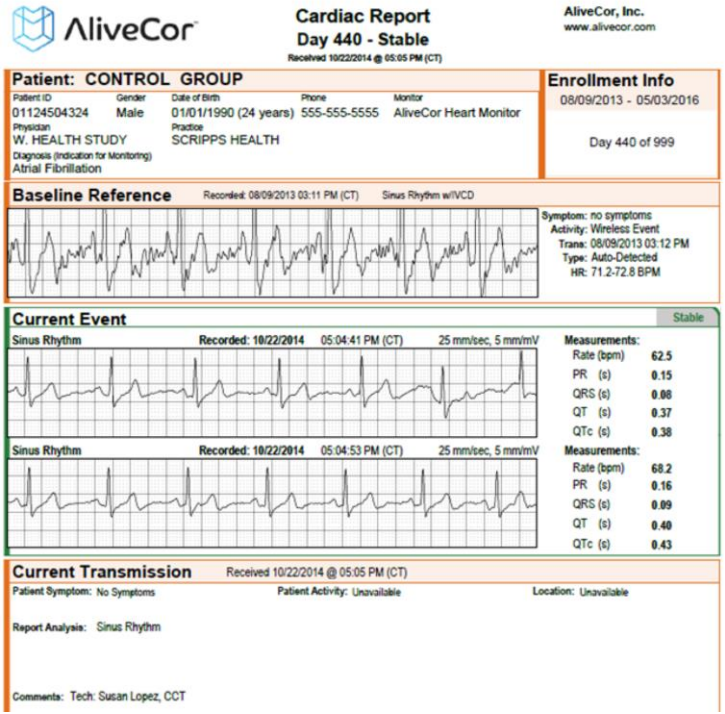


Data are necessary but not always sufficient

Patient….. EMR.....Big Data.... Big Answers

Clinicians may be important too

Data Deluge for Clinicians



AliveCor

Cardiac Report
Day 440 - Stable
Received 10/22/2014 @ 05:05 PM (CT)

AliveCor, Inc.
www.alivecor.com

Patient: CONTROL GROUP

Patient ID	Gender	Date of Birth	Phone	Monitor
01124504324	Male	01/01/1990 (24 years)	555-555-5555	AliveCor Heart Monitor

Physician: W. HEALTH STUDY
Practice: SCRIPPS HEALTH
Diagnosis (Indication for Monitoring): Atrial Fibrillation

Enrollment Info
08/09/2013 - 05/03/2016
Day 440 of 999

Baseline Reference Recorded: 08/09/2013 03:11 PM (CT) Sinus Rhythm w/IVCD

Symptom: no symptoms
Activity: Wireless Event
Trans: 08/09/2013 03:12 PM
Type: Auto-Detected
HR: 71.2-72.8 BPM

Current Event Stable

Sinus Rhythm Recorded: 10/22/2014 05:04:41 PM (CT) 25 mm/sec, 5 mm/mV

Measurements:	
Rate (bpm)	62.5
PR (s)	0.15
QRS (s)	0.08
QT (s)	0.37
QTc (s)	0.38

Sinus Rhythm Recorded: 10/22/2014 05:04:53 PM (CT) 25 mm/sec, 5 mm/mV

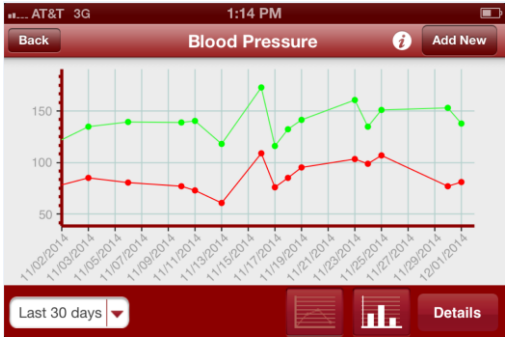
Measurements:	
Rate (bpm)	68.2
PR (s)	0.16
QRS (s)	0.09
QT (s)	0.40
QTc (s)	0.43

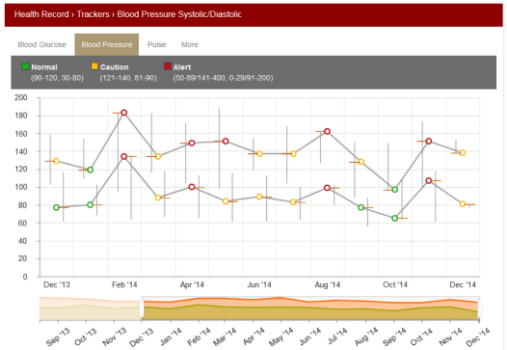
Current Transmission Received 10/22/2014 @ 05:05 PM (CT)

Patient Symptom: No Symptoms
Patient Activity: Unavailable
Location: Unavailable

Report Analysis: Sinus Rhythm

Comments: Tech: Susan Lopez, CCT





Research Letter

FREE

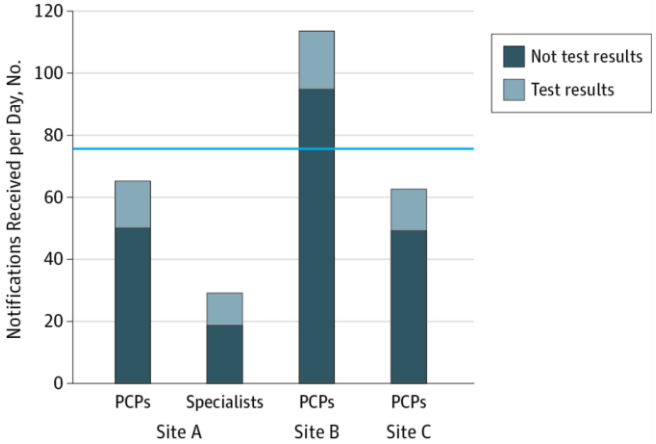
April 2016

The Burden of Inbox Notifications in Commercial Electronic Health Records

Daniel R. Murphy, MD, MBA[1,2]; Ashley N. D. Meyer, PhD[1,2]; Elise Russo, MPH[1,2]; et al

» Author Affiliations | Article Information

JAMA Intern Med. 2016;176(4):559-560. doi:10.1001/jamainternmed.2016.0209



Doing the right thing for the right patient

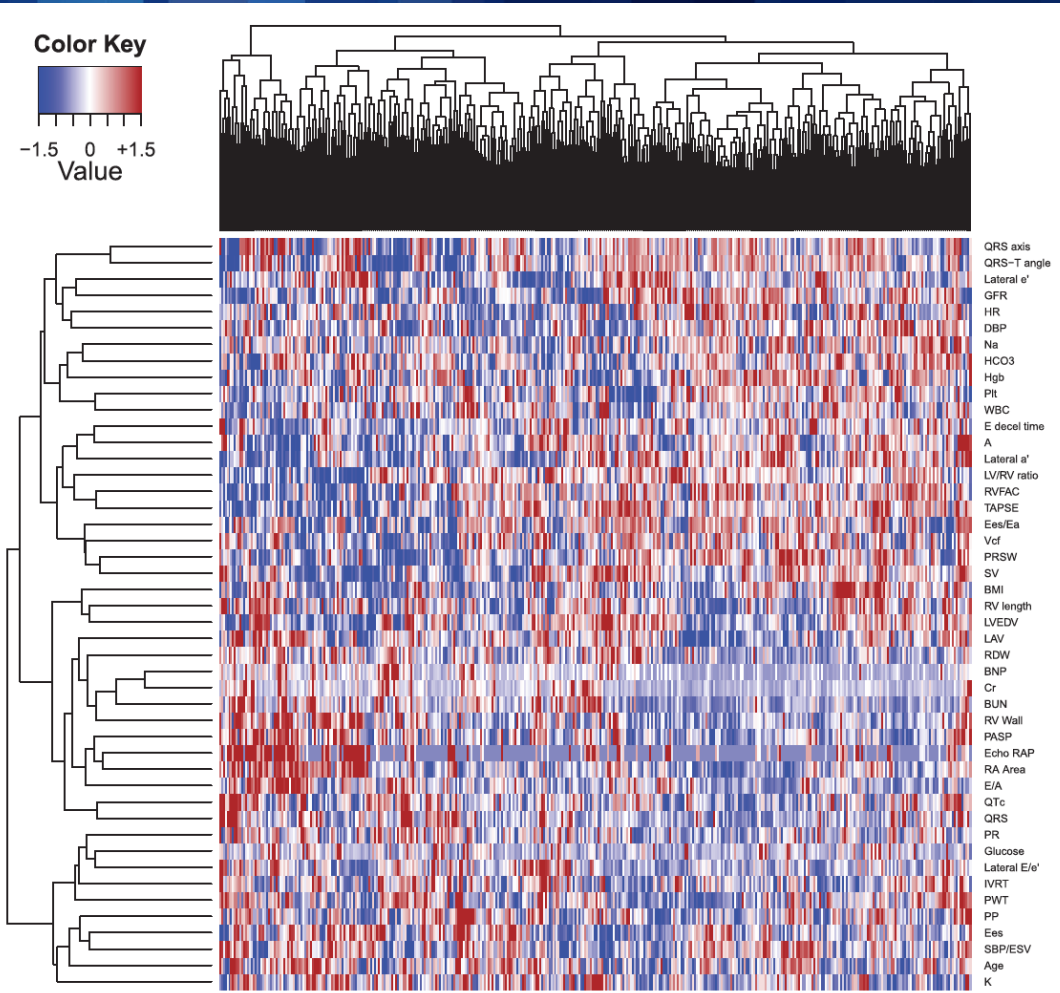
Extreme Phenotyping

Circulation January 20, 2015

Heart Failure

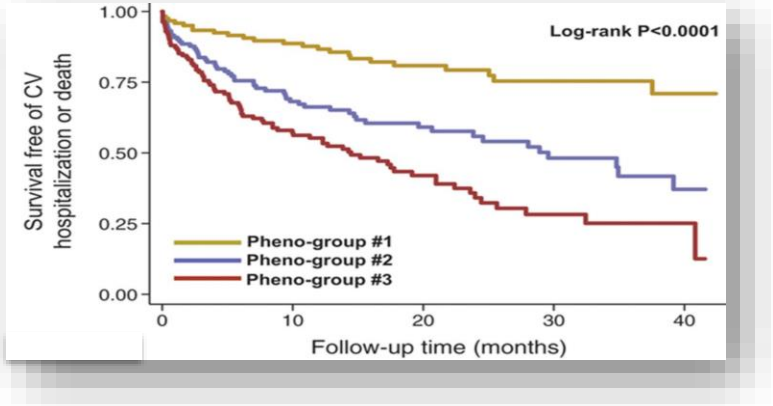
Phenomapping for Novel Classification of Heart Failure With Preserved Ejection Fraction

Sanjiv J. Shah, MD; Daniel H. Katz, MD; Senthil Selvaraj, MD, MA; Michael A. Burke, MD; Clyde W. Yancy, MD, MSc; Mihai Gheorghiade, MD; Robert O. Bonow, MD; Chiang-Ching Huang, PhD; Rahul C. Deo, MD, PhD


Color Key
−1.5 0 +1.5
Value
QRS axis
QRS−T angle
Lateral e'
GFR
HR
DBP
Na
HCO3
Hgb
Plt
WBC
E decel time
A
Lateral a'
LV/RV ratio
RVFAC
TAPSE
Ees/Ea
Vcf
PRSW
SV
BMI
RV length
LVEDV
LAV
RDW
BNP
Cr
BUN
RV Wall
PASP
Echo RAP
RA Area
E/A
QTc
QRS
PR
Glucose
Lateral E/e'
IVRT
PWT
PP
Ees
SBP/ESV
Age
K

3 HFpEF “Pheno-Groups” Identified

- Younger patients with lower BNP elevations
- Obese patients with sleep apnea and DM
- Older patients with CKD



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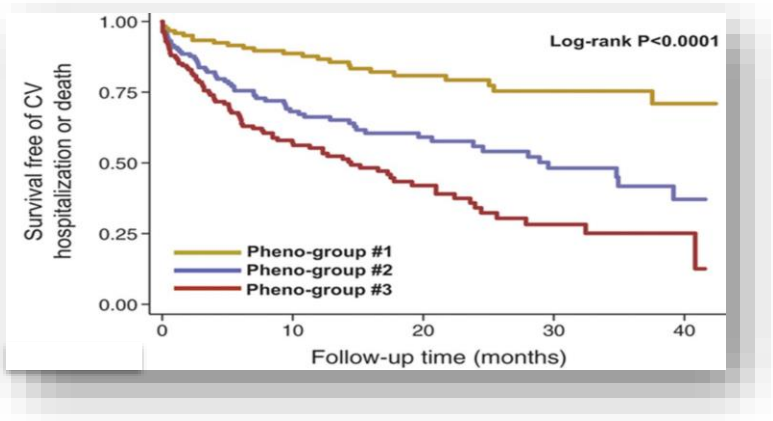

Only one small issue: What’s the treatment?

Agenda

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What would a data scientist want?

Multi-Dimensional Research Platforms

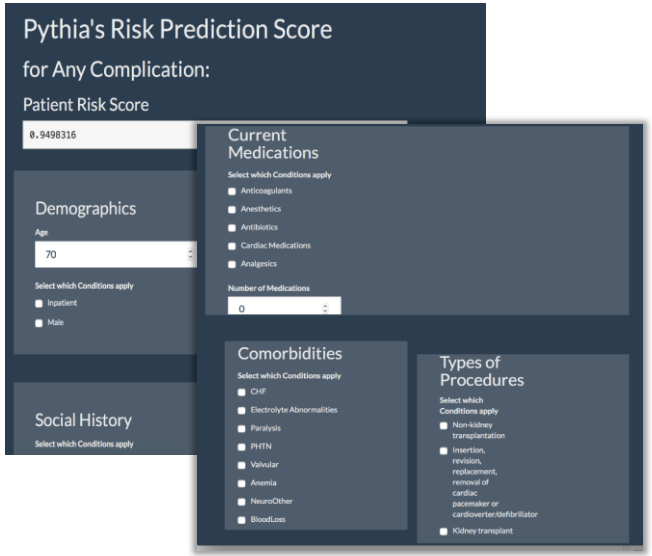
Automated, reliable, high quality

Common Data Models

- Content coverage
- Integrity
- Flexibility
- Queriability
- Integration/Standards
- Implementability

Predicting Sepsis

Pythia's surgical complications risk prediction calculator:
A fully-functioning prototype application



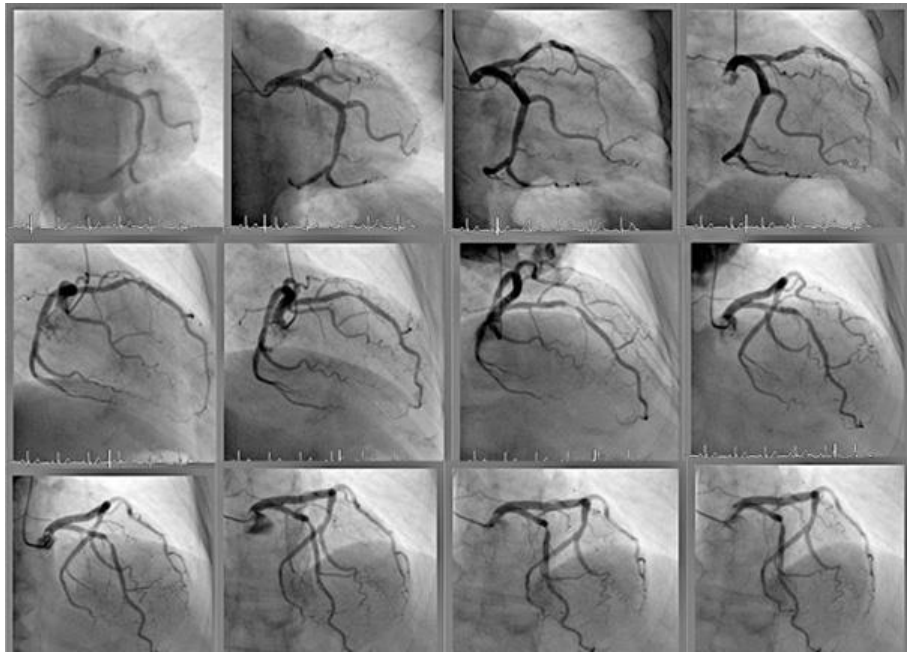
An **institute-specific**, **open-access**, **automated** **database** used to build healthcare research, QI and decision support tools using **best-in-class methodologies** featuring innovative and original technology

Duke Institute for Health Innovation

Courtesy Suresh Balu

Quality Assurance:

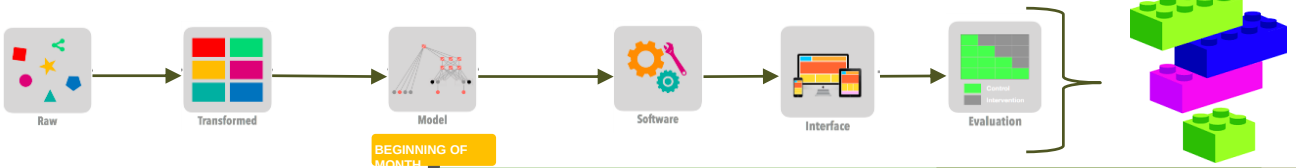
Using machine learning to advance imaging



USING MACHINE LEARNING TO ADVANCE CARE

Deep Care Management in Duke Connected Care

"Lego" Building Blocks for Data Science: Snap together components to be leveraged for other LHU projects



BEGINNING OF MONTH

10 YEAR RETROSPECTIVE HER (COMMON DATA MODEL) DATA

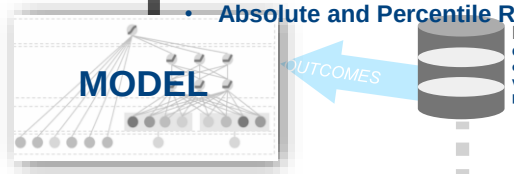
12-MONTH RETROSPECTIVE CMS CLAIMS DATA

6 MONTH PREDICTION WINDOW

CARE MANAGEMENT WORKFLOW

Probability of Unplanned Admissions for:

- **Any Cause**
- **31 Diagnostic Categories**
- **Absolute and Percentile Rank**



OUTCOMES

REGISTRY
Of interventions, outcomes, model versions, patient-level prediction history

Deepcare management

Monthly Data Refresh
Monthly Predictive Model *Retraining*

- Weekly rounding on high risk patients by PHMO care managers
- High risk patient list distributed to primary care practices
- Care redesign efforts around intensive case management and management of serious illness including patient, provider, and practice engagement
- Foundational work around population health management for value based contracts

Duke | FORGE HEALTH DATA IN ACTION

Courtesy Erich Huang, MD

Can you imagine a world that you simply had a conversation with a patient …and didn’t type a note?

GIZMOS

Why Alexa's Next Big Move Is Into Health Care

The shrewd logic behind Amazon's reported plan.

Agenda

- Origins of the learning health system
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Hypothetical Situation

750,000

- Imagine you are the CEO of a health system responsible for the care and outcomes of this population..
- And you are tied (anchored) to an academic health system
- And you have to be fiscally responsible
- What would you do with the data generated every day to improve the heath of the next person?

Choices on your desk

B

(2 years)

A

(6 months)

C

(??)

What's the net present value?

Choices on your desk

D

(7 years)

What's the net present value?

Flipping the Model: New Environment, Different Expectations

Clinical/Population

Blue PREMIER NC

NC DEPARTMENT OF HEALTH AND HUMAN SERVICES

Medicare Shared Savings Program

Better Care for Individuals. | Better Health for Populations. | Lowering Growth in Expenditures.

Quality

BEST HOSPITALS U.S.News & WORLD REPORT 2018-19

LEAPFROG HOSPITAL SAFETY GRADE

Science

NIH National Institutes of Health

FDA U.S. FOOD & DRUG ADMINISTRATION

NSF

DUKE UNIVERSITY

DUKE HEALTH

LEARNING HEALTH

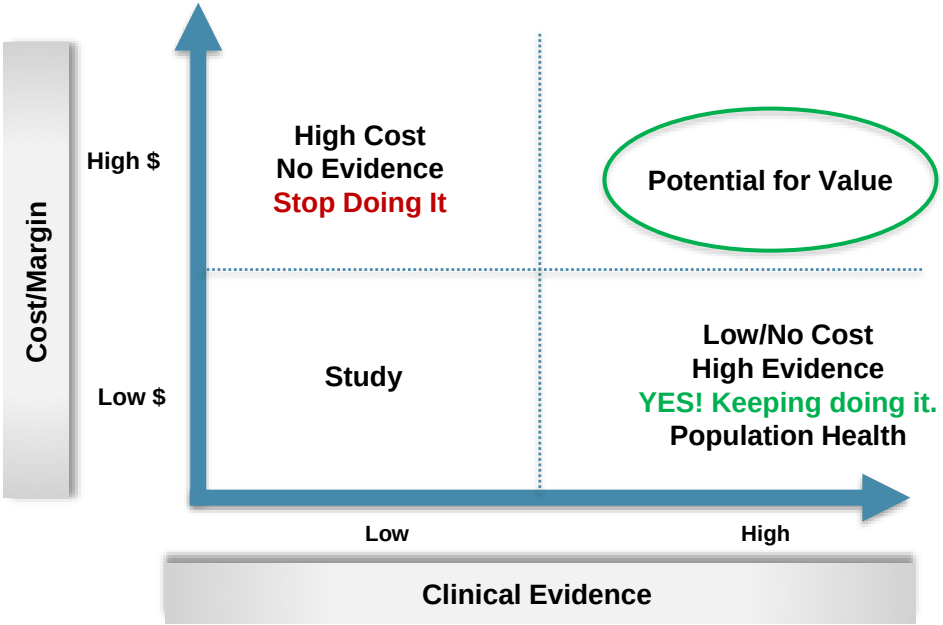
Transition to Value-based Care

Fee-For-Service

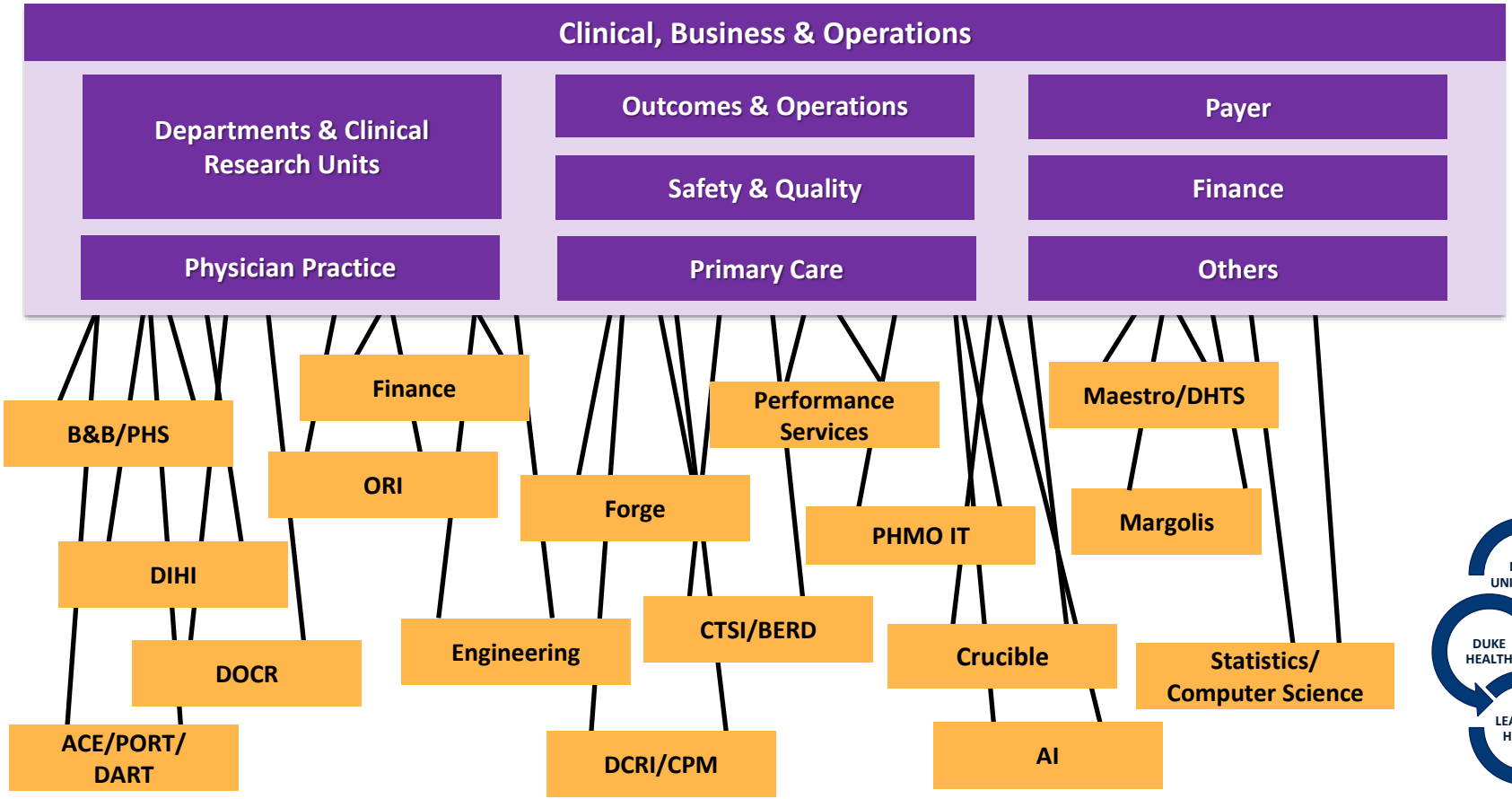
Value-based Care

Use Case: Transitions for Cardiovascular Care

- Historically designed to improve access to highly reimbursed care
- Now, that is not enough…



A Typical Health System: How Supply Tries to Meet Demand Today



DUKE UNIVERSITY
DUKE HEALTH
LEARNING HEALTH

Learning Health Units: Transforming Health in One Duke

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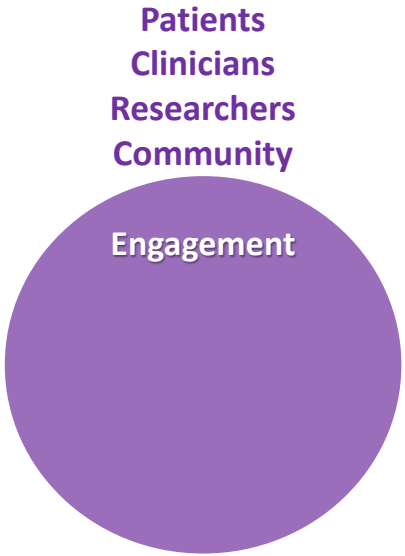
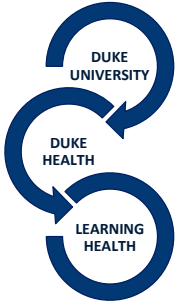
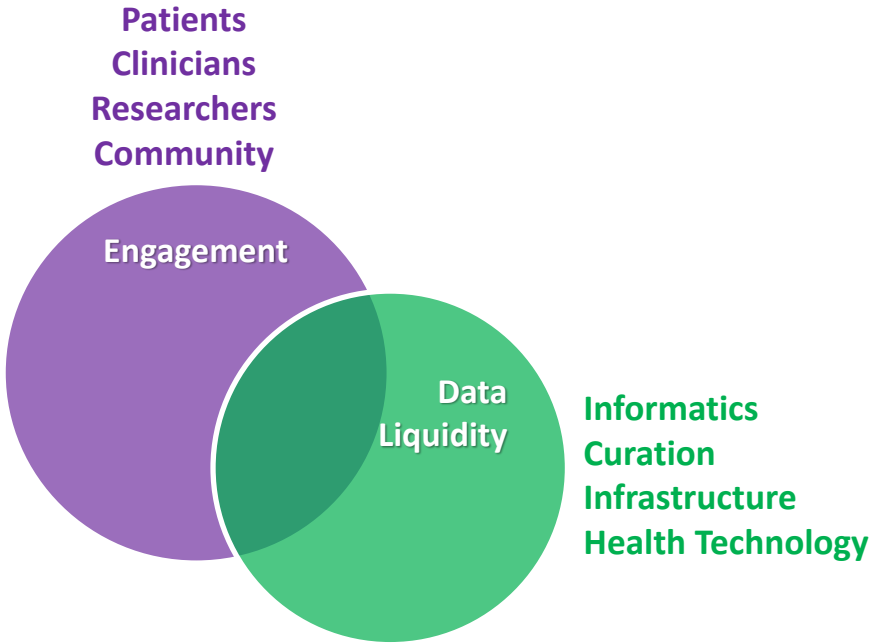




Learning Health Units: Transforming Health in One Duke



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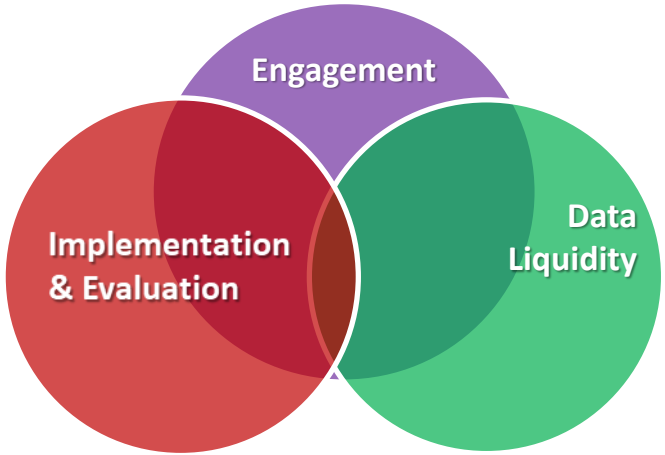
LEARNING HEALTH

Learning Health Units: Transforming Health in One Duke

Patients
Clinicians
Researchers
Community

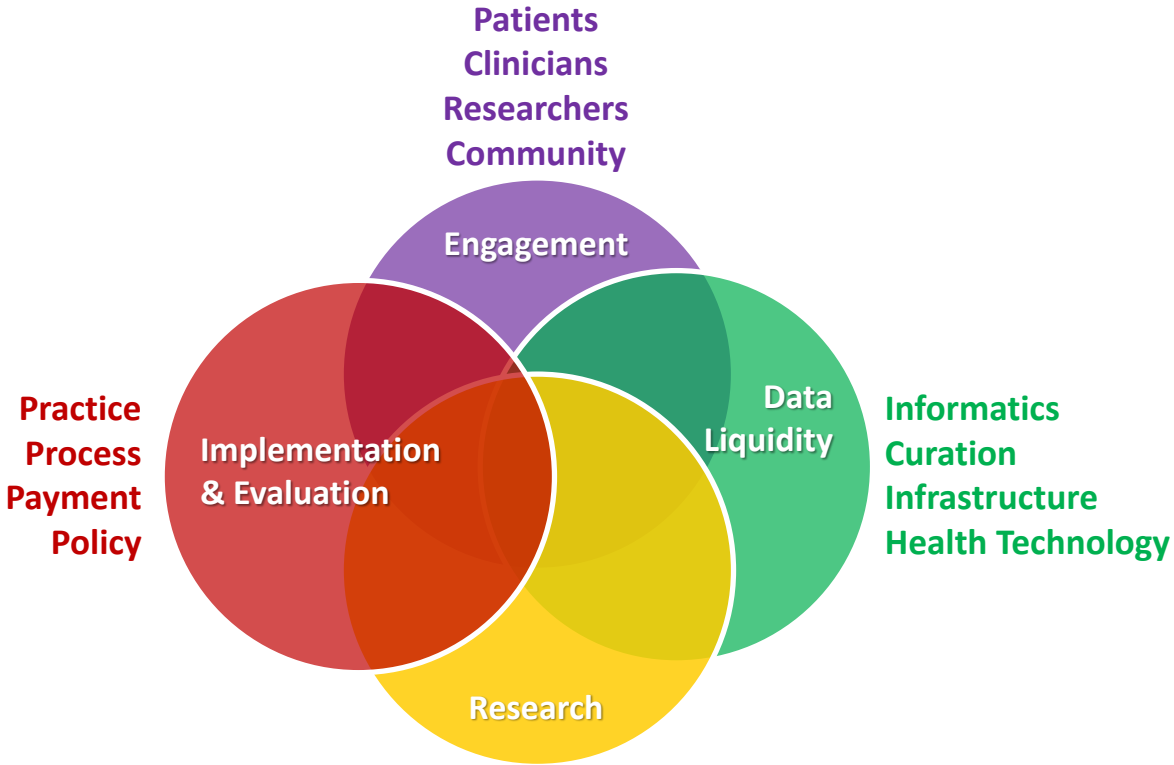


Practice
Process
Payment
Policy

Informatics
Curation
Infrastructure
Health Technology

DUKE UNIVERSITY
DUKE HEALTH
LEARNING HEALTH

Learning Health Units: Transforming Health in One Duke



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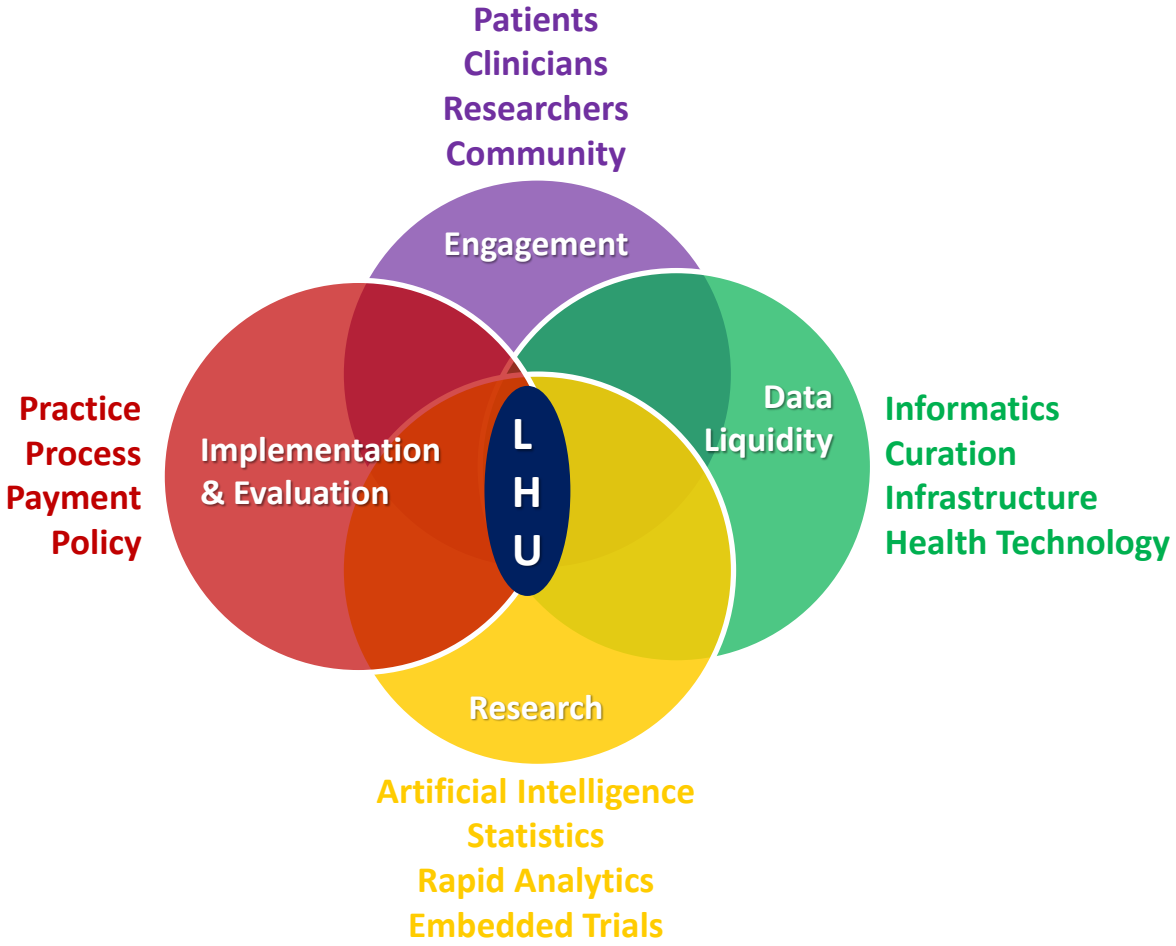

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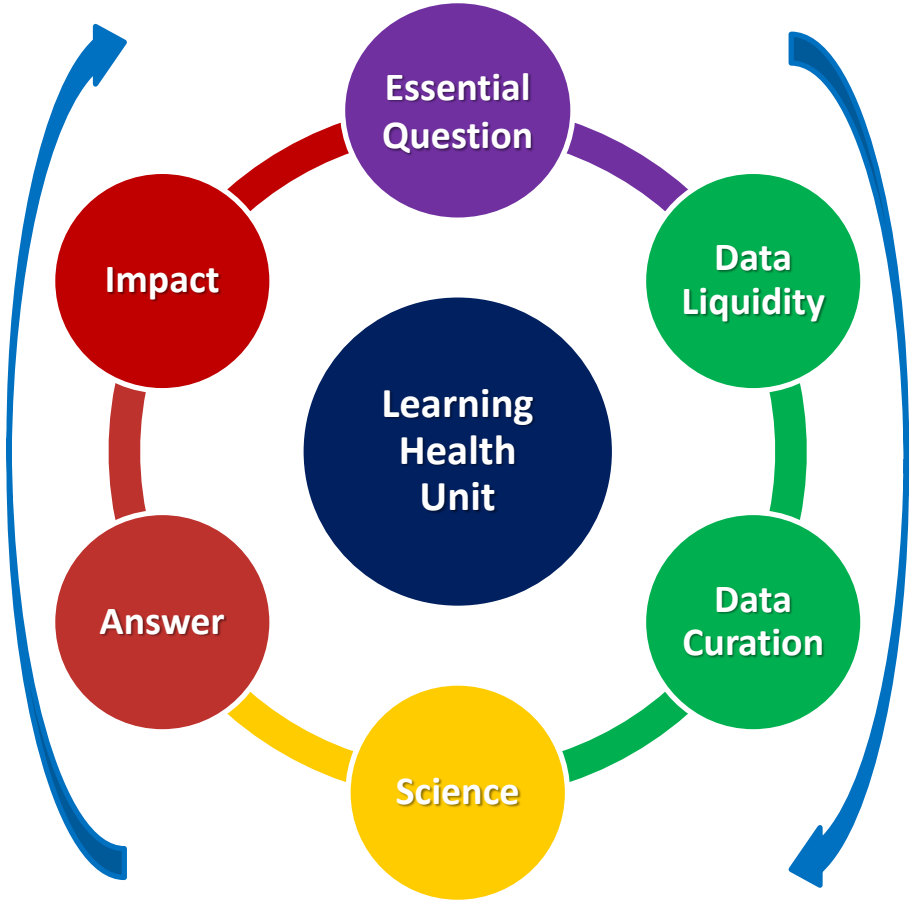
LHU: Uniting Clinicians, Researchers, and Data Scientists



Derivatives:

- Embedded data science
- Implementation science
- Clinical innovation

IMPLEMENTATION & EVALUATION

RESEARCH & DEVELOPMENT

Derivatives:

- Curated cohorts for research
- Workforce development
- Academic advances

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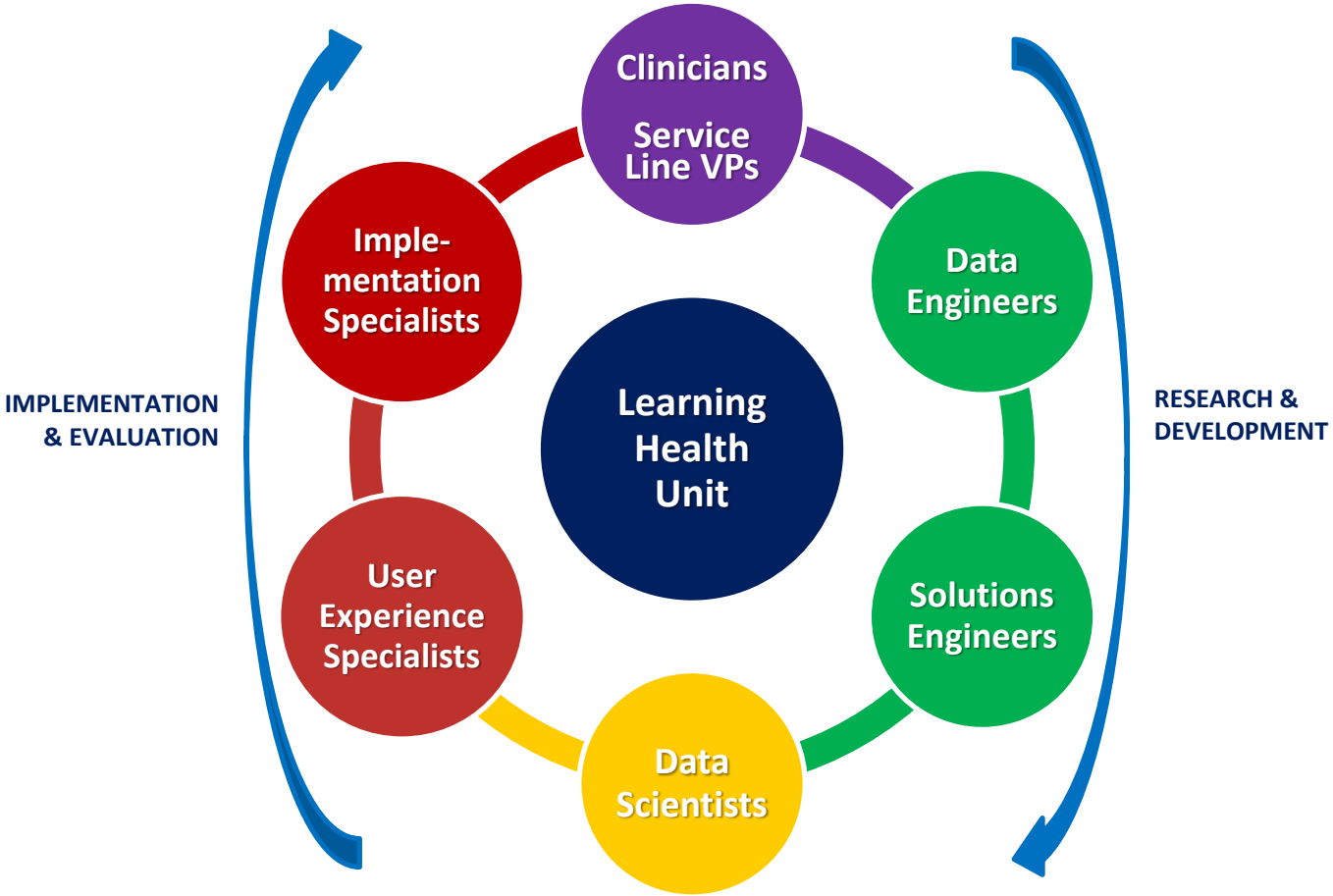

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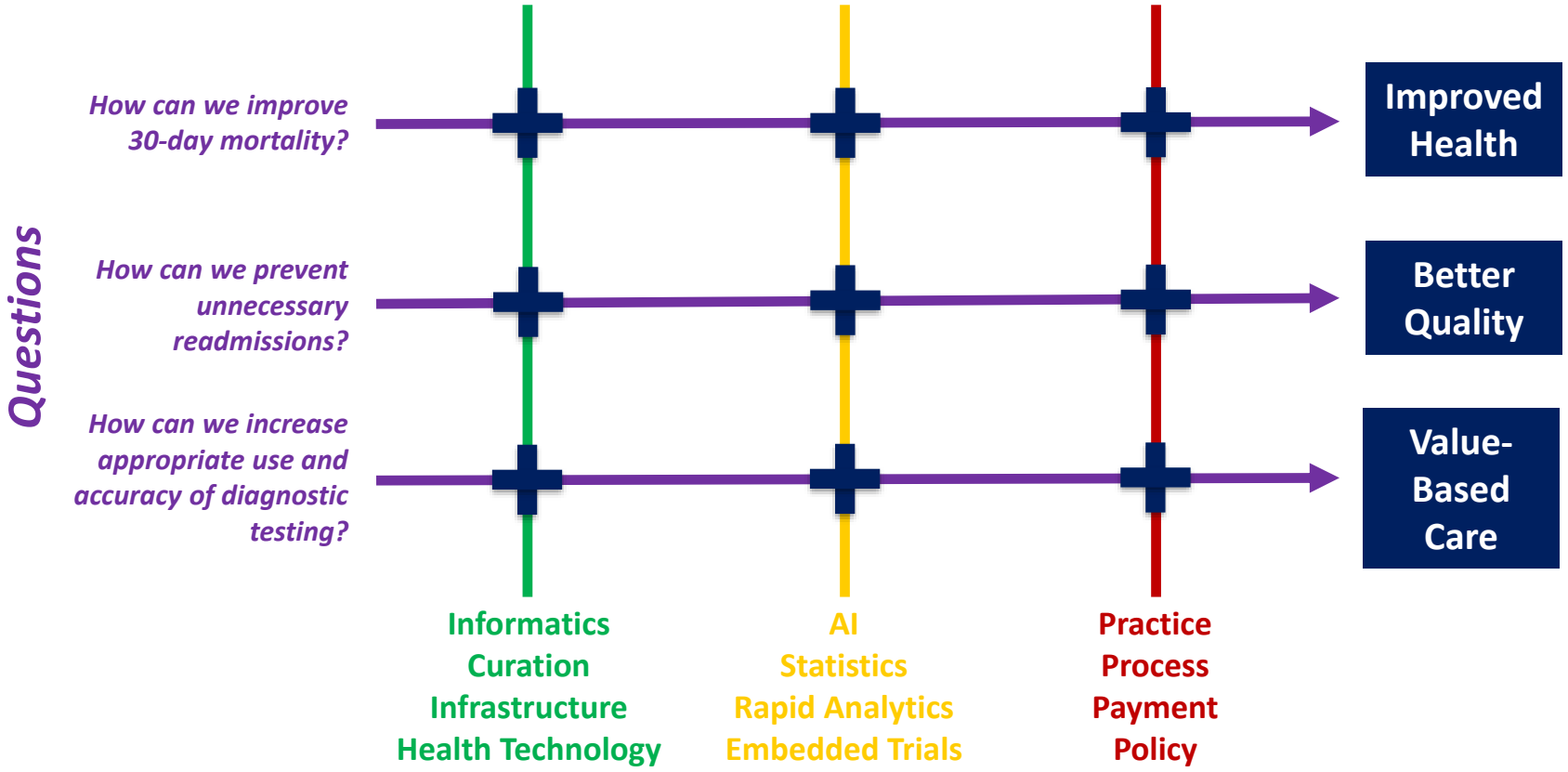
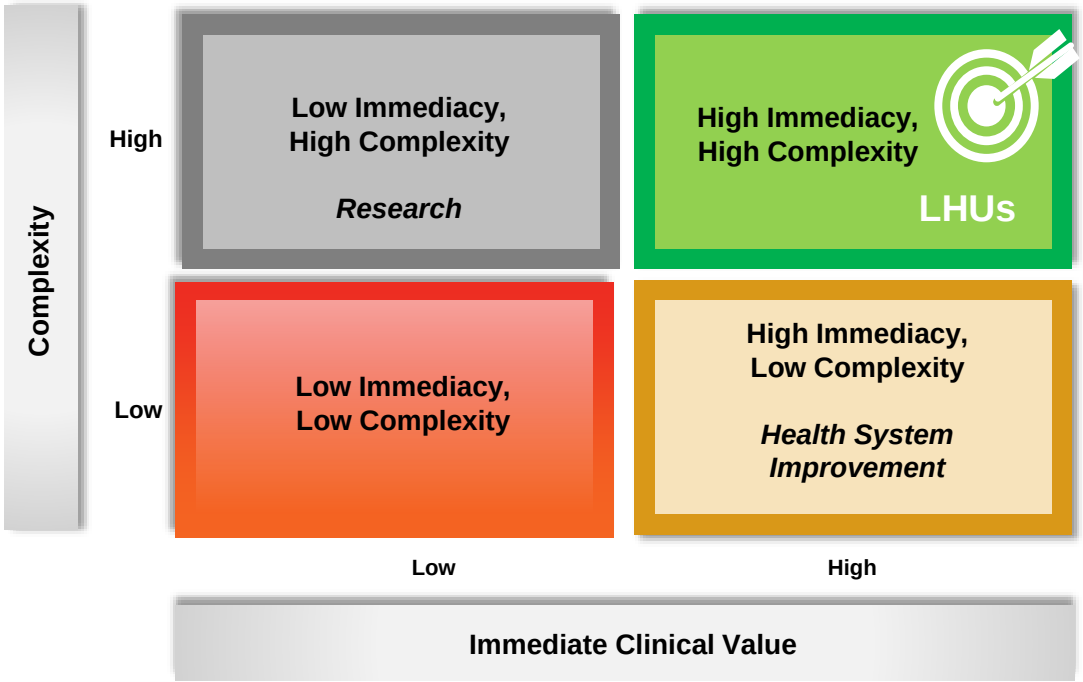
Value-Based Care Demands Integrated Responses



LHU Focus


Complexity
High
Low
Low Immediacy,
High Complexity
Research
High Immediacy,
High Complexity
LHUs
Low Immediacy,
Low Complexity
High Immediacy,
Low Complexity
Health System
Improvement
Low
High
Immediate Clinical Value

Summary:

- Are we achieving our goals of a learning health system?
  - Not yet
- Based on your experience so far, what are the key key attributes for a learning health system?
  - Culture, investment, data, research, results…
- If you wanted to get real results, really fast…how would you design it?
  - That's the question