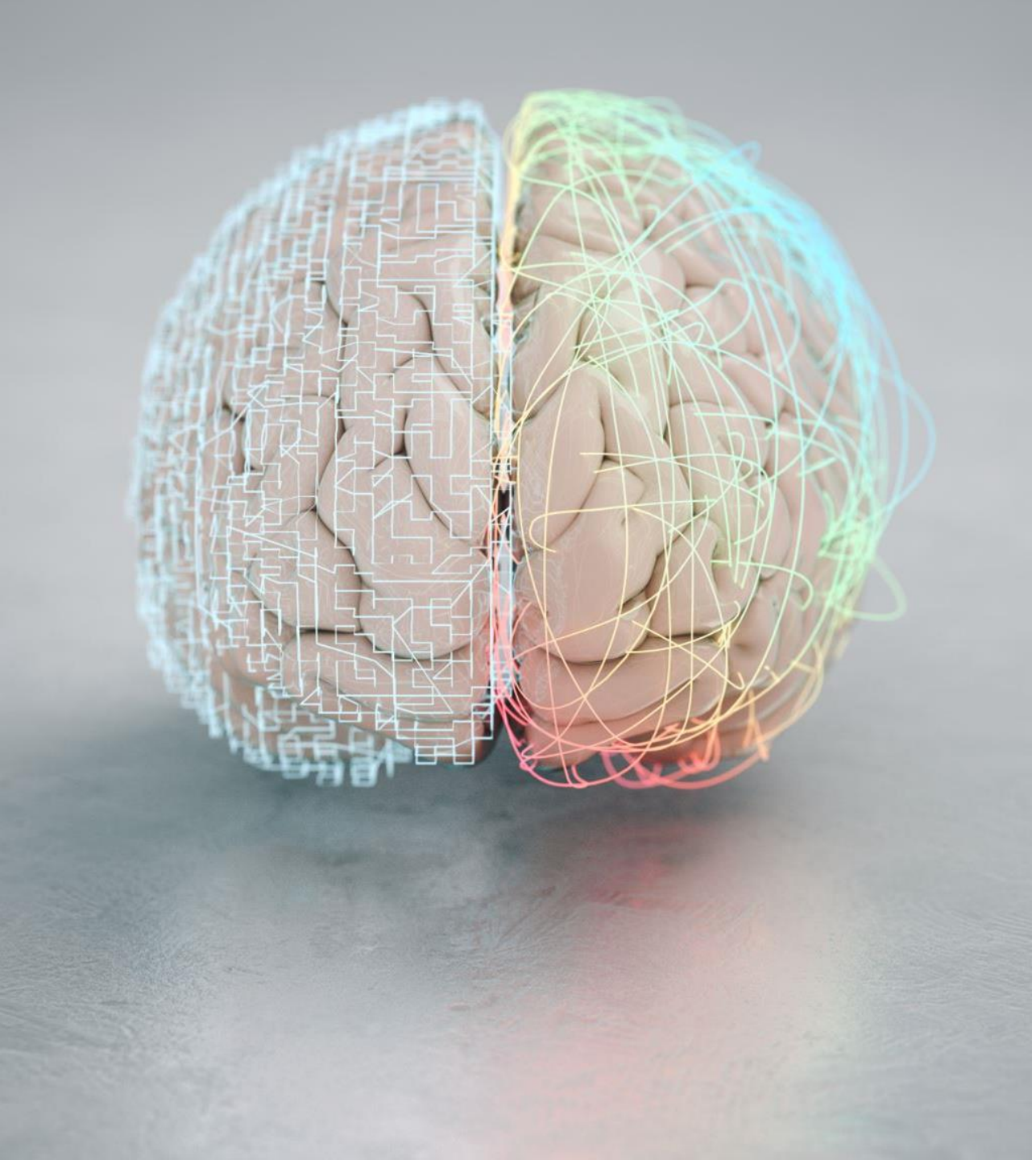


Creating an AI-Enabled, Academic Learning Health System: *Now it's Personal*

Peter J. Embí, MD, MS, FACP, FACMI, FIAHSI

Professor of Biomedical Informatics & Medicine
Endowed Directorship in Biomedical Informatics
Co-Director, ADVANCE AI Center
Co-Director, RAPID Learning Health System Center
Vanderbilt University Medical Center

Texas AI Symposium - 2025
Houston, TX
May 15, 2025

VANDERBILT UNIVERSITY
MEDICAL CENTER

AI Discovery & Vigilance to Accelerate Innovation & Clinical Excellence

ADVANCE

Let’s start with a case…

Dec 11, 2017: 5:30am…

October, 2017: To the ER…

- Acute Paroxysms
  - Severe Headache
  - Profuse Sweating
  - Palor
  - Palpitations
  - Panic/Anxiety
  - Flank Pain
  - Nausea
  - Tachycaria
  - Severe Hypertensive

- Years of symptoms
- Discharged as atypical migraine…

Spells continue… what is this?!

- Back home to Indy

- 4 more ”spells”
- Neurologist – “occipital neuralgia”
- Back to work -> another spell

- In my office, realized what this must be...
- Called MD to get tested…

Diagnosis: Results while at AMIA 2017

- Metanephrines >30x normal!
  - Diagnosis confirmed:
    - Pheochromocytoma

- Next steps…
  - Needed CT abdomen
    - Had to push
  - Needed treatment
    - Rushed Endo visit
    - Started Rx
  - Needed experienced surgeon
    - Had to search
  - Ramping up Rx
    - I accelerated by 1-2 months

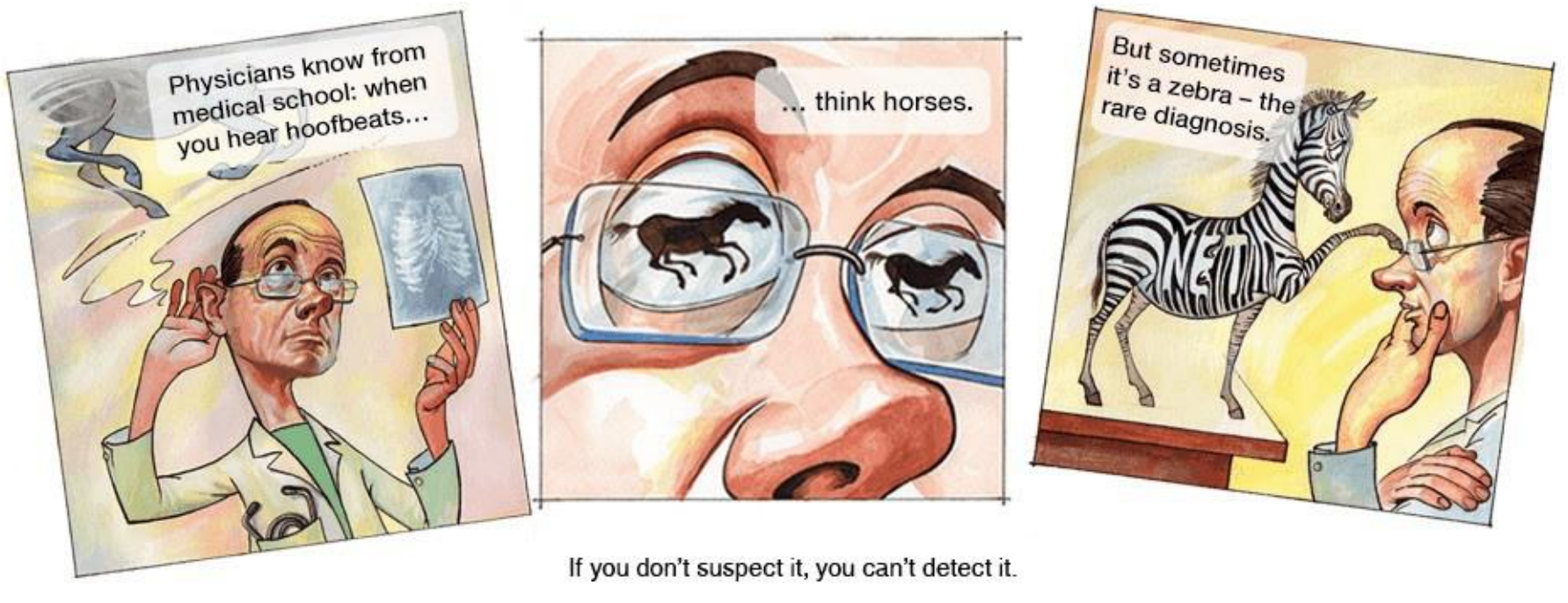
Recovery and Lessons/Realizations

- Upon awakening:
  - Grateful! Lucky!
  - Realization:
    - I could have died
    - Others have
    - I didn’t because of who I am
  - Not right! Not necessary!

- Many ways that my diagnosis, care, & future care of others like me could have been improved through informatics

- **We must learn and do better!**

Lesson #1: Diagnostic Error Abounds!
We ~~can~~ must do better!



Alternative:

"When you hear hoofbeats, expect horses, but <u>consider</u> zebras"

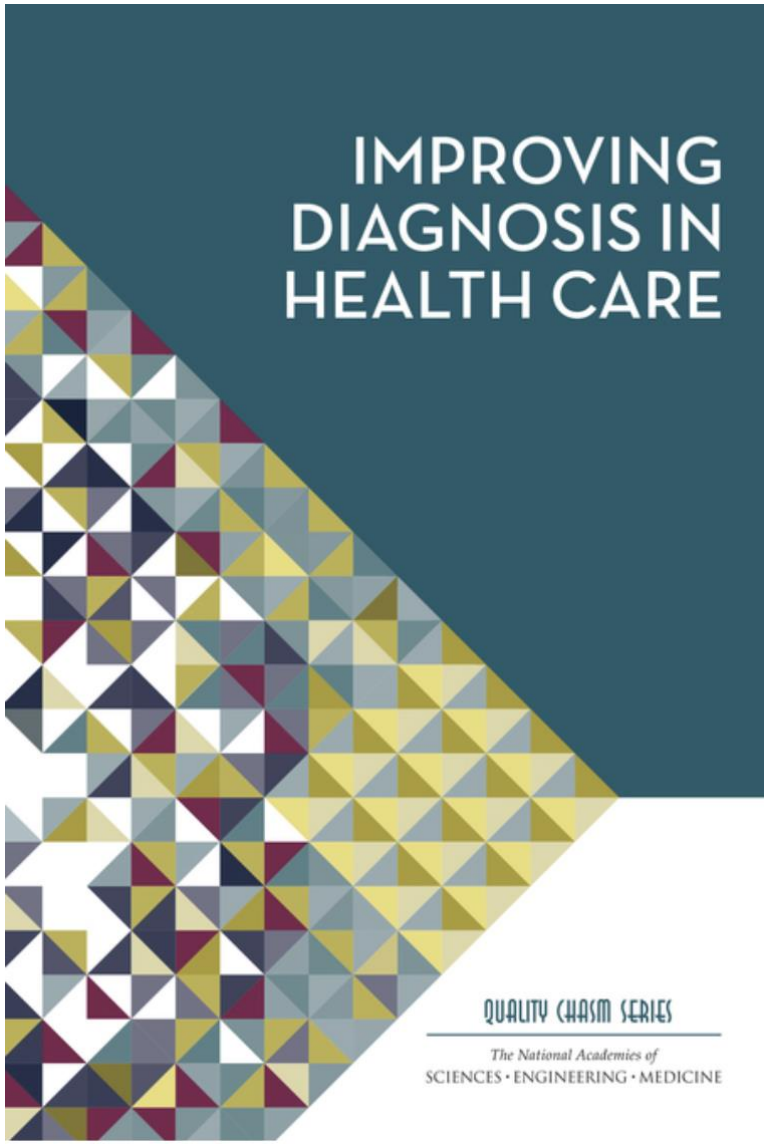
Diagnostic DSS – still limited at point-of-care

DXplain®

Internist-1/QMR

MYCIN

IBM Watson



hypertension tachycardia headache

All Images News Videos Shopping More Settings Tools

About 3,410,000 results (0.43 seconds)

Pheochromocytoma: high blood pressure, headaches, and anxiety ...

https://www.endocrineweb.com/conditions/.../pheochromocytoma-tumor-central-adre...

May 27, 2014 - The classic symptoms of pheochromocytomas (or pheos) are those attributable to excess adrenaline production. Often these patients will have recurring episodes of sweating, **headache**, and a feeling of high anxiety. ... Excess sweating (generalized) Racing heart (**tachycardia** and palpitations)

People also ask

- Can you have tachycardia and hypertension?
- What is the most common symptom of pheochromocytoma?
- Can high blood pressure cause headaches and eye pain?
- Can you feel high blood pressure in your head?

Feedback

Severe Paroxysmal Hypertension (Pseudopheochromocytoma ...

https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/484999

by SJ Mann - 1999 - Cited by 106 - Related articles

Severe, symptomatic paroxysmal **hypertension** always generates suspicion of a ... such as **headache**, chest pain, dizziness, nausea, palpitations, flushing, and ... pressure, unilateral flushing, dizziness, weakness, **tachycardia**, and polyuria.

Lesson #2: We don’t have a LHS today

Lesson/Realization #2a:
Actually, we do have one common way of learning, as a system…

The Learning Health System (LHS) - Definitions

COMMENTARY

POLICY

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Charles P.

Published 10 N

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CREDIT: C. BICKEL/SCIENCE TRANSLATIONAL MEDICINE

Received: 30 June 2022 | Accepted: 30 June 2022

DOI: 10.1002/lrh2.10328

EDITORIAL

Learning Health Systems

What is unique about learning health systems?

My infatuation with Learning Health Systems (LHS) began in 2009, soon after the concept was first advanced by the organization then known as the Institute of Medicine, but now known as the National Academy of Medicine. The definition of an LHS offered in their 2012 report has been an inspirational guidepost for many:

> A system in which science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the care process, patients and families as active participants in all elements, and new knowledge is captured as an integral by-product of the care experience.[1]

In the ensuing years, as the concept of learning health systems matured and a substantial literature emerged, many definitions and elaborations have appeared.[2-4] This has inevitably led to uncertainty regarding what lies at the core of the LHS and also to a blurring of its boundaries: how the LHS differs from other approaches to health and health care improvement. Not surprisingly, I have been frequently asked: *What's new here? Isn't this the way to improve anything? How else would you do it?* This short essay offers some answers, grounded in a conception of what lies at the core of the LHS, that I would now give to these questions.

The differentiation begins with the concept of a learning or improvement cycle and the assertion that Learning Health Systems improve individual and population health by marrying discovery to implementation through cycles of the type illustrated in Figure 1.[5,6] The cycle begins at "5 o'clock" with the establishment of a multistakeholder learning community. Guided by the community, the cycle proceeds with collection of data to capture what is happening now (performance to data), analysis of these data to generate evidence of how improvement might be effected (data to knowledge), integration of locally generated evidence with relevant evidence gathered by others, and intervention based on that evidence to engender improvement (knowledge to performance). From there, the cycle repeats in a series of iterations over which data-driven improvement can occur.

There is nothing fundamentally new about cyclic improvement processes. This concept traces back to the seminal work of Deming and the subsequent widespread use of PDSA cycles in health care improvement.[7] The differentiators of the LHS—three in number, in my estimation—rest on how these cycles are executed and how a set of cycles composes into a scalable system. These differentiators also assume that the health problem addressed by the improvement cycle is a complex, even "wicked," problem that will prove resistant to unidimensional straightforward solutions.

The three differentiators are: (1) at the beginning of the cycle, establishing a multistakeholder learning community that is focused on the problem and collaboratively executes the entire cycle; (2) embracing, at the outset, the uncertainty of how to improve against the problem by undertaking a rigorous discovery process before any implementation takes place; and (3) supporting multiple co-occurring cycles with a socio-technical infrastructure to create a learning system.

1 | CONTINUITY OF COLLABORATIVE EXECUTION

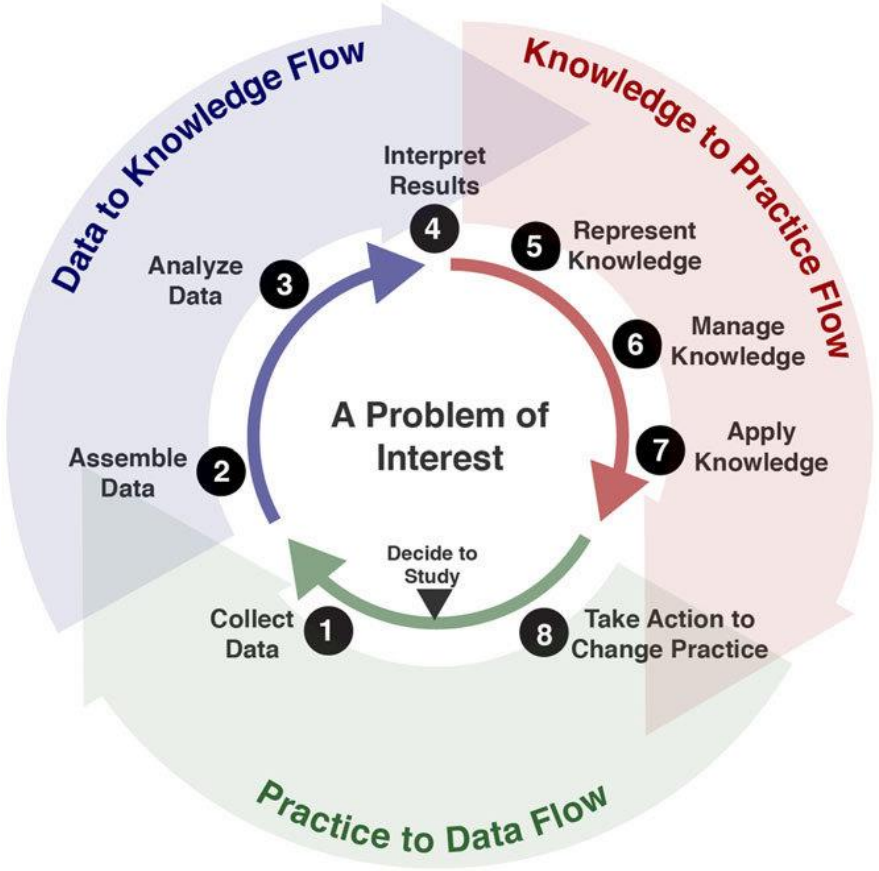
Members of a learning community are driven by a shared passion to improve against the health problem that brought them together. With reference to the left side of Figure 2, after a learning community forms into a cohesive group, that same group directs the cycle through the sequence of discovery (P2D and D2K), implementation (K2P), and back to discovery again as the cycle continues. Individuals with specialized expertise can enhance the execution of each phase of the cycle, augmenting the work of the persistent core membership of the community.

Continuity avoids the challenges of the "interrupted cycle" illustrated on the right side of Figure 2. Interrupted cycles occur when entirely different, specialized professional groups within an organization execute each component of the cycle. As shown in the figure, a group specializing in P2D might be focused exclusively on program evaluation or quality assessment; a group specializing in D2K might be focused on health services research; a group specializing the K2P might be exclusively focused on change implementation. The members of each of these relatively homogeneous groups will have similar educational backgrounds and professional cultures, but the backgrounds and cultures of each group may differ greatly from each other.

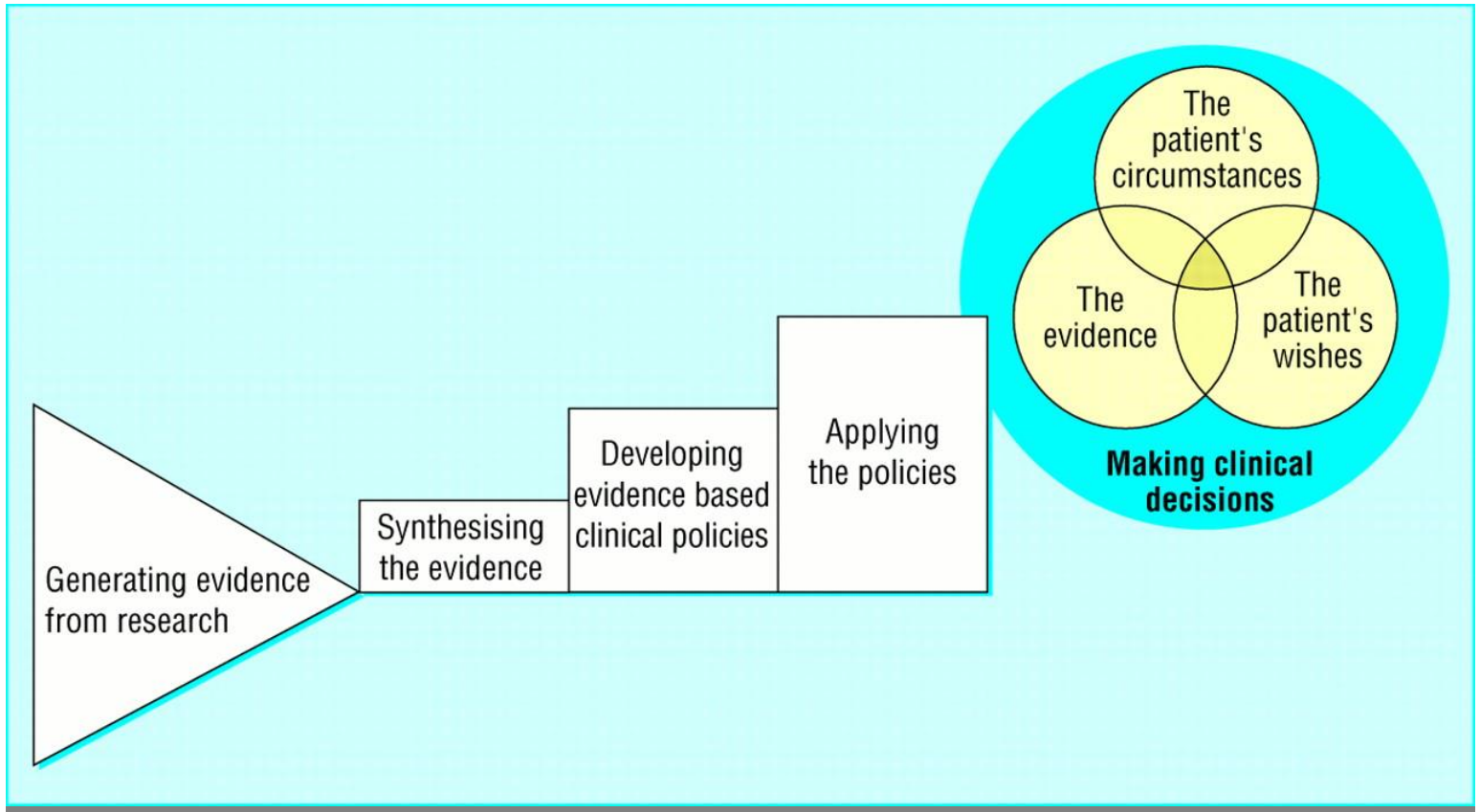
Interrupted cycles necessitate challenging handoffs between these different groups. Less than perfect communication between the

"Learning health systems (LHS) are healthcare systems in which knowledge generation processes are embedded in daily practice to produce continual improvement in care."

Source: Olsen L, Aisner D, McGinnis JM. The learning healthcare system: workshop summary. Natl Academy Pr; 2007



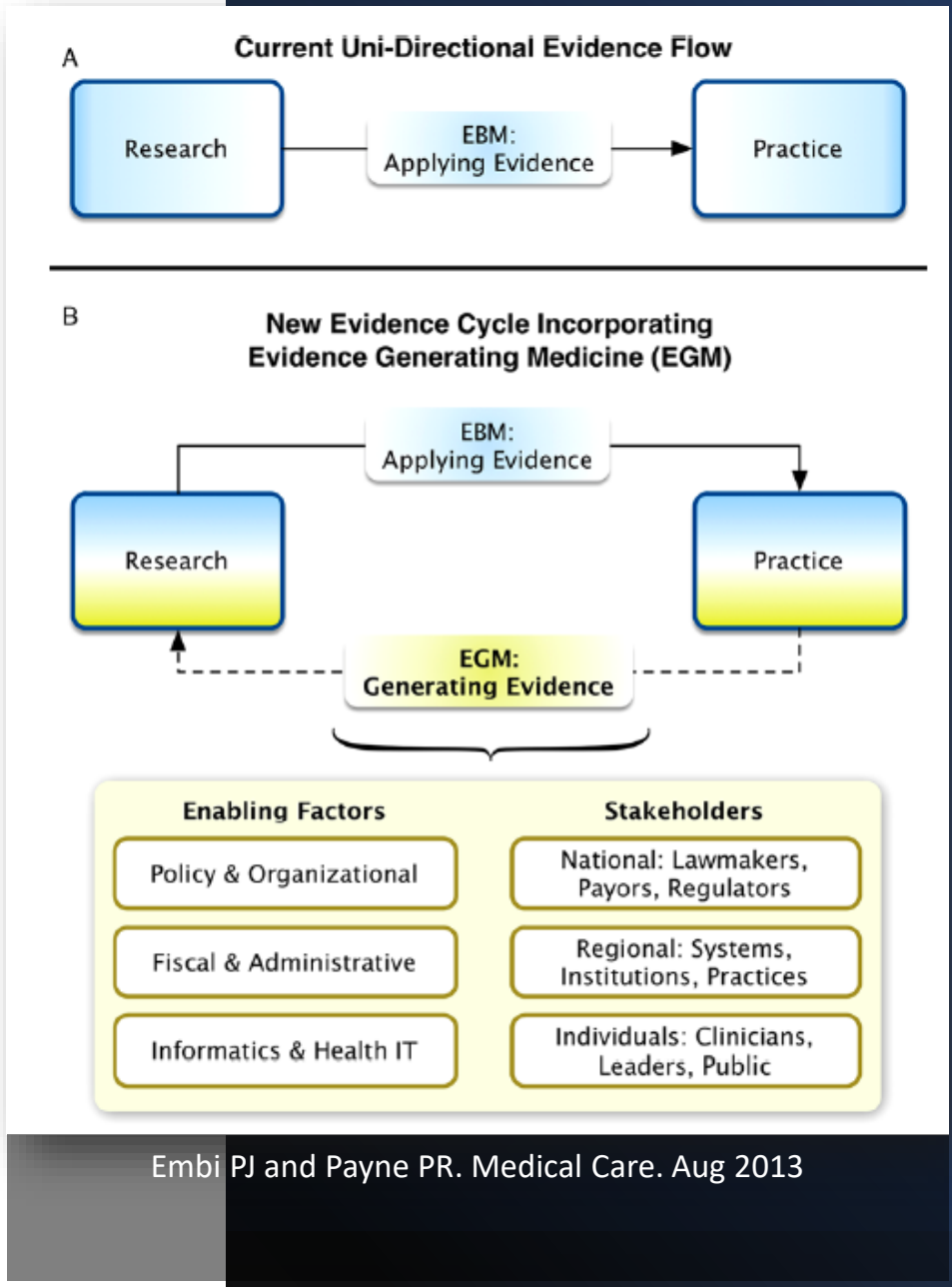
Traditional path from generation of evidence to its application



Haynes, B. et al. BMJ 1998;317:273-276

Research-Practice Paradigm – EBM+EGM

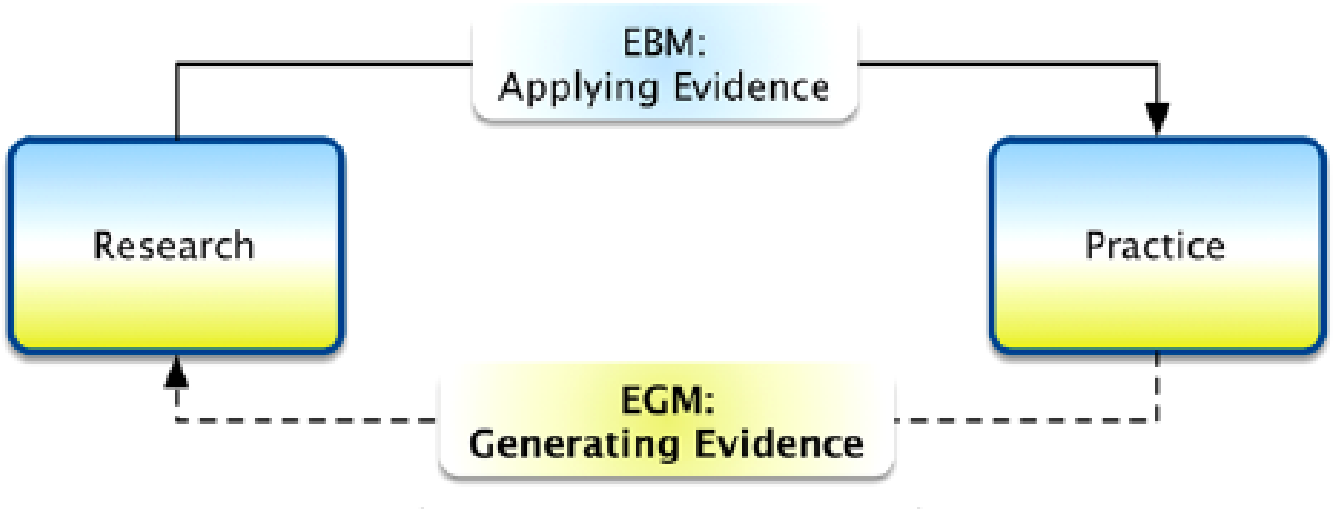
- Clinical care activities not entirely distinct from research activities
- Must consider EGM when we practice to advance science and care
- Many EGM activities ongoing & need support to achieve goals
- Advancing EGM is critical to completing the EBM lifecycle
- Multiples enabling factors & stakeholders



Embi PJ and Payne PR. Medical Care. Aug 2013

We want a learning cycle, but…

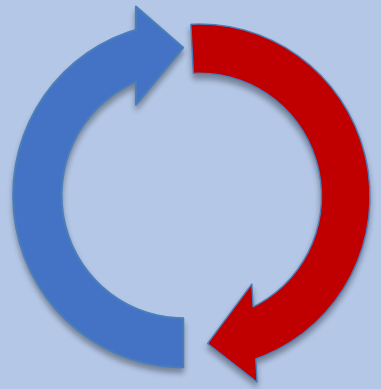
- Even a simple form of learning – “What did I miss?”
- Absence* of feedback loops for clinicians, the system
- Even when “system” has/can share new evidence
- We haven’t *decided* to use system for “learning”



Embi & Payne. Medical Care, 2013

Local Learning Systems…

Goals



- “Learn from every patient”
- Overcome fragmentation among current units/committees, ”silos of excellence”
- “Scale & Spread” - systematically monitor, study, scale
- Improve care/satisfaction among stakeholders
- Improve processes, efficiency, outcomes, costs (value)… In an equitable manner
- Accelerate discoveries and translation of evidence
- Disseminate discoveries, experiences and best practices
- Leverage LHS approaches as key differentiator

Received: 21 December 2020 | Revised: 30 May 2021 | Accepted: 3 June 2021
DOI: 10.1002/lrh2.10281

EXPERIENCE REPORT

Learning Health Systems

The Indiana Learning Health System Initiative: Early experience developing a collaborative, regional learning health system

Titus Schleyer[1,2] | Linda Williams[3,4,5] | Jonathan Gottlieb[6] | Christopher Weaver[7,8] | Michele Saysana[8,9] | Jose Azar[2,10] | Josh Sadowski[11] | Chris Frederick[12] | Siu Hui[1,13] | Areeba Kara[2] | Laura Ruppert[1] | Sarah Zappone[1] | Michael Bushey[14,15] | Randall Grout[1,9,16] | Peter J. Embi[2,12,17]

DMCN Developmental Medicine & Child Neurology

DEVELOPMENTAL MEDICINE & CHILD NEUROLOGY ORIGINAL ARTICLE

‘Learn From Every Patient’: implementation and early results of a learning health system

LINDA P LOWES[1*] | GAREY H NORITZ[1,2*] | AMY NEWMEYER[2] | PETER J EMBI[4] | HAN YIN[1] | WILLIAM E SMOYER[1,2] | ‘LEARN FROM EVERY PATIENT’ STUDY GROUP[†]

VIEWPOINT

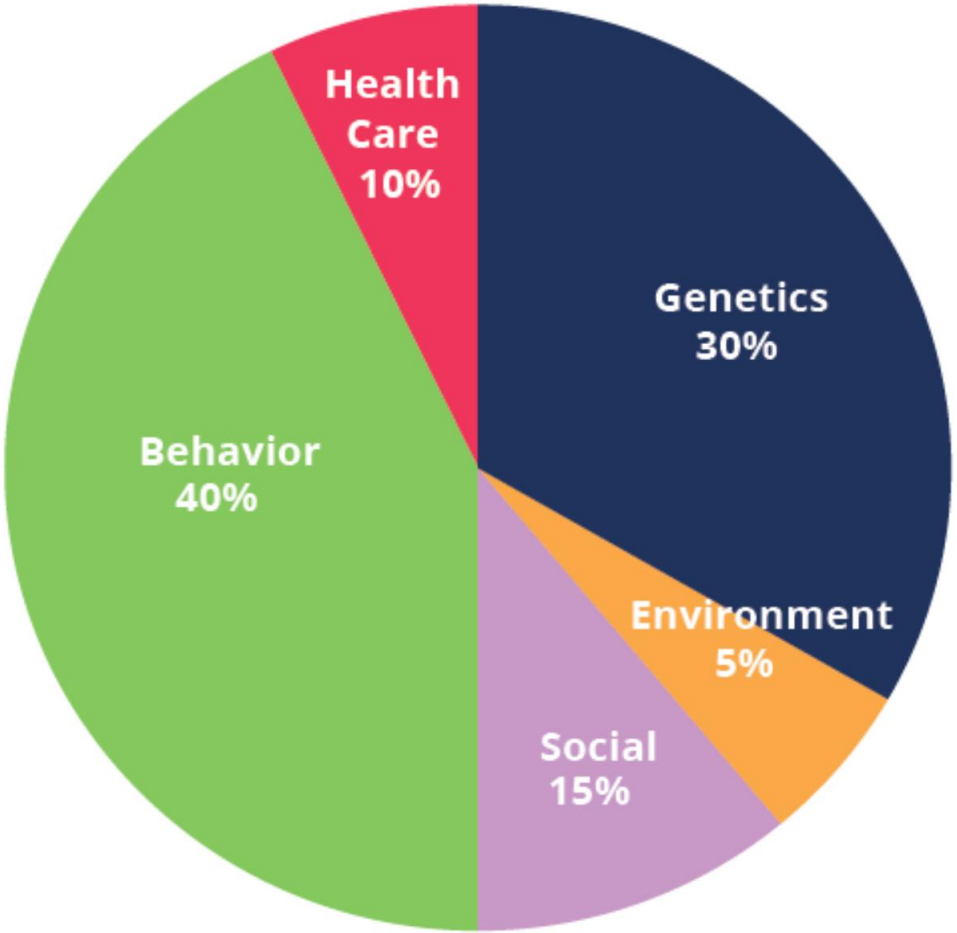
INNOVATIONS IN HEALTH CARE DELIVERY

Creating Local Learning Health Systems
Think Globally, Act Locally

William E. Smoyer, MD
Peter J. Embi, MD, MS
Susan Moffatt-Bruce, MD, PhD, MBA

Lesson #3: Data are Critical

- Data relevant to health largely exist beyond traditionally collected healthcare data

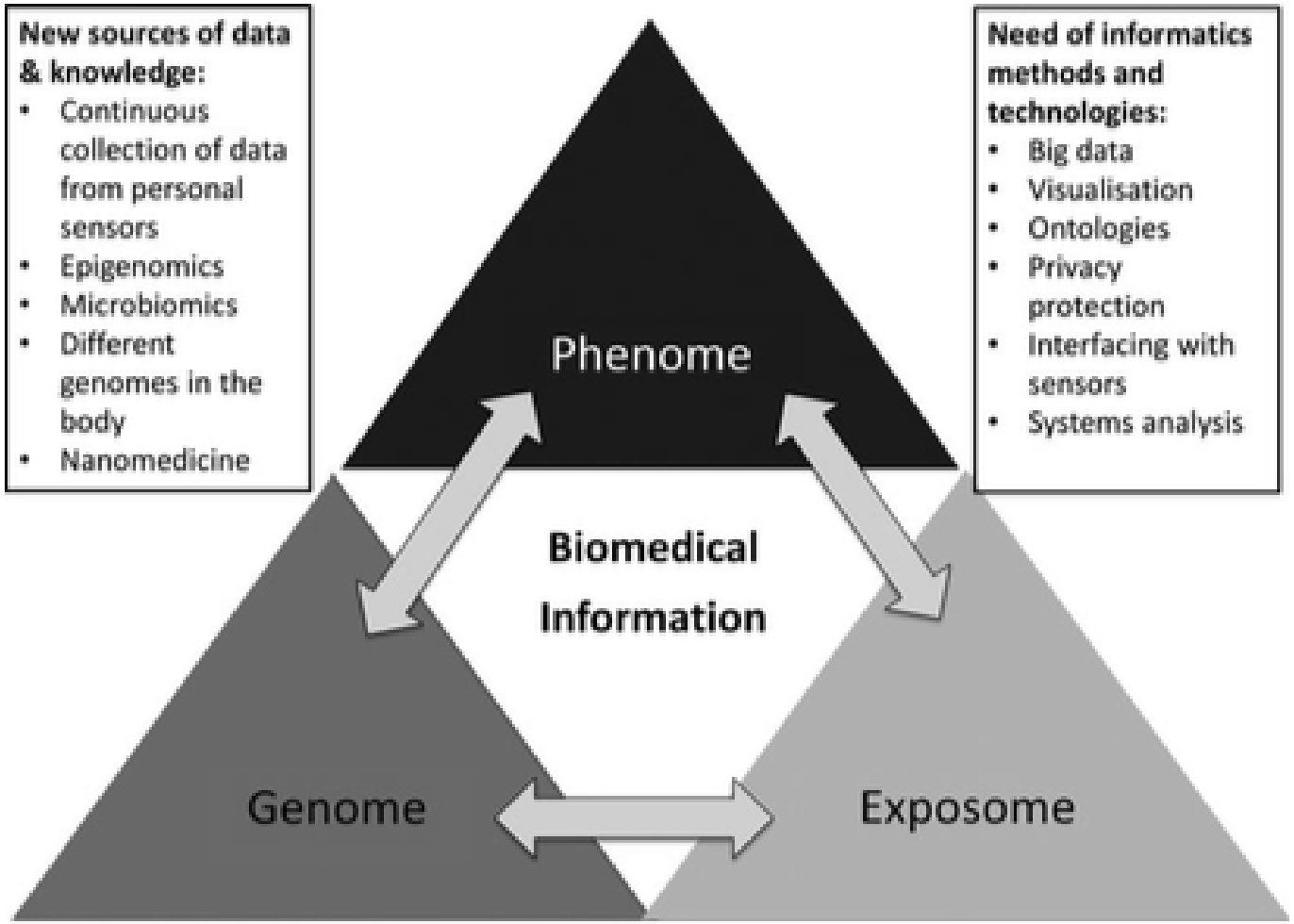


In my case: Tachycardia at rest each day

Informatics & ‘omics integration

Informatics must provide coherent framework for dealing with multi-scale, population data, including:

- Phenome,
- Genome,
- Exposome
- their interconnections.



Exposome informatics: considerations for the design of future biomedical research information systems (Sanchez FM, et al. JAMIA. 2014.)

LHS Infrastructure: *Learning From Data*

Bridging Health IT and Informatics

Received: 22 February 2022 | Revised: 11 March 2022 | Accepted: 12 March 2022

DOI: 10.1002/lrh2.10309

LEARNING FROM DATA

Learning Health Systems

Better together: Integrating biomedical informatics and healthcare IT operations to create a learning health system during the COVID-19 pandemic

Philip R.O. Payne[1] | Adam B. Wilcox[1] | Peter J. Embi[2] | Christopher A. Longhurst[3]

[1]Washington University School of Medicine, Institute for Informatics, St. Louis, Missouri, USA

[2]Department of Biomedical Informatics, Vanderbilt University Medical Center, Nashville, Tennessee, USA

[3]Department of Biomedical Informatics, UC San Diego Health, La Jolla, California, USA

Correspondence
Philip R.O. Payne, Institute for Informatics, Washington University School of Medicine, 4444 Forest Park Ave, Campus Box 8102, St. Louis, MO 63110-2212, USA.
Email: prpayne@wustl.edu

Abstract

The growing availability of multi-scale biomedical data sources that can be used to enable research and improve healthcare delivery has brought about what can be described as a healthcare "data age." This new era is defined by the explosive growth in bio-molecular, clinical, and population-level data that can be readily accessed by researchers, clinicians, and decision-makers, and utilized for systems-level approaches to hypothesis generation and testing as well as operational decision-making. However, taking full advantage of these unprecedented opportunities presents an opportunity to revisit the alignment between traditionally academic biomedical informatics (BMI) and operational healthcare information technology (HIT) personnel and activities in academic health systems. While the history of the academic field of BMI includes active engagement in the delivery of operational HIT platforms, in many contemporary settings these efforts have grown distinct. Recent experiences during the COVID-19 pandemic have demonstrated greater coordination of BMI and HIT activities that have allowed organizations to respond to pandemic-related changes more effectively, with demonstrable and positive impact as a result. In this position paper, we discuss the challenges and opportunities associated with driving alignment between BMI and HIT, as viewed from the perspective of a learning healthcare system. In doing so, we hope to illustrate the benefits of coordination between BMI and HIT in terms of the quality, safety, and outcomes of care provided to patients and populations, demonstrating that these two groups can be "better together."

KEYWORDS
informatics, information systems, leadership, organization and administration

1 | INTRODUCTION

Biomedical research and healthcare practice is experiencing a new "data age," where bio-molecular, clinical, and population-level data are increasingly available and suitable for use in support of both hypothesis generation and testing as well as operational decision-making. Ideally, these data can and should be accessed by researchers, clinicians, and administrators to support data-driven solutions to a broad variety of use cases, from drug discovery to point-of-care decision-making to precision approaches to individual and population health.[1-3] Considering these opportunities, we believe that it is important to consider the ways in which the design and delivery of biomedical informatics (BMI)

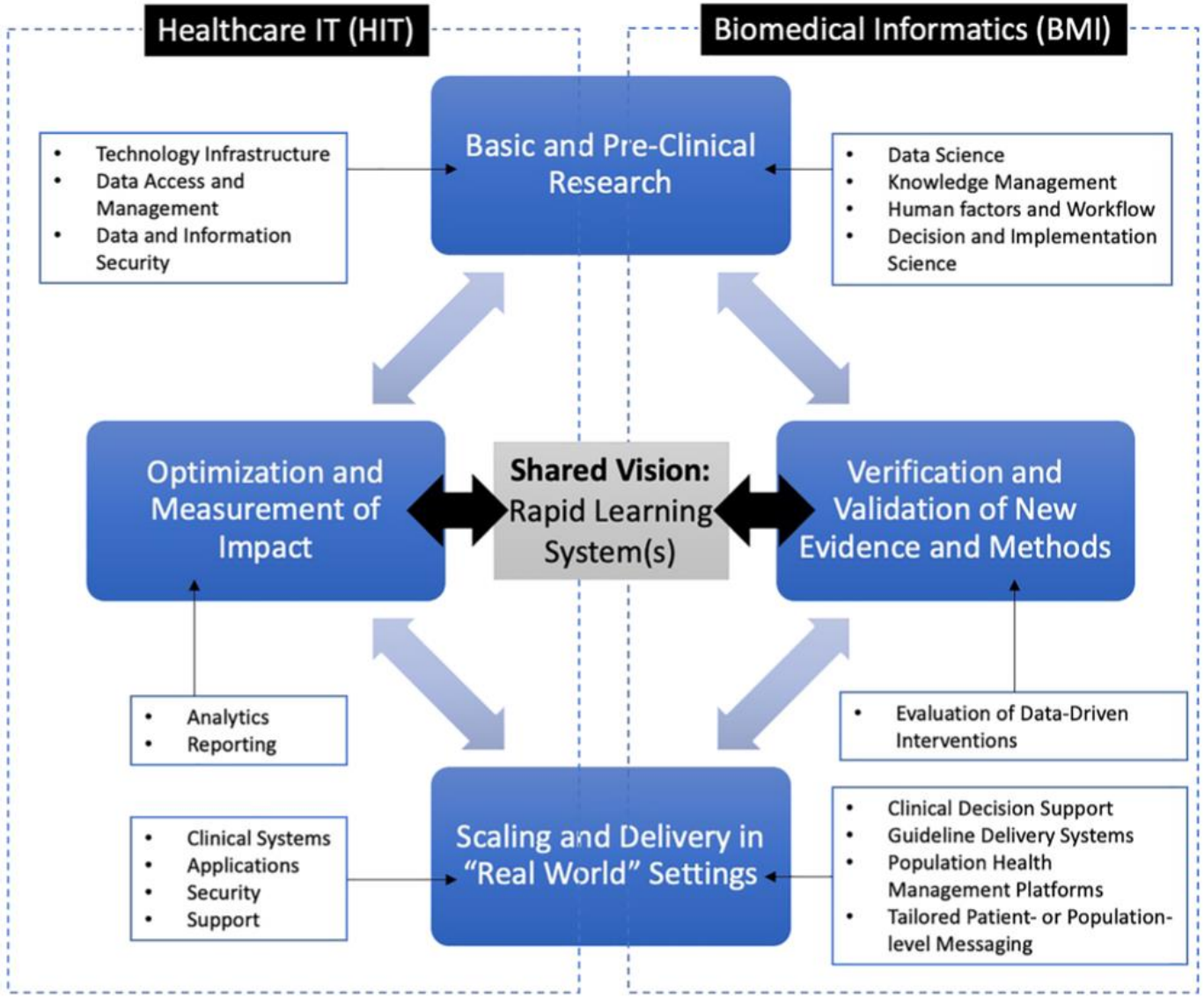


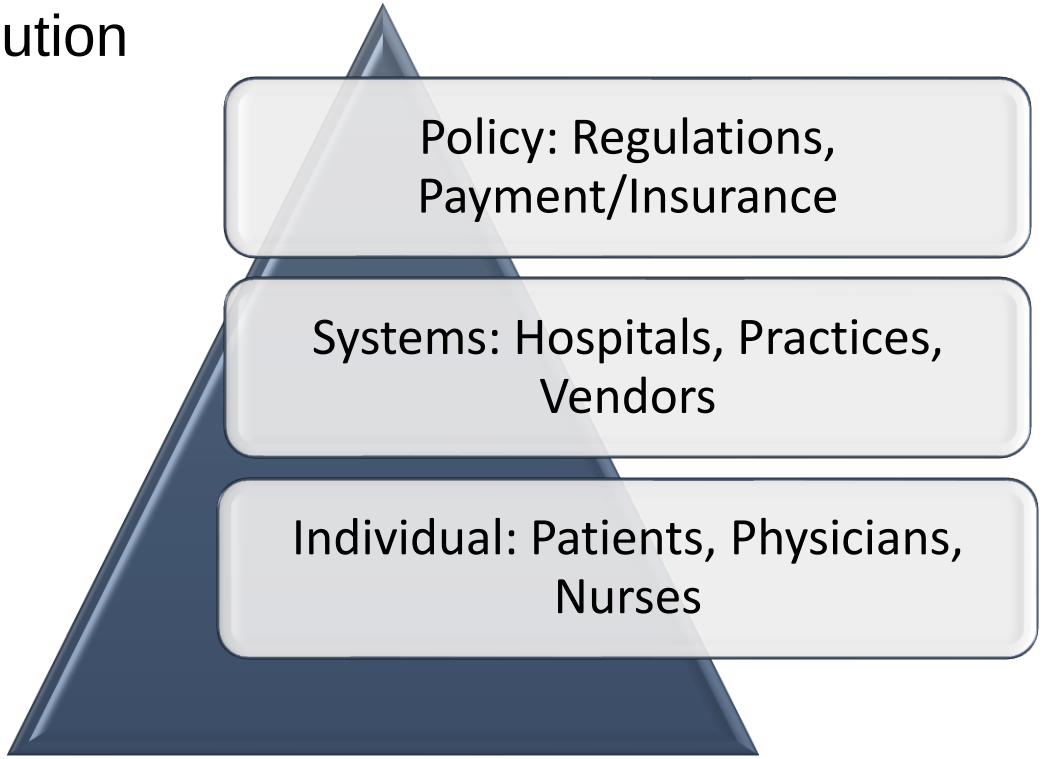
FIGURE 2 Conceptual model for a "rapid learning" healthcare system in which BMI and HIT work synergistically. In this example, four major stages for the design and implementation of a data-driven intervention strategy are shown, spanning the capabilities of BMI and HIT leaders and practitioners. For each stage, examples of the types of competencies and methods that contribute to each such phase are shown

Payne, PRO, Wilcox A, Embi PJ, Longhurst C. Learning Health Systems. 2022 (Learning from Data Series)

Lesson #4: Creating AI-Enabled LHS is a Socio-Technical Challenge

- Information Technologies only part of the solution
  - Fiscal/Administrative
  - Aligning incentives
  - Cultural/Behavioral
  - Individual/Societal concerns

- Must consider EGM issues at several levels
  - Policy level
  - Systems level
  - Individual level



- A growing area in need of focus: **Artificial Intelligence** in Health/care…

AI Poised to Transform Healthcare and Academic Medicine

BRIDGE2AI

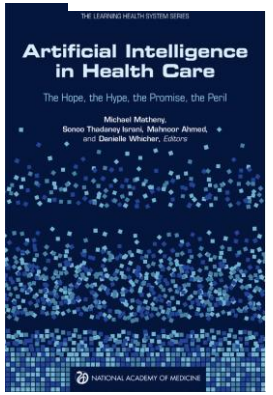
BRIDGE CENTER

AIM AHEAD

ARPA-H

NATIONAL ACADEMY OF MEDICINE

Health Care Artificial Intelligence Code of Conduct



PEW

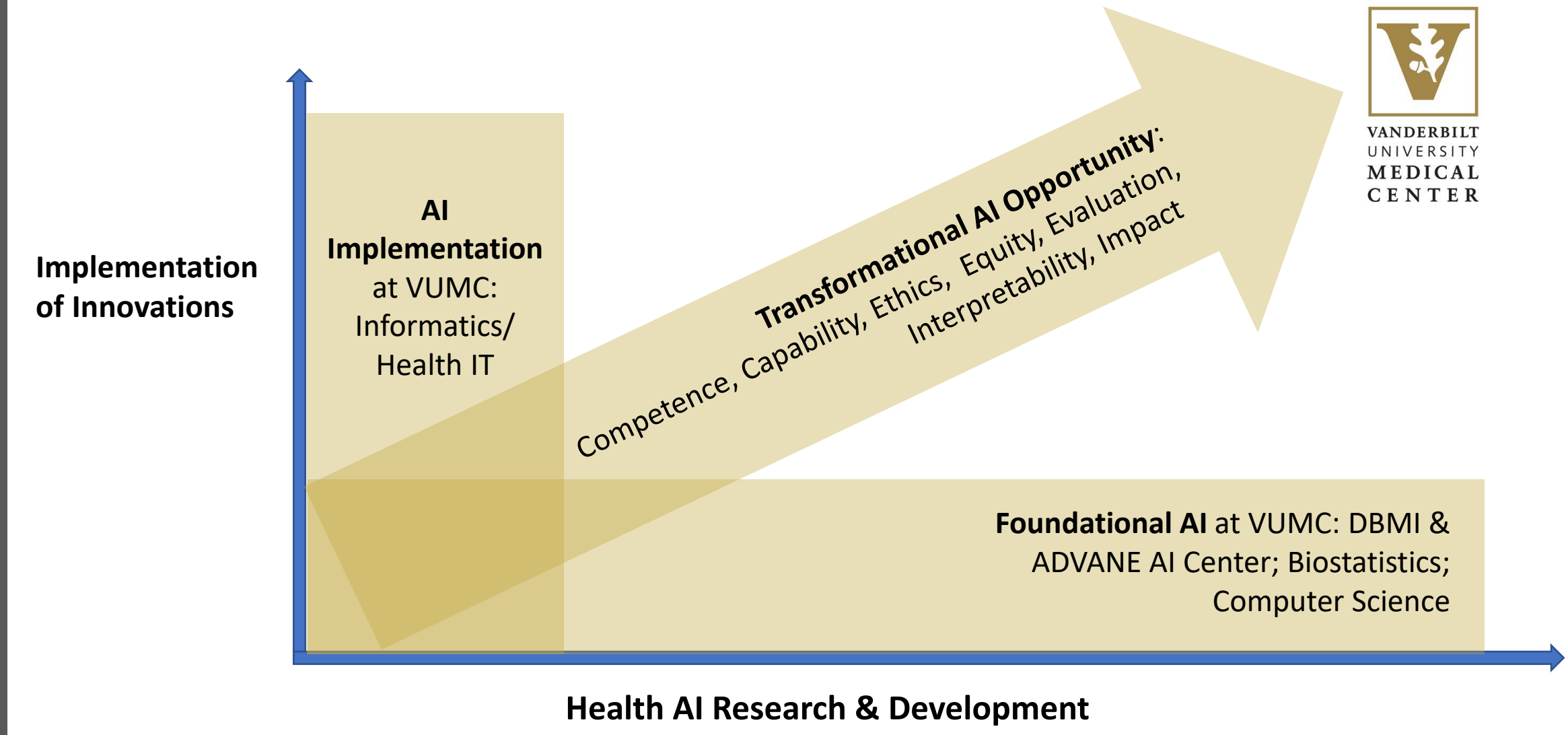
GORDON AND BETTY MOORE FOUNDATION

TRAIN
TRUSTWORTHY & RESPONSIBLE AI NETWORK

CHAI
Coalition for Health AI

Ongoing Activities in Health Artificial Intelligence

MEDICAL CENTER


Implementation of Innovations
AI Implementation at VUMC: Informatics/ Health IT
Transformational AI Opportunity: Competence, Capability, Ethics, Equity, Evaluation, Interpretability, Impact
Foundational AI at VUMC: DBMI & ADVANE AI Center; Biostatistics; Computer Science
Health AI Research & Development
VANDERBILT UNIVERSITY MEDICAL CENTER

AI Discovery & Vigilance to Accelerate Innovation & Clinical Excellence

ADVANCE

Focus and Goals of ADVANCE Center

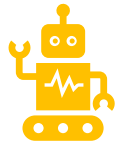
Accelerate	Accelerate adoption and use of AI solutions and develop best practices
Increase	Increase access to expertise in Health AI across enterprise
Strengthen	Strengthen AI capabilities to provide new and impactful insights into health and disease
Enable	Provide shared infrastructure, knowledge diffusion and professional services for AI-driven solutions
Educate	Expand AI in medical education across training spectrum
Grow	Grow academic and industry partnerships in AI
Ensure	Ensure that AI systems and solutions are effective, safe, and ethical
Transform	Develop AI best practices to transform health care at VUMC Health and beyond

VUMC AI Governance:

Led by AI Technology (AIT) Committee

Tracking and responding to changes in federal and state AI regulation

Writing policies and refining approaches to safe, effective, compliant use, while enabling research/innovation



Managing procurement of "internally-" & "exeternally sourced" AI solutions

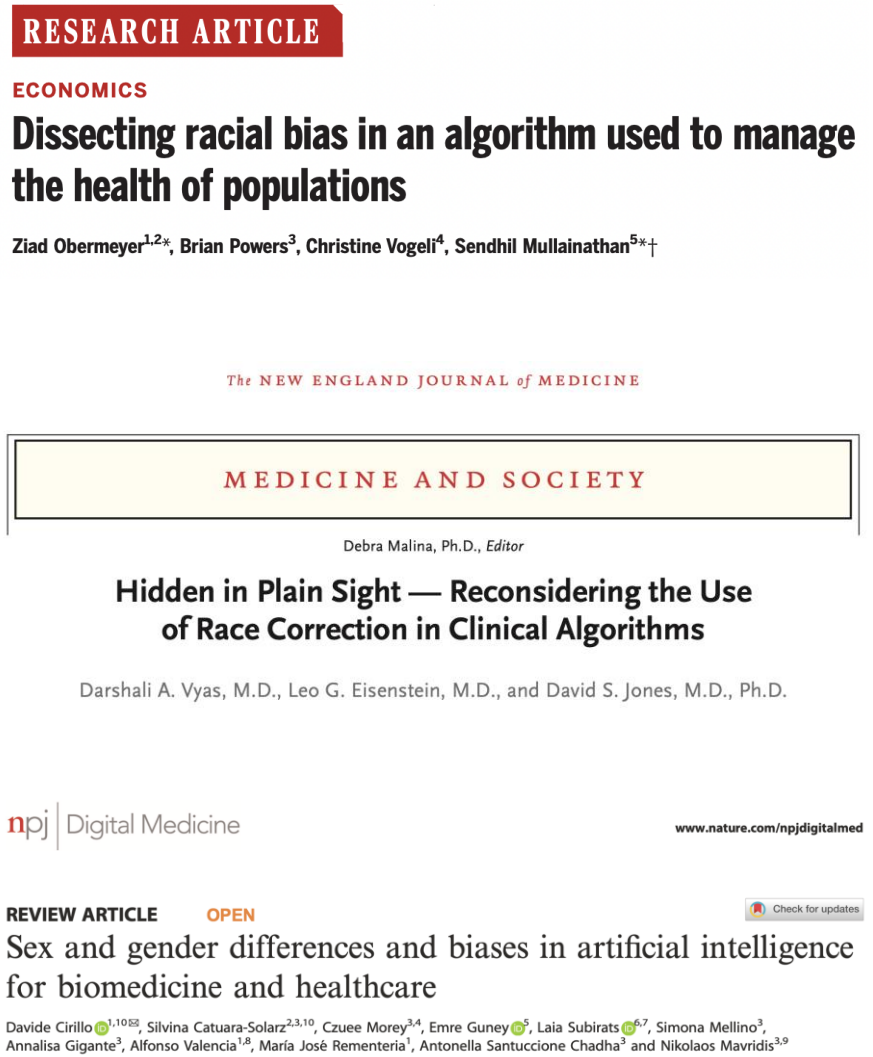
Inventory of AI solutions and deployments

Development of AI capabilities for ongoing monitoring of algorithms (Algorithmovigilance)

AI-driven Healthcare

- Growth in AI-driven healthcare
- Ongoing development and application of such tools
- Significant potential for **improved care and efficiencies**
- Evidence of **unintended negative impacts**

- We need for a “learning system” to:
  - Monitor algorithm-driven healthcare for effects
  - Mechanisms respond/adjust to unintended effects, drift



RESEARCH ARTICLE

ECONOMICS

Dissecting racial bias in an algorithm used to manage the health of populations

Ziad Obermeyer[1,2]*, Brian Powers[3], Christine Vogeli[4], Sendhil Mullainathan[5]*†

The NEW ENGLAND JOURNAL of MEDICINE

MEDICINE AND SOCIETY

Debra Malina, Ph.D., *Editor*

Hidden in Plain Sight — Reconsidering the Use of Race Correction in Clinical Algorithms

Darshali A. Vyas, M.D., Leo G. Eisenstein, M.D., and David S. Jones, M.D., Ph.D.

npj | Digital Medicine

www.nature.com/npjdigitalmed

REVIEW ARTICLE OPEN

Check for updates

Sex and gender differences and biases in artificial intelligence for biomedicine and healthcare

Davide Cirillo[1,10], Silvina Catuara-Solarz[2,3,10], Czuee Morey[3,4], Emre Guney[5], Laia Subirats[6,7], Simona Mellino[3], Annalisa Gigante[3], Alfonso Valencia[1,8], María José Rementeria[1], Antonella Santuccione Chadha[3] and Nikolaos Mavridis[3,9]

Need to monitor healthcare Algorithms

Biases in Data:
Known and Unknown

Caution about generalizability

Unexpected results can be expected

Must monitor to promote trust

Need new systems and approaches

Essential for safe, efficient, effective and equitable care

”Algorithmovigilance”

“The scientific methods and activities relating to the evaluation, monitoring, understanding, and prevention of adverse effects of algorithms in health care.”

Akin to pharmacovigilance for monitoring drug effects

Increasingly important as AI/ML-derived algorithms are used

JAMA Network Open

Invited Commentary | Health Informatics

Algorithmovigilance—Advancing Methods to Analyze and Monitor Artificial Intelligence–Driven Health Care for Effectiveness and Equity

Peter J. Embi, MD, MS

In recent years, there has been rapid growth and expansion in the use of machine learning and other artificial intelligence approaches applied to increasingly rich and accessible health data sets to develop algorithms that guide and support health care.[1] As they make their way into practice, such algorithms have the potential to fundamentally transform how health care decisions are made and, therefore, how patients are diagnosed and treated.[2] While such approaches hold great promise for enabling more precise, accurate, timely, and even fair decision-making when properly developed and applied, there is also growing evidence that systematic biases can lead to unintended and even severe consequences.[3,4] Mirroring disparities and inequities inherent in our society and health system,[5] such biases can be inherent in not only the underlying data used to develop algorithms but also how algorithmic interventions are deployed.

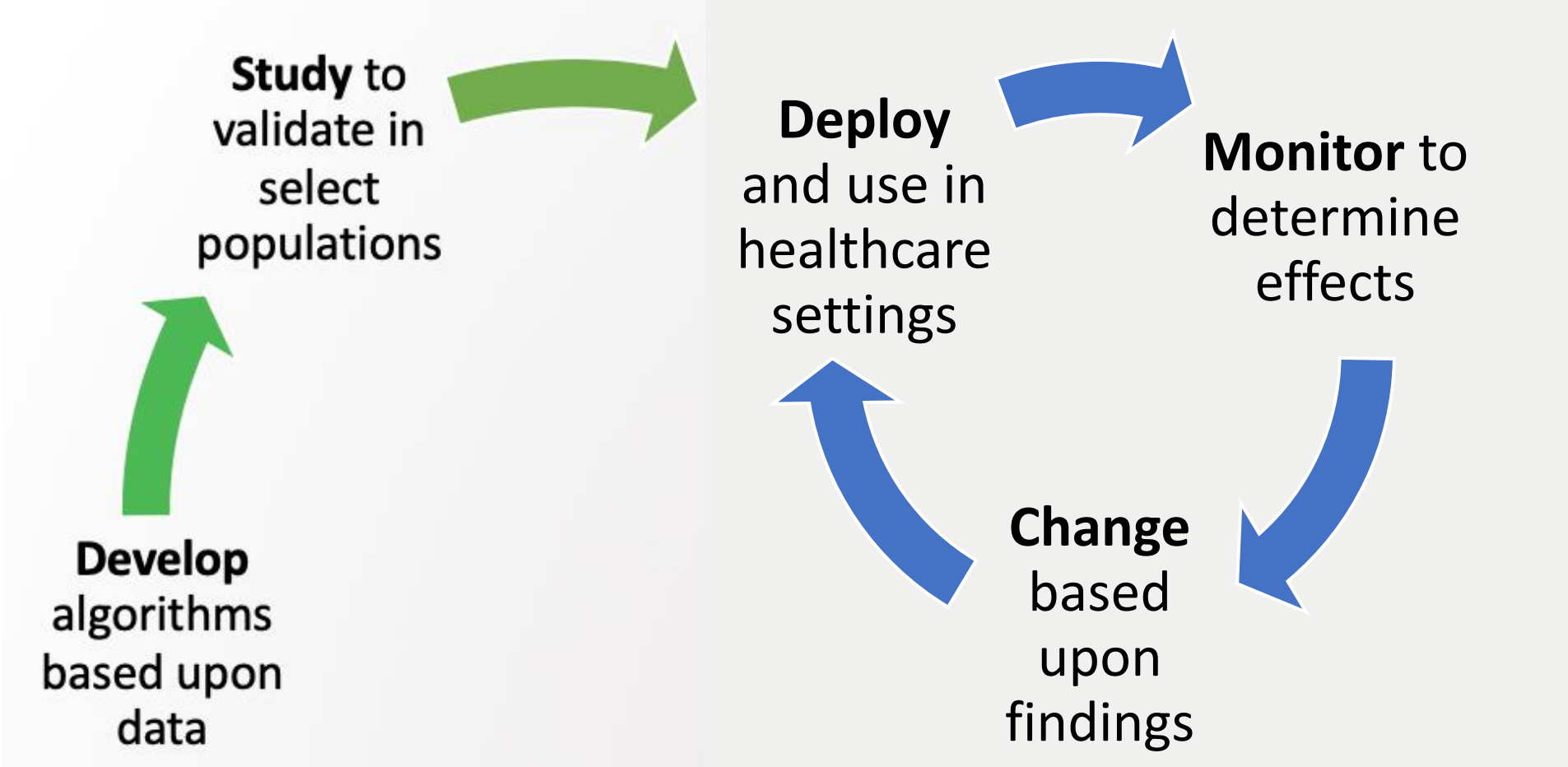
Elsewhere in *JAMA Network Open*, Park and colleagues[6] present findings from a study evaluating different approaches to the debiasing of health care algorithms developed to predict postpartum depression (PPD) among a cohort of pregnant women with Medicaid coverage. The researchers, from IBM Research, leveraged the IBM MarketScan Medicaid Database, a deidentified, individual-level claim records data set with approximately 7 million Medicaid enrollees across multiple states, to derive their algorithms. They started by developing 2 sets of machine learning models trained to predict 2 outcomes: (1) diagnosis or treatment for PPD and (2) postpartum mental health service utilization. Their initial, risk-adjusted generalized linear models for each outcome demonstrated a notable difference in the cohort with binarized race, with White patients having twice the predicted likelihood of being diagnosed with PPD compared with Black patients and a significantly higher likelihood of utilizing mental health services. However, as the authors point out,

+ Related article

Author affiliations and article information are listed at the end of this article.

Embi PJ. JAMA Network Open. 2021;4(4):e214622.

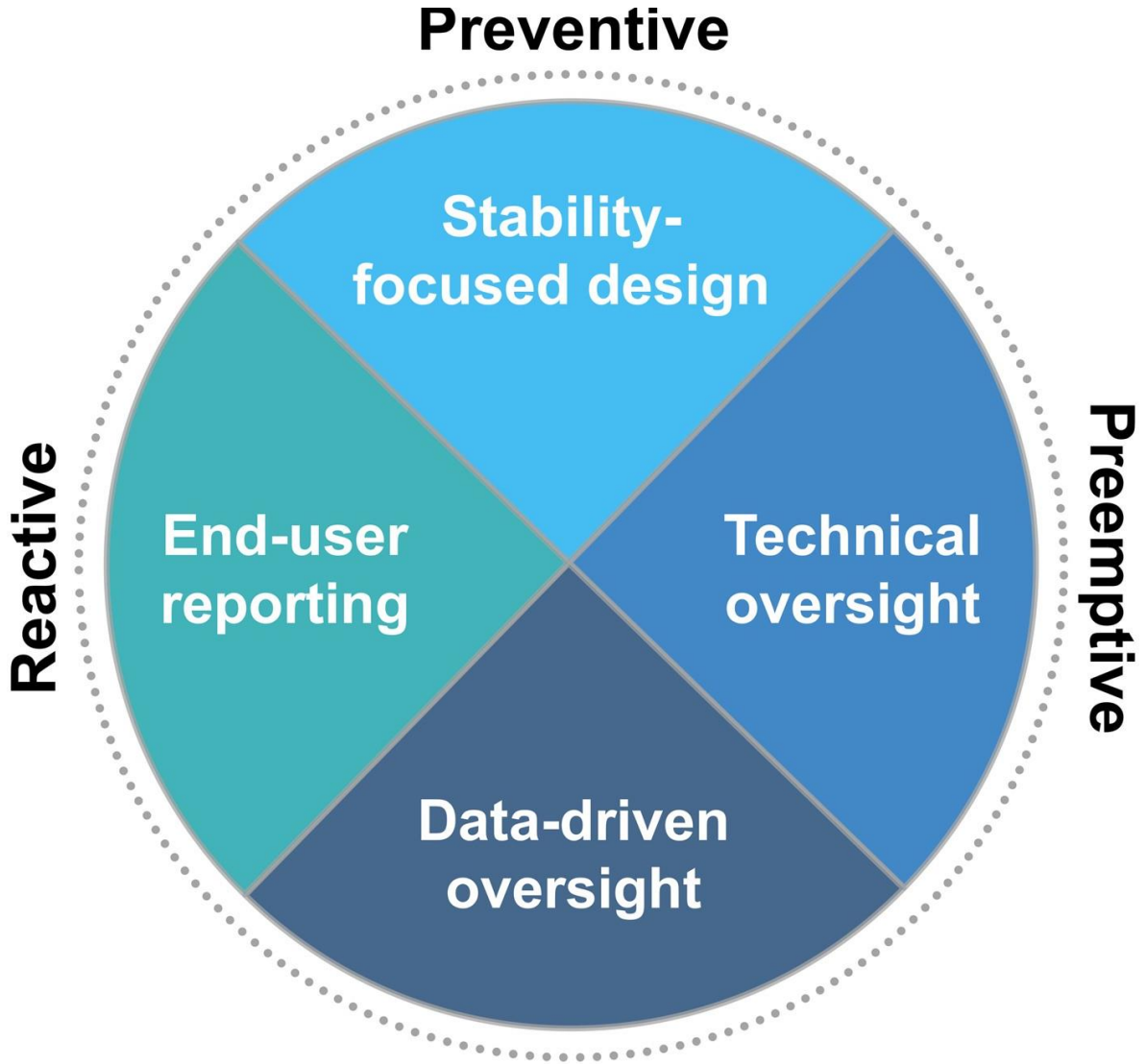
Algorithmovigilance via learning health system



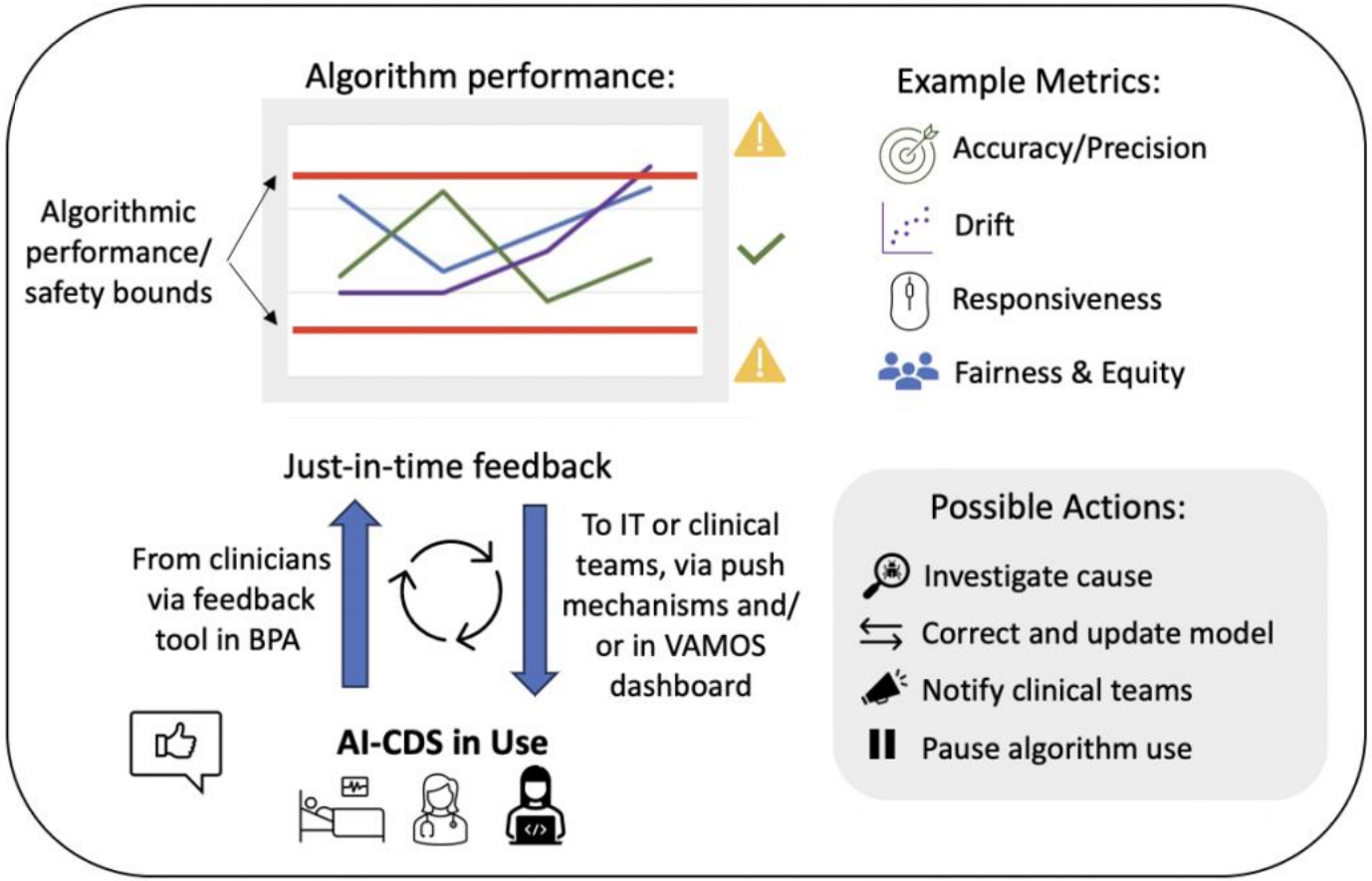
Continuum of algorithmovigilance approaches to ongoing model monitoring and maintenance

Sustainable deployment of clinical prediction tools—a 360° approach to model maintenance

Davis S, Embi PJ, Matheny M. J Am Med Inform Assoc, May 2024



The Vanderbilt Algorithmovigilance Monitoring and Operations System (VAMOS)



- Novel socio-technical system of processes and analytical dashboarding for (near) real-time Health AI monitoring:
  - Organizational governance and oversight
  - Capturing and Reporting Adverse events
  - Team-based monitoring
  - Responding to issues

VAMOS Human Centered Design:

Emergent Design Considerations

Users	Support a broad range of users with differing goals and expertise
Use Cases	Support diverse algorithms and implementation use cases
Meta-Data	Enable access to model facts, criticality and organizational contacts
Analytics	Support analytic functions including performance metric monitoring and drift detection
Flexibility	Provide flexible & customizable temporal displays of algorithm performance and impact
Feedback	Receive and display feedback from algorithm end-users
Notes	Log notes and action items for each algorithm
Reporting	Provide reporting tools geared to multiple audiences
Communication	Support communication about algorithmic management between technical, operational, and clinical teams

VAMOS (VIGILANT AI MONITORING AND OPERATIONS SYSTEM)

Initial Users:

- ✓ AIT – VUMC AI Governance Committee
- ✓ VUMC Health IT

VANDERBILT UNIVERSITY MEDICAL CENTER

AI Discovery & Vigilance to Accelerate Innovation & Clinical Excellence

ADVANCE

VAMOS DASHBOARD: MOCKUP

Show: All | Search: | Show Alerts | Generate Task List | Generate Reports

Model Name	State	Criticality	Class	Type	Notices	PERFORMANCE	PROCESS	OUTCOMES	FAIRNESS
Cornelius	Active	3	Clinical	BPA		✓	! Fire rate increase	✓	✓
Surgical scheduling	Inactive	1	Operations	Patient list		⚠ Accuracy drift	✓	✓	✓
Post-partum hemorrhage	Maint.	1	Research	Storyboard		✓	✓	✓	! Urban/rural issue
AI-VTE	Active	2	Clinical	Order set		✓	✓	⚠ VTE rate increase	✓
Others ...									

Multiple metrics continuously monitored for drift, anomalies, and differences in sub-populations

Alerts generated and sent to model contacts for any "red" status

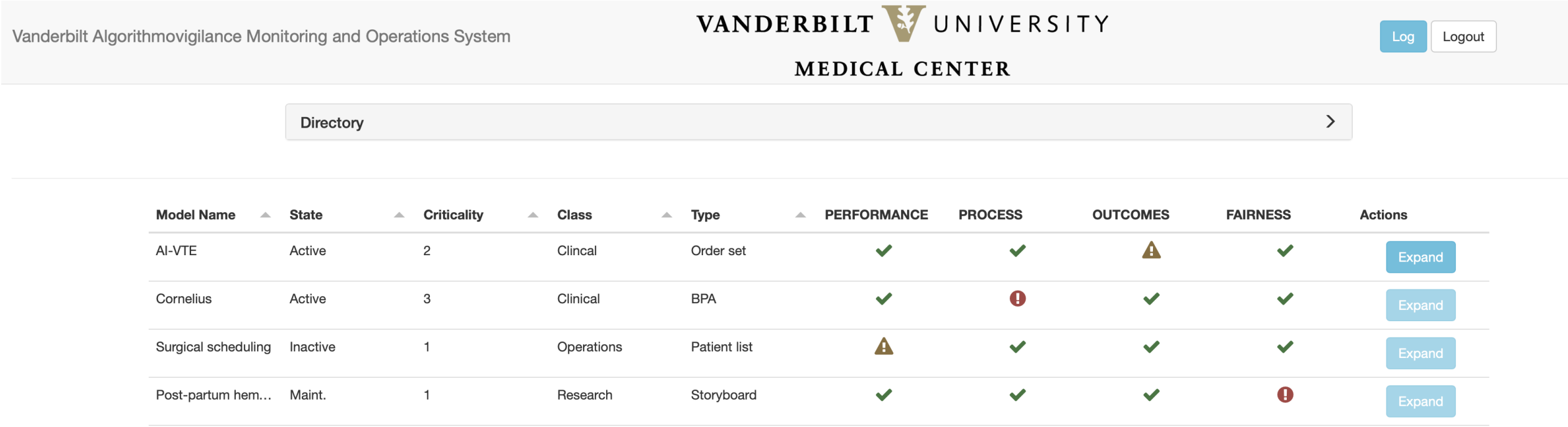
Show: All
- ☒ All/None
- ☒ Active State
- ☒ Maintenance State
- ☒ Inactive State
- ☒ Research Class
- ☒ Clinical Class
- ☒ Operational Class
- ☒ *Others ...*

Types of notices:
- Review due soon
- Feedback from end users
- Input features
- Upcoming planned downtimes
- Upcoming changes/upgrades

Other anomalies ...

Patent Pending

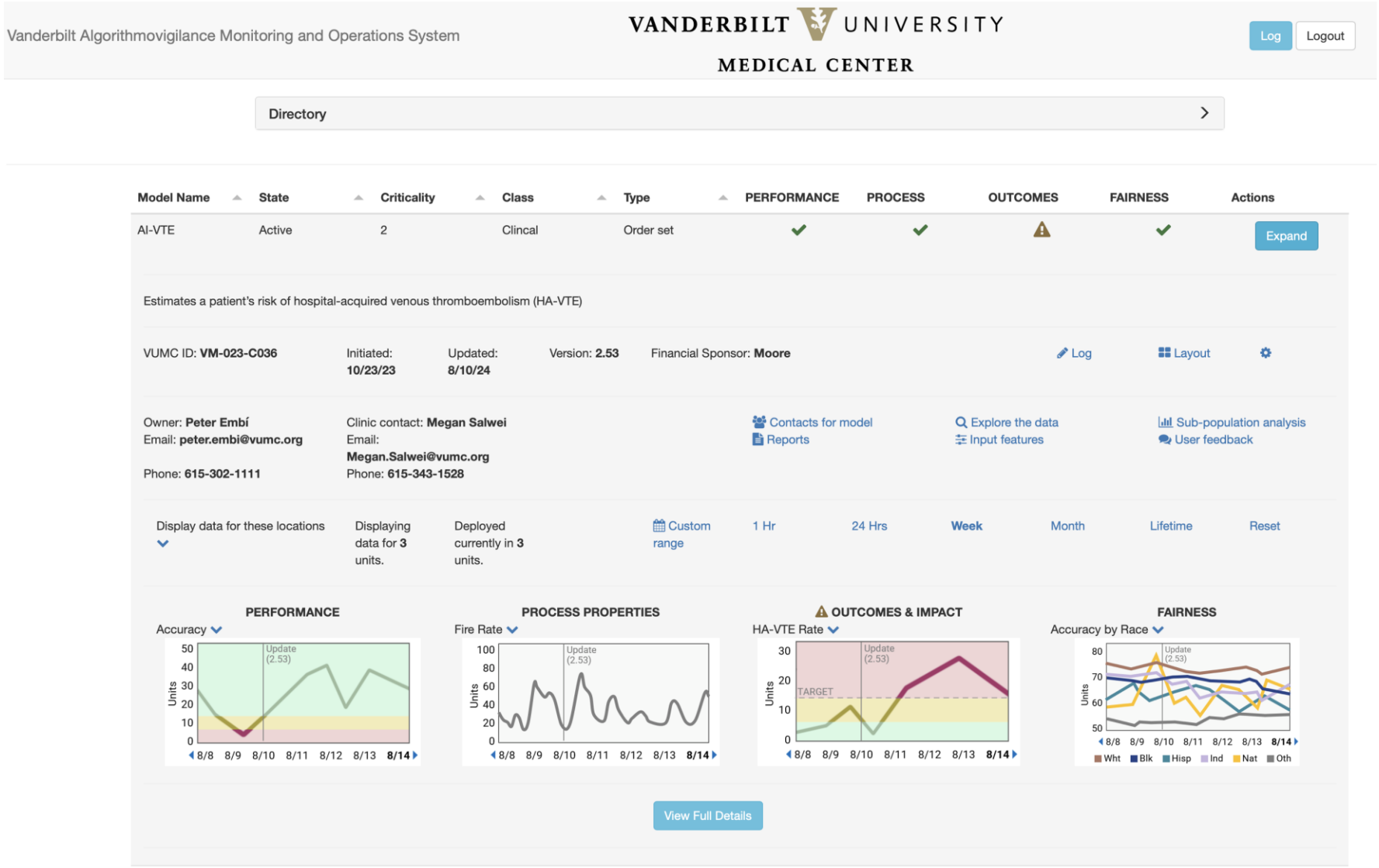
VAMOS Application



Model Name	State	Criticality	Class	Type	PERFORMANCE	PROCESS	OUTCOMES	FAIRNESS	Actions
AI-VTE	Active	2	Clincal	Order set	✓	✓	⚠	✓	Expand
Cornelius	Active	3	Clinical	BPA	✓	!	✓	✓	Expand
Surgical scheduling	Inactive	1	Operations	Patient list	⚠	✓	✓	✓	Expand
Post-partum hem…	Maint.	1	Research	Storyboard	✓	✓	✓	!	Expand

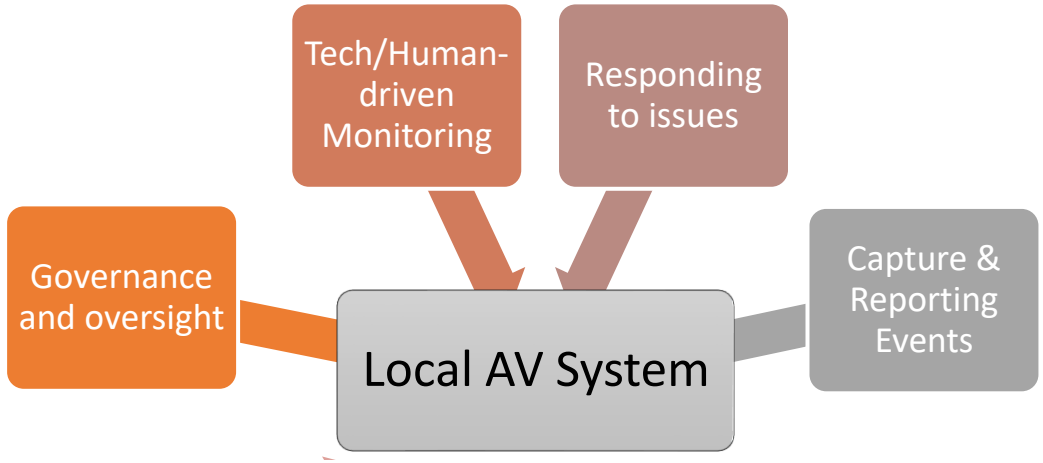
**Patent Pending*

VAMOS Application



**Patent Pending*

Creating a Federated Algorithmovigilance (AV) Network



Next Steps / Opportunities

Expand to other users / use cases & Validate

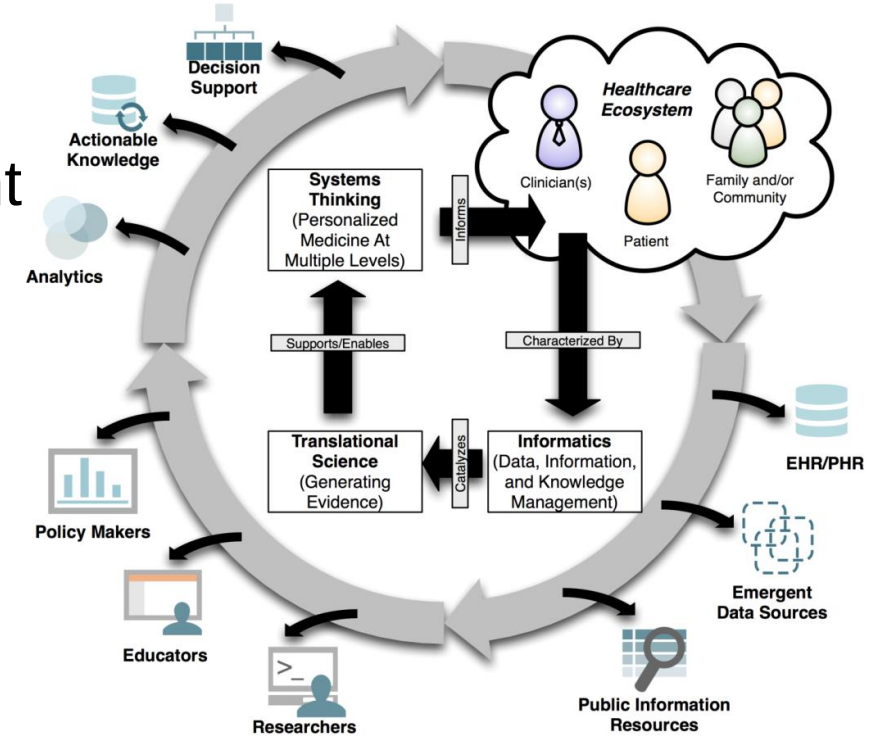
Invitations for early adopter sites/ VAMOS Collaborative partners

Standards development (technical, data, API, Measures, Responses, etc.)

Enhance Platform, Grow Open-Access efforts, Establish Network

Lesson #5: Informatics ~~can~~ must help

- Support Informatics-enabled LHS for discovery & care
- Effective AI to improve prevention, diagnosis, treatment
- AI to accelerate discovery and translation to practice
- Informatics & AI to overcome health disparities
- Empower people and systems to improve health/care
- Create a virtuous cycle of activities to advance healthcare, quality, research, and public health



Embi, Peter J., Payne, Philip R.O. *"Evidence generating medicine: redefining the research-practice relationship to complete the evidence cycle."* *Medical care* 51 (2013): S87-S91.

Lesson #5: We ~~can~~ must help

- Urgency!
  - People are suffering. Needlessly.
- Shouldn't have to be an MD, well-connected, to get great care
- The system isn't working for too many
- Where we know how to fix it, we must act!
- Where we don't (yet), we must continue to innovate!

Art by M. Natter

Thank You!

Business Card

Questions or Comments?

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