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

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Vice Dean for Clinical Research
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?
• 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 health system

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.

Courtesy: Eric Larson
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

- Proteomics and other effector molecules
- Functional Genetics: Gene expression profiles
- Structural Genetics: e.g. SNPs, haplotypes
- Decisions by Clinical Phenotype


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. Furthermore, the proportion of guidelines with high evidence levels has not increased over time (green vs. blue).
Selective Reflections

Expanded capacity for new knowledge

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.

Redesigning the Clinical Effectiveness Research Paradigm, 2010. Evidence development in the learning health system.
• Origins of the learning health system
• Getting answers:
  – The patient?
  – The clinician?
  – The data scientist?
• Designing a learning health unit
If you had a health question, what would you do?
Why does my chest hurt? 26 Causes of Chest Pain & Tightness in Chest

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/cheet-pain/symptoms-jpye-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 pain?
Where do you feel chest pain during a heart attack?
What do you do when you have chest pain?

Angina (Heart 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

Can be a symptom of coronary artery disease

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...

Public willingness to participate in clinical trials
Percent of total ‘very’ and ‘somewhat’ willing to participate

- Overall: 87%
- North America: 93%
- Europe: 58%
- South America: 64%
- Asia Pacific: 73%

Source: Ciscrp, 2013 Perceptions & Insights Study; N=5,701 Respondents

2-3%
• Origins of the learning health system
• Getting answers:
  – The patient?
  – The clinician?
  – The data scientist?
• Designing a learning health unit
What would a clinician want?

I'm treatin' the computer screen

- ZDoggMD  http://zdoggmd.com/ehr-state-of-mind/
Evolving Health Data EcoSystem

Setting:
- Individual
- Health system
- National

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

Solutions:
- Integration
- Cultural
- Regulatory
- Legal

doi:10.1001/jama.2014.4228
Data are necessary but not always sufficient

Patient..... EMR......Big
Data.... Big Answers
Data are necessary but not always sufficient

Patient..... EMR......Big
Data.... Big Answers
Data are necessary but not always sufficient

Patient..... EMR......Big
Data.... Big Answers
Data are necessary but not always sufficient

Patient..... EMR......Big Data.... Big Answers
Data are necessary but not always sufficient

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

Clinicians may be important too
Data Deluge for Clinicians

Cardiac Report
Day 440 - Stable

Patient: CONTROL GROUP

Enrollment Info
06/09/2016 - 06/03/2016

Baseline Reference
Symptom: No symptoms
Activity: Wireless Event
Time: 06/09/2016 03:12 PM
Type: Auto-Detected
RR: 75.3-2.9 BPM

Current Event

Sinus Rhythm
Recorded: 06/23/2016
25 mm/s, 6 mm/mv
Measurements:
PR (ms): 20.5
QRS (ms): 80.0
QT (ms): 37.0

Current Transmission
Received: 06/22/2016 06:05 PM

Report Analysis: Sinus Rhythm

Comments: Tech: Susan Lopez, OCT

Blood Pressure
Last 30 days

Health Record - Variables - Blood Pressure System Details
Research Letter

April 2016

The Burden of Inbox Notifications in Commercial Electronic Health Records

Daniel R. Murphy, MD, MBA¹,²; Ashley N. D. Meyer, PhD¹,²; Elise Russo, MPH¹,²; et al

Author Affiliations | Article Information


![Bar chart showing notifications per day for PCPs at Site A, Specialists at Site A, PCPs at Site B, and PCPs at Site C. The chart indicates the number of test and not test results.]
Extreme Phenotyping

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
3 HFpEF “Pheno-Groups” Identified

- Younger patients with lower BNP elevations
- Obese patients with sleep apnea and DM
- Older patients with CKD
3 HFpEF “Pheno-Groups” Identified

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

Only one small issue: What’s the treatment?
• Origins of the learning health system
• Getting answers:
  – The patient?
  – The clinician?
  – The data scientist?
• Designing a learning health unit
What would a data scientist want?
Multi-Dimensional Research Platforms
Automated, reliable, high quality data?

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

Future opportunities: Healthcare tools and research
• Outcomes research
• Resource utilization
• Comparative efﬁcacy research
• Real-time QA analysis by provider, division, and department
• Development of patient-as-a-service models
• Potential for pragmatic clinical trials leveraging EHRs

Next Step:
Develop strategy with Department Chair and key stakeholders
Procedure specific lassos

Courtesy Suresh Balu
Quality Assurance:

Using machine learning to advance imaging
Deep Care Management in Duke Connected Care

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

- 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
Can you imagine a world that you simply had a conversation with a patient …and didn’t type a note?
Why Alexa’s Next Big Move Is Into Health Care

The shrewd logic behind Amazon’s reported plan.
• Origins of the learning health system
• Getting answers:
  – The patient?
  – The clinician?
  – The data scientist?
• Designing a learning health units
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 health of the next person?
Choices on your desk

What’s the net present value?

A (6 months)

B (2 years)

C (??)
What’s the net present value?

D

(7 years)
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
  - 2018-19
- Leapfrog Hospital Safety Grade

**Science**
- National Institutes of Health
- U.S. Food & Drug Administration
- NSF
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…

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<tr>
<th>Cost/Margin</th>
<th>Low $</th>
<th>High $</th>
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<tbody>
<tr>
<td>Low</td>
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<td>High</td>
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<table>
<thead>
<tr>
<th>Clinical Evidence</th>
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<tr>
<td>Study</td>
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- High Cost, No Evidence: Stop Doing It
- Low/No Cost, High Evidence: YES! Keeping doing it.
- Potential for Value
- Population Health
A Typical Health System: How Supply Tries to Meet Demand Today

Clinical, Business & Operations

- Departments & Clinical Research Units
- Physician Practice
- Outcomes & Operations
- Primary Care
- Safety & Quality
- Payer
- Finance
- Others

Departments & Clinical Research Units:
- B&B/PHS
- ORI
- DIHI
- DOCR
- ACE/PORT/DART

Outcomes & Operations:
- Finance
- Performance Services
- PHMO IT
- Maestro/DHTS
- Margolis

Primary Care:
- Engineering
- CTSI/BERD
- Crucible
- Statistics/Computer Science

Safety & Quality:
- Finance
- Performance Services
- PHMO IT
- Maestro/DHTS
- Margolis

Finance:
- Performance Services
- PHMO IT
- Maestro/DHTS
- Margolis

Others:
- Performance Services
- PHMO IT
- Maestro/DHTS
- Margolis

AI

Statistics/Computer Science
Learning Health Units: Transforming Health in One Duke

Patients
Clinicians
Researchers
Community

Engagement
Learning Health Units: Transforming Health in One Duke

- Patients
- Clinicians
- Researchers
- Community

Engagement

Data Liquidity

Informatics
Curation
Infrastructure
Health Technology
Learning Health Units: Transforming Health in One Duke

- Patients
- Clinicians
- Researchers
- Community

Engagement

Implementation & Evaluation

Data Liquidity

Informatics
Curation
Infrastructure
Health Technology

Practice
Process
Payment
Policy
Learning Health Units: Transforming Health in One Duke

- Patients
- Clinicians
- Researchers
- Community

Engagement

Practice
Process
Payment
Policy

Implementation & Evaluation

Data Liquidity

Informatics
Curation
Infrastructure
Health Technology

Research

Artificial Intelligence
Statistics
Rapid Analytics
Embedded Trials

DUKE UNIVERSITY
DUKE HEALTH
LEARNING HEALTH
Learning Health Units: Transforming Health in One Duke

- Patients
- Clinicians
- Researchers
- Community

Engagement

- Practice
- Process
- Payment
- Policy

Implementation & Evaluation

- Artificial Intelligence
- Statistics
- Rapid Analytics
- Embedded Trials

Data Liquidity

Informatics
- Curation
- Infrastructure
- Health Technology

Research

Informatics Curation Infrastructure Health Technology
LHU: Uniting Clinicians, Researchers, and Data Scientists

Derivatives:
- Embedded data science
- Implementation science
- Clinical innovation

IMPLEMENTATION & EVALUATION

Derivatives:
- Curated cohorts for research
- Workforce development
- Academic advances

RESEARCH & DEVELOPMENT

Learning Health Unit

Essential Question

Impact

Answer

Data Liquidity

Data Curation

Science

Answer

Impact

Essential Question
LHU: Uniting Clinicians, Researchers, and Data Scientists

IMPLEMENTATION & EVALUATION

IMPLEMENTATION & EVALUATION

RESEARCH & DEVELOPMENT
Value-Based Care Demands Integrated Responses

Questions

- How can we improve 30-day mortality?
- How can we prevent unnecessary readmissions?
- How can we increase appropriate use and accuracy of diagnostic testing?

Improved Health
Better Quality
Value-Based Care

Informatics
Curation
Infrastructure
Health Technology

AI
Statistics
Rapid Analytics
Embedded Trials

Practice
Process
Payment
Policy
LHU Focus

Complexity

Low Immediacy, Low Complexity

Research

High Immediacy, High Complexity

LHUs

Low Immediacy, Low Complexity

Health System Improvement

Immediate Clinical Value

High Immediacy, High Complexity
Summary:

• Are we achieving our goals of a learning health system?
  – Not yet

• Based on your experience so far, what are the 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