DUKE University School of Medicine | DUKE Institute for Health Innovation

Bridging the AI Digital Divide in the Safety Net

Insights from the Health AI Partnership Program

Suresh Balu, MS, MBA

Alifia Hasan, B Pharm, MBA

June 5, 2025

Agenda

- Overview of Duke Institute for Health Innovation (DIHI)
- Overview of Health AI Partnership (HAIP)
- HAIP's 8 Key Decision Points: Guiding AI Adoption, Governance & Oversight
- AI Adoption Acceleration Program: Supporting Safety Net & FQHC AI Readiness through Technical Assistance & Peer Learning

Learning Objectives

1. Gain insight into HAIP's mission, structure, and key initiatives for responsible and ethical AI in health care
2. Identify common stages and decision points that healthcare organizations navigate along the AI product lifecycle.
3. Describe the implementation of best practices throughout the AI product lifecycle at Duke Health
4. Explore how HAIP's AI Adoption Acceleration Program supports AI readiness for Safety Net organizations and FQHCs

DIHI Background

Duke Institute for Health Innovation

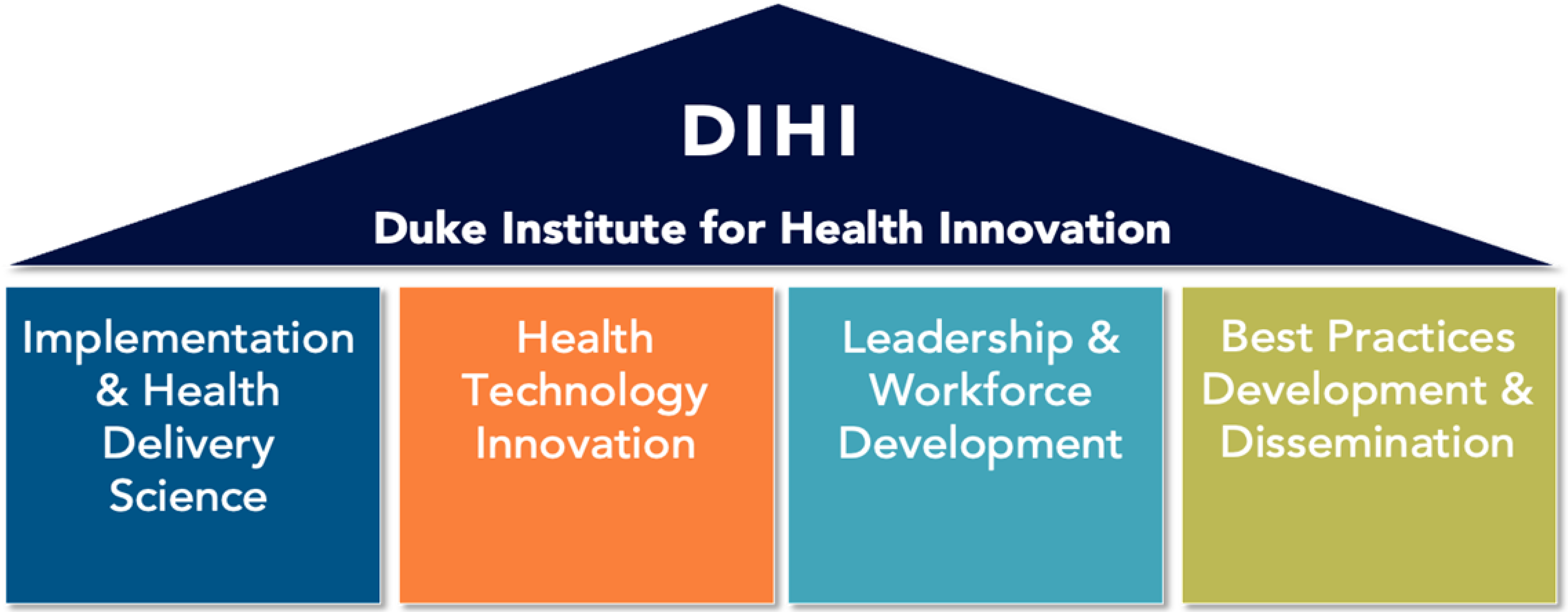
Catalyzing and Sustaining Innovations

mission: Catalyze innovations at Duke

Catalyze transformative innovation in health and healthcare through high-impact research, leadership development and workforce training and the cultivation of a community of entrepreneurship

approach: Innovation by design

Understand user workflow, desired outcomes and problems (needs) and then collaboratively develop concepts and prototypes, and iterate through to finalize solution



Industry Best-Practice Approach in Catalyzing Innovation

RFA

Structured

DIHI RFA

"Top-down + Bottom-Up" approach

- Annual strategic themes for innovation
- Systematic review and due diligence: Assessments on team, feasibility, resource needs, impact and value to patients
- Operational Lead engaged at every stage
- Metrics: clinical utility, economic utility, clinical efficiency, IP & academic outputs

12 Years Catalyzing Innovations	100+ Innovation Projects	800 Proposals

IJ

Unstructured

DIHI Innovation Jam

Health focused Shark Tank

- Source high-potential healthcare and health **innovations ready for commercialization**
- **Duke Leadership as Dolphins**
- Internal syndicated investment
- Proceeds used for product/service development and entrepreneurship

6 Years of Jamming	30+ Pitches	12 Companies Incubated

Duke Institute for Health Innovation

DIHI Spectrum of AI Value Creation

LLMs for Cardiothoracic ICU Shift Handoff	Early Detection of Pediatric Deterioration				
Behavioral Emergency Prediction	CTICU bounce back prediction		LLMs for organ transplant matching support		
Reducing Post-Operative Opioid Use After Gynecologic Surgery	RFID Surgical Instrument Tracking to Optimize OR	Machine Learning to Triage Patients with Low Back Pain	LLMs for screening oncology referrals	NAFLD population health rounding	
Immune-Related Adverse Events Following ICIs	Prediction of Steroid-Induced Hyperglycemia	Assistive Triage of Traumatic Brain Injury	LLMs for social service identification and referral	Dermatology clinical decision support for PCPs	
Pediatric Sepsis	Early Detection of Cardiogenic Shock	Patient Identification for Hospital at Home	LLMs for surgery prior authorization	AI to Identify Normal Transthoracic Echocardiograms	
Predicting Bacteremia and Improving Blood Culture Result Interpretation	CTICU Triage Algorithm for Stable NSTEMIs in ED	Immune-Related Adverse Events from ICIs	LLMs for chemotherapy prior authorization	Community-Based Palliative Care	
Early Identification and Management of PE	Improving Goals of Care Conversations	Hospital at Home	Machine Learning to Interpret PFTs	Surgery Risk Prediction for Older Adults	COVID-19 Symptom Monitoring
Maternal Early Warning System	Post-Operative Risk Prediction	Index Admissions with MSSP	Peripheral Artery Disease Population Health Rounding	Implementation of Novel PSA Screening Algorithm	Patient-Directed LVAD Acoustic Surveillance
Early Detection of Adult Deterioration	Mortality Models (inpatient / 30-day)	Readmissions (Social Drivers for HF)	Predicting Post Operative Complications Following Lung Transplant	Surgery Risk Prediction from NSQIP Data	Outpatient Procedure Concierge Program
ED Triaging to Inpatient and ICU Beds	Sepsis Watch	SNF transition	HIV Pre-Exposure Prophylaxis Identification	CKD population health rounding	Autism and Beyond
Inpatient Innovations		**Transition Setting**	**Outpatient/ Gaps in Care**		**Patient & Community**

Guiding Principles

Build to show value	Build to integrate	Build to scale
• Work on the right problem • Align front-line staff and organizational leaders • Start building minimal viable solutions	• Create interfaces for trans-disciplinary innovation • Staff projects to move quickly • Adapt workflows, roles, and organization	• Targeted and sustained innovator engagement • Build a modular infrastructure to support many projects • Build organizational capabilities and capacity

Build Responsibly

Health AI Partnership (HAIP)

www.healthaipartnership.org

Network of 22+ Healthcare Organizations and Ecosystem Partners

Health AI Partnership

Mission

Empowering healthcare professionals to use AI effectively, safely, and ethically through community-informed, up-to-date best practices.

Vision

Be the trusted partner and up-to-date source of actionable guidance for healthcare professionals using AI

Values

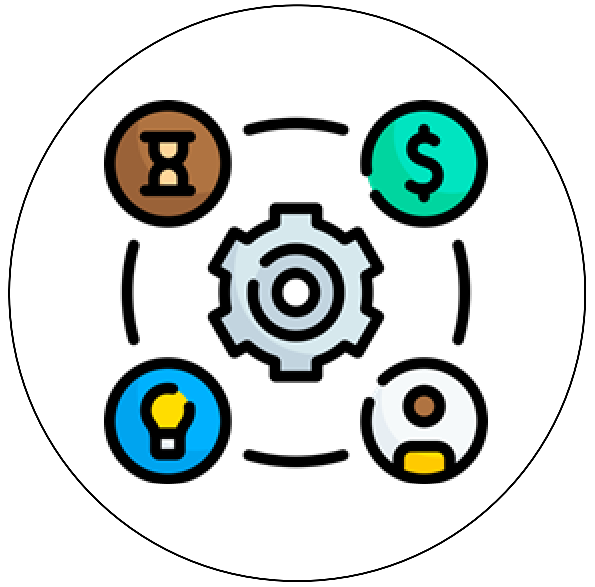
- Eliminate the digital divide
- Improve patient care
- Improve the workplace
- Build community

Uniqueness of HAIP

What distinguishes HAIP from other organizations?

Voice of healthcare organizations from Safety Net Organizations to AMCs

Inform and shape policies by raising awareness for local capacity building



Best practice development and sharing to support high- and low-resource environments

Team of clinical, technical, operational, strategic, community and patient representative and regulatory stakeholders

Provider of technical assistance for AI implementation including for Safety Net Organizations

HAIP Community of Practice (CoP)

Healthcare Organizations in the Corps Network

DukeHealth
Mayo Clinic
MetroHealth
PCCI
NewYork-Presbyterian
Corewell Health
Contra Costa Health
Kaiser Permanente
Franciscan Missionaries of Our Lady Health System
UCSF University of California San Francisco
OCHIN
Morehouse School of Medicine
NCPC National Center for Primary Care
Michigan Medicine University of Michigan
Jefferson Thomas Jefferson University
Washington University School of Medicine in St. Louis
Geisinger
UC San Diego Health
VA U.S. Department of Veterans Affairs Veterans Health Administration Office of Discovery, Education and Affiliate Networks
BJC HealthCare
UNC Health
UW Health

Research Partners

Epic
UW Health

Ecosystem Collaborators

SCAN Health Plan
HL7 International
AMA
CCI Center for Care Innovations
CDT Center for Democracy & Technology
DLA Piper
Berkeley University of California
AHIMA

Federal Observers

CMS Centers for Medicare & Medicaid Services
*Participating as a federal observer

ASTP Assistant Secretary for Technology Policy
*Participating as a federal observer

Practice Network

North Country Healthcare
San Ysidro Health
Health Center of Southeast Texas — Your care in our hands
Community-University Health Care Center, University of Minnesota — Driven to Discover
WakeMed

Sponsor: Gordon and Betty Moore Foundation

Ongoing HAIP Programs

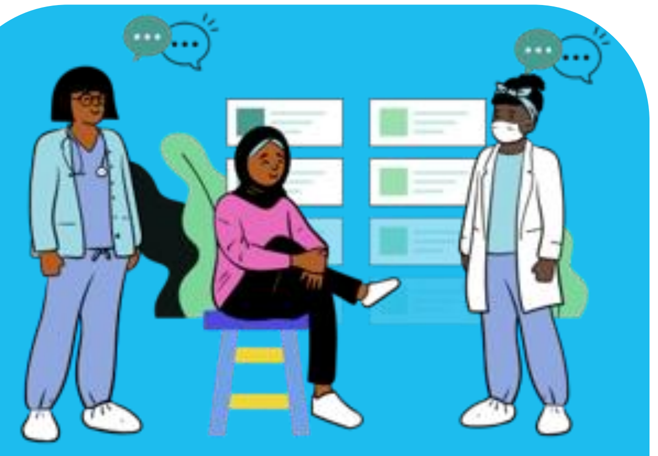
Democratizing AI through Community Building and Enhancing AI Readiness

Community of Practice CoP :
- Corps Network
- Practice Network
- Virtual Meetups
- Exclusive Events

Education Events:
- AI Hub
- Real World AI
- AI in Action

Advocacy
- Senate testimonies and Capitol Hill visits
- Discussion forums
- Policy briefs

CoCreation of Resources
- Vendor disclosure workgroup
- RedTeaming/AI risk assessment framework
- Case based ethics training for physicians



Knowledge Dissemination
- Publications
- Opinion Columns
- Media relations
- Invited Talks

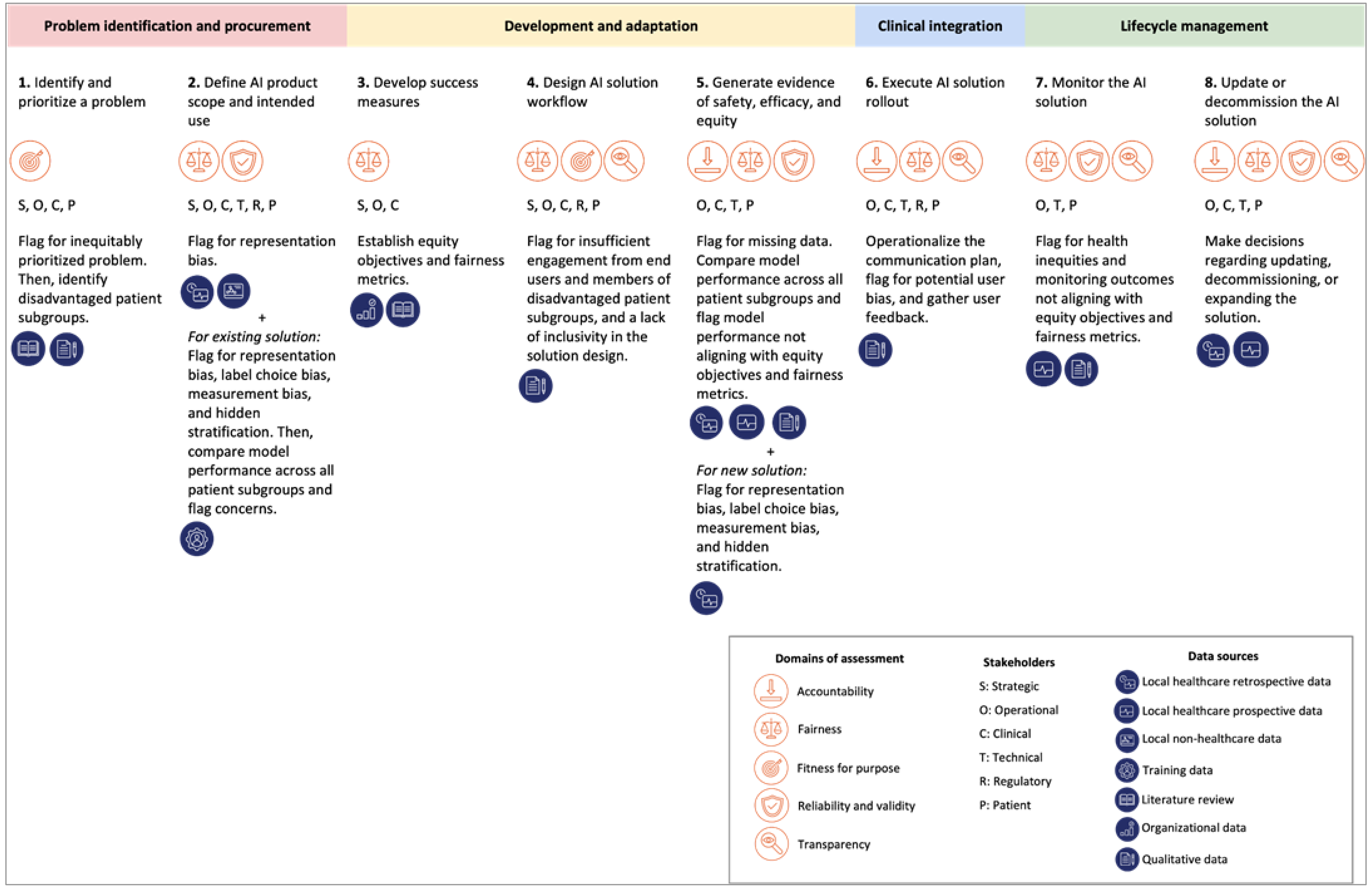
HAIP Key Frameworks: 8 Key Decision Points

Problem Identification and Procurement	Development and Adaptation	Clinical Integration	Lifecycle Management
1 Identify and prioritize a problem	3 Develop measures of outcomes and success of the AI product	6 Execute AI product roll out, workflow integration, communication, education, and scaling	7 After operationalization, monitor and maintain the AI product and work environment
2 Identify requirements for an AI product as a viable component of the solution	4 Design a new optimal workflow to facilitate integration		8 Update or decommission the AI product and work environment
	5 Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use		

Kim JY, Boag W, Gulamali F, Hasan A, Hogg HD, Lifson M, Mulligan D, Patel M, Raji ID, Sehgal A, Shaw K. Organizational Governance of Emerging Technologies: AI Adoption in Healthcare. InProceedings of the 2023 ACM Conference on Fairness, Accountability, and Transparency 2023 Jun 12 (pp. 1396-1417).

HAIP Key Frameworks: Health Equity Across the AI Lifecycle (HEAAL)

- A framework that ensures the AI solution supports health parity
- Details step-by-step procedures for assessing biases across the entire AI lifecycle
- Describes the engagement of various stakeholders and data sources



Kim JY, Hasan A, Kellogg KC, Ratliff W, Murray SG, Suresh H, Valladares A, Shaw K, Tobey D, Vidal DE, Lifson MA, Patel M, Raji ID, Gao M, Knechtle W, Tang L, Balu S, Sendak MP. Development and preliminary testing of Health Equity Across the AI Lifecycle (HEAAL): A framework for healthcare delivery organizations to mitigate the risk of AI solutions worsening health inequities. PLOS Digit Health. 2024 May 9;3(5):e0000390. doi: 10.1371/journal.pdig.0000390. PMID: 38723025; PMCID: PMC11081364

Takeaways: Health Equity Across the AI Lifecycle (HEAAL) framework

Primary audience: Health Delivery Org. Leaders

- Provides a comprehensive list of step-by-step procedures to assess the impacts of AI tools on health for all.
- Community-generated, capturing diverse perspectives from an interdisciplinary team.
- Practical, grounded on real-world examples.
- HEAAL is applied in a context-specific fashion
- Implementation of HEAAL requires expertise, technology infrastructure, and personnel effort.
- A HAIP Free resource!

Access the free resource here!

Kim JY, Hasan A, Kellogg KC, Ratliff W, Murray SG, Suresh H, Valladares A, Shaw K, Tobey D, Vidal DE, Lifson MA, Patel M, Raji ID, Gao M, Knechtle W, Tang L, Balu S, Sendak MP. Development and preliminary testing of Health Equity Across the AI Lifecycle (HEAAL): A framework for healthcare delivery organizations to mitigate the risk of AI solutions worsening health inequities. PLOS Digit Health. 2024 May 9;3(5):e0000390. doi: 10.1371/journal.pdig.0000390. PMID: 38723025; PMCID: PMC11081364.

Standard AI solution procurement milestone

Eight key decision points

Building “practical” best practices for AI adoption

Design research

- **Goal:** Design a prototype of the AI adoption best practice
- **Participants**: Health system leaders, representatives from the partner sites, and external AI ethics experts
- **Method**: Usability-testing sessions

Qualitative research

- **Goal:** Understand the current and aspirational state of AI adoption in healthcare
- **Participants:** Interviews with **89 professionals** in healthcare and other relevant fields
- **Method**: Semi-structured in-depth interviews

Decision point 1

Problem Identification and Procurement	Development and Adaptation	Clinical Integration	Lifecycle Management
1 **Identify and prioritize a problem**	3 Develop measures of outcomes and success of the AI product	6 Execute AI product roll out, workflow integration, communication, education, and scaling	7 After operationalization, monitor and maintain the AI product and work environment
2 Identify requirements for an AI product as a viable component of the solution	4 Design a new optimal workflow to facilitate integration		8 Update or decommission the AI product and work environment
	5 Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use		

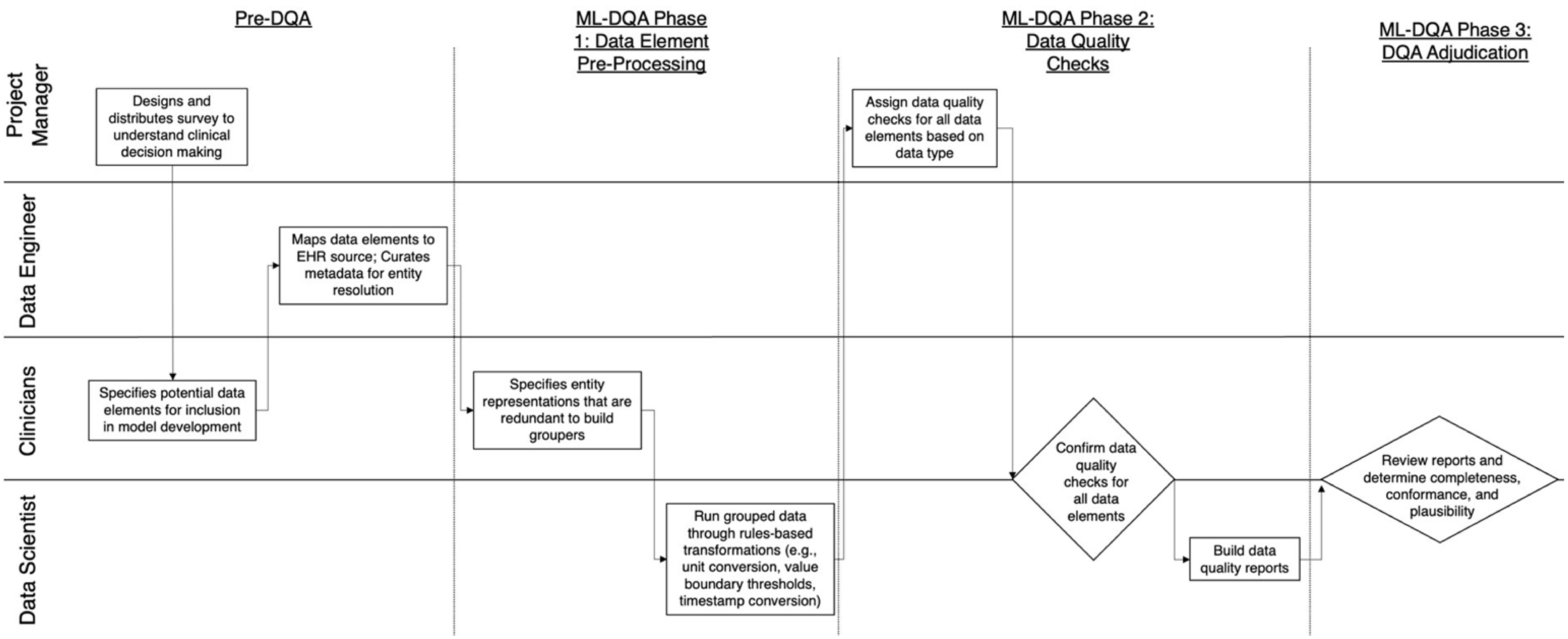
Create alignment with frontline staff and organizational leaders throughout project selection

	Strategic Priorities	Proposal Solicitation	Project Selection	Scoping	Solution Development	Implementation & Evaluation
C-Suite	Specify 4-5 organizational innovation priorities	Publicize RFA	Rate oral pitches to select ~10 projects			Evaluate and determine impact and sustainability plans
Clinical and Operational Leaders (control resources)		Publicize RFA and work with front-line staff on proposal	Provide written reviews to select ~20 projects for oral pitches	Define problem, solution, stakeholders, metrics, and measures	Design and develop solution with DIHI	Define operationalizatio n and dissemination, including communication and training
Front-Line Staff		Iterate on proposal with buy-in from clinical and operational leaders				

Decision point 2

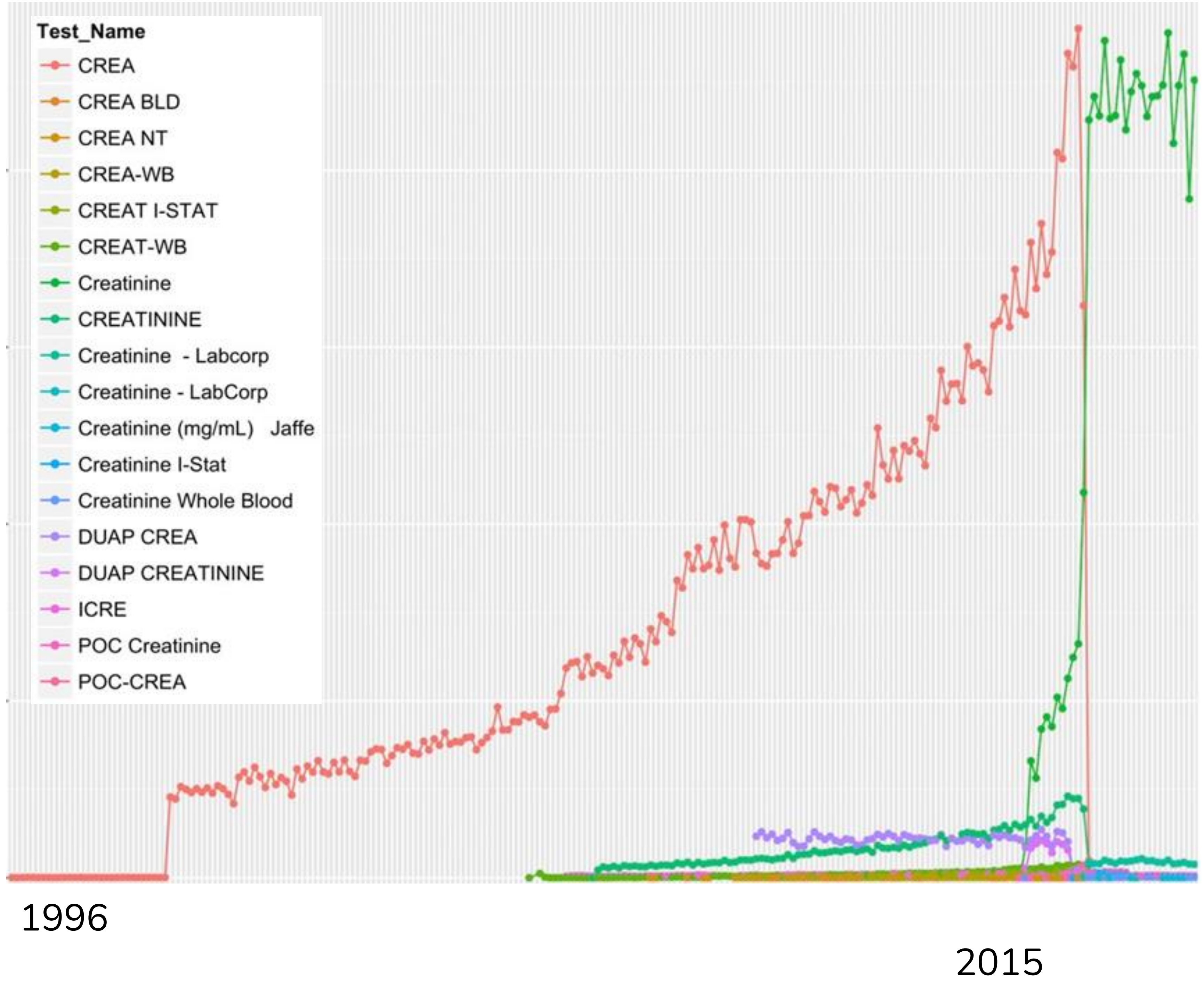
Problem Identification and Procurement	Development and Adaptation	Clinical Integration	Lifecycle Management
1 Identify and prioritize a problem	3 Develop measures of outcomes and success of the AI product	6 Execute AI product roll out, workflow integration, communication, education, and scaling	7 After operationalization, monitor and maintain the AI product and work environment
2 Identify requirements for an AI product as a viable component of the solution	4 Design a new optimal workflow to facilitate integration		8 Update or decommission the AI product and work environment
	5 Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use		

Conduct data quality assurance (DQA) and create actionable data



Conduct data quality assurance (DQA) and create actionable data

Which Creatinine?



	Pediatric Sepsis Prediction	Immune-Related Adverse Event Prediction	Maternal Morbidity and Mortality Prediction
Phase I: Data Element Pre-Processing			
Pre-existing groupers	108	39	310
Project-specific groupers	73	41	12
Phase II: ML-DQA Checks			
Completeness checks	144	508	404
Conformance checks	122	225	69
Plausibility checks	123	301	404
Total quality checks	389	1,034	877

Decision point 3

Problem Identification and Procurement

Development and Adaptation

Clinical Integration

Lifecycle Management

1 Identify and prioritize a problem

2 Identify requirements for an AI product as a viable component of the solution

3 **Develop measures of outcomes and success of the AI product**

4 Design a new optimal workflow to facilitate integration

5 Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use

6 Execute AI product roll out, workflow integration, communication, education, and scaling

7 After operationalization, monitor and maintain the AI product and work environment

8 Update or decommission the AI product and work environment

Define categories of measures

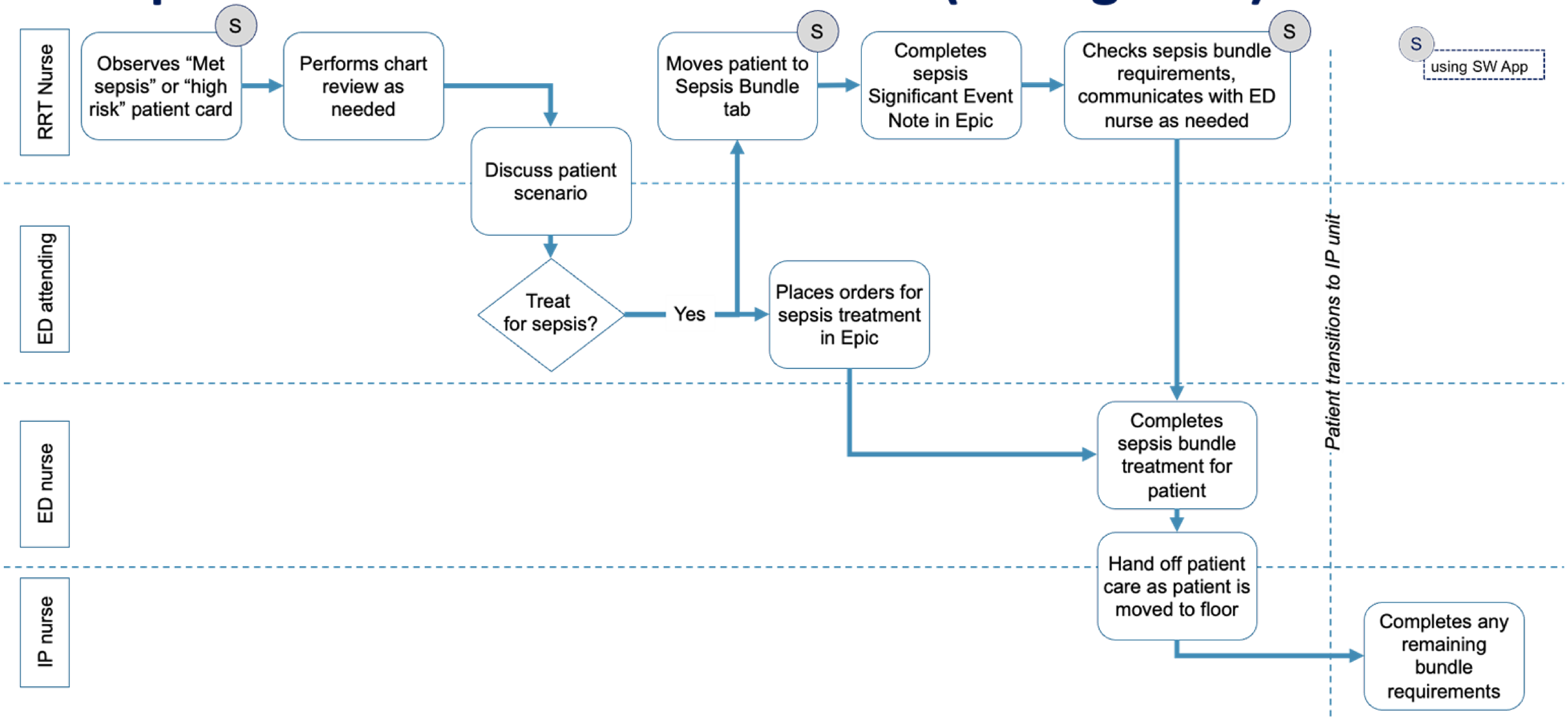
Category	Definition	Example Metrics
Model performance	**Effectiveness, accuracy, and reliability of the AI model** or algorithm in fulfilling its intended tasks within the clinical or healthcare context.	Sensitivity (recall, true positive rate), Specificity (true negative rate), Area Under the ROC Curve (AUC-ROC), F1 Score, Precision (positive predictive value).
Software performance	**Efficiency and responsiveness of processing tasks**, delivering results, and overall performance of the software components and its interactions.	Inference time, throughput, model latency, response time, resource utilization, scalability.
Clinical effectiveness	Assessment of impact of product use on healthcare outcomes.	**Mortality rate, intensive care unit requirement, complication rate**
Usability	**Quality of users' interactions with the AI-based medical software.**	Clinician satisfaction, user error rates, ease of use.
Safety and security	Safe and secure operating software, evaluating harm to patients and protection against unauthorized access, data breaches, and cyber threats.	Number of identified safety risks and mitigations, adherence to cybersecurity standards, detection of adversarial attacks, incident response time.
Business	Business objectives and outcomes	**Reduction in diagnostic time, cost savings.**

Decision point 4

Problem Identification and Procurement	Development and Adaptation	Clinical Integration	Lifecycle Management
1 Identify and prioritize a problem	3 Develop measures of outcomes and success of the AI product	6 Execute AI product roll out, workflow integration, communication, education, and scaling	7 After operationalization, monitor and maintain the AI product and work environment
2 Identify requirements for an AI product as a viable component of the solution	4 **Design a new optimal workflow to facilitate integration**		8 Update or decommission the AI product and work environment
	5 Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use		

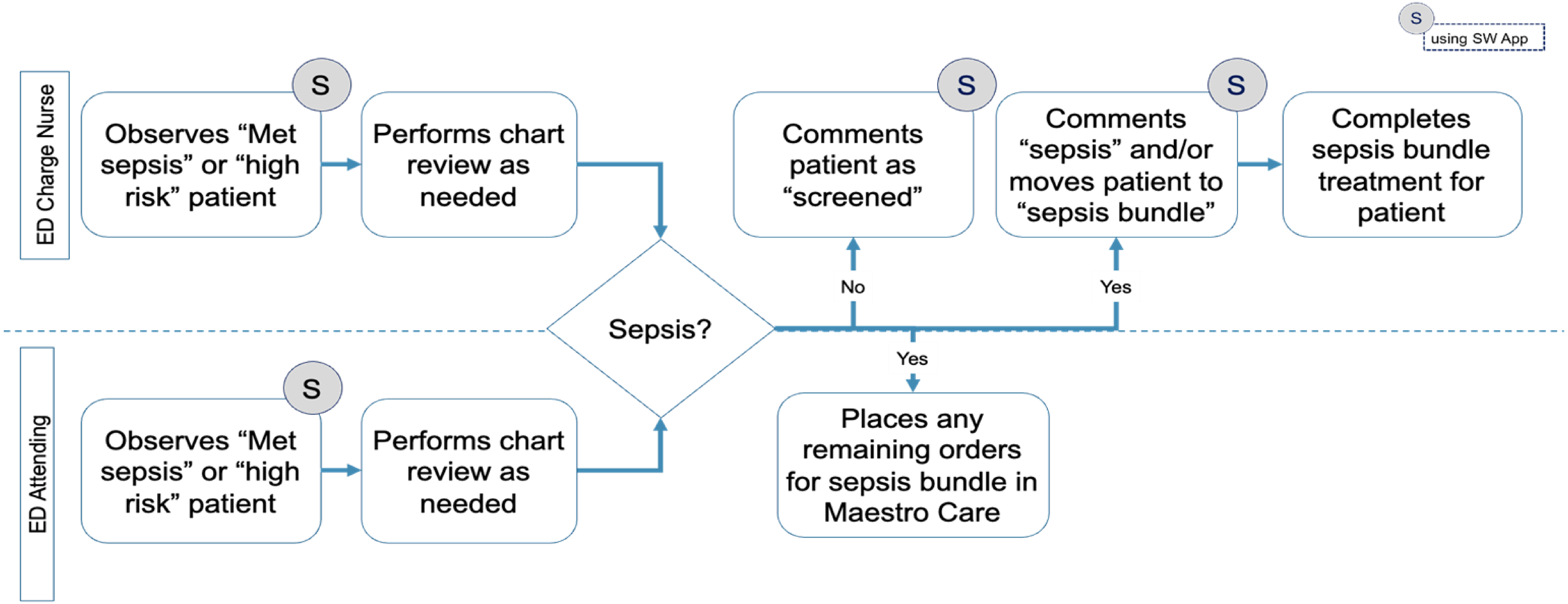
Adapt workflows, roles, and organization to solve problems: Don’t rely on existing workflows

Sepsis Watch ED Workflow at DUH (2018 go live)



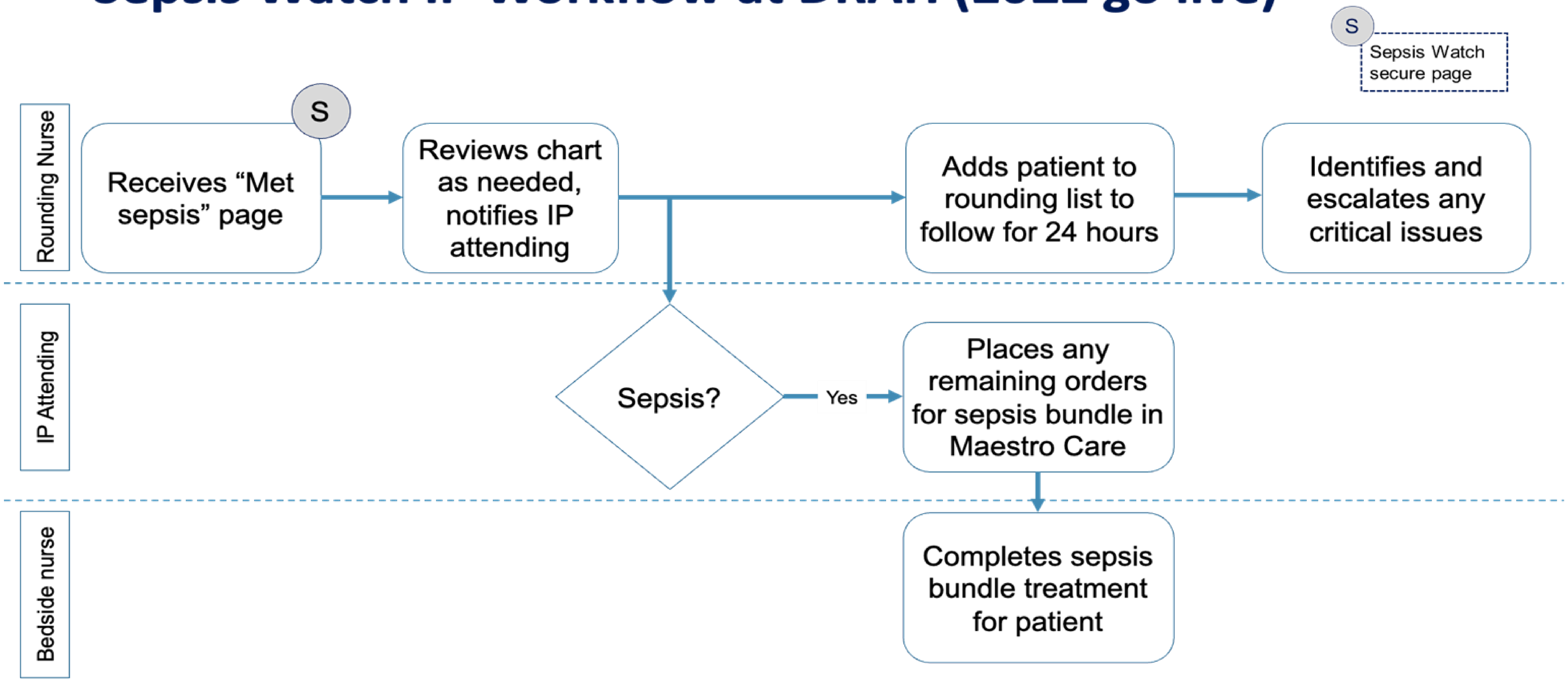
Adapt workflows, roles, and organization to solve problems: Don't rely on existing workflows

Sepsis Watch ED Workflow at DRAH (2019 go live)



Adapt workflows, roles, and organization to solve problems: Don't rely on existing workflows

Sepsis Watch IP Workflow at DRAH (2022 go live)



Decision point 5

Problem Identification and Procurement	Development and Adaptation	Clinical Integration	Lifecycle Management
1 Identify and prioritize a problem	3 Develop measures of outcomes and success of the AI product	6 Execute AI product roll out, workflow integration, communication, education, and scaling	7 After operationalization, monitor and maintain the AI product and work environment
2 Identify requirements for an AI product as a viable component of the solution	4 Design a new optimal workflow to facilitate integration		8 Update or decommission the AI product and work environment
	5 **Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use**		

Identify label leakage during a silent trial

Pediatric sepsis prediction

- Outcome definition: Blood Culture ∩ Antibiotics for 4 days ∩ Acute organ dysfunction
- LSTM with 6-hour prediction window and 3-hour snooze
- Retrospective training set:
  - 17,491 unique encounters for children between 30 days old and 18 years old
  - Between November 1, 2016 – December 31, 2020
- Temporal validation set:
  - 6,545 unique encounters for children between 30 days old and 18 years old
  - Between January 1, 2021 – June 30, 2022

Identify label leakage during a silent trial

Silent Trial Design

A custom-built database extracted real-time patient data from EPIC every 15 minutes. → The model calculated risk scores for all current encounters in the hospital. → High risk notifications were sent to an internal HIPAA-compliant message channel. → Alarm volumes were tracked and technical issues were resolved.

	AUROC	AUPRC	PPV at 20% sensitivity (with 3hr snooze)	PPV at 50% sensitivity (with 3hr snooze)
Retrospective test set	0.816	0.483	0.769	0.612
Temporal validation	0.862	0.386	0.851	0.611

Identify label leakage during a silent trial

Silent trial results

- Model ran on 1,475 unique encounters over 2 months
- Model generated 30 alarms per day >> 2 alarms per day expected
- The model fired an alarm on almost all patients in the ED within the first hour of arrival

Identify label leakage during a silent trial

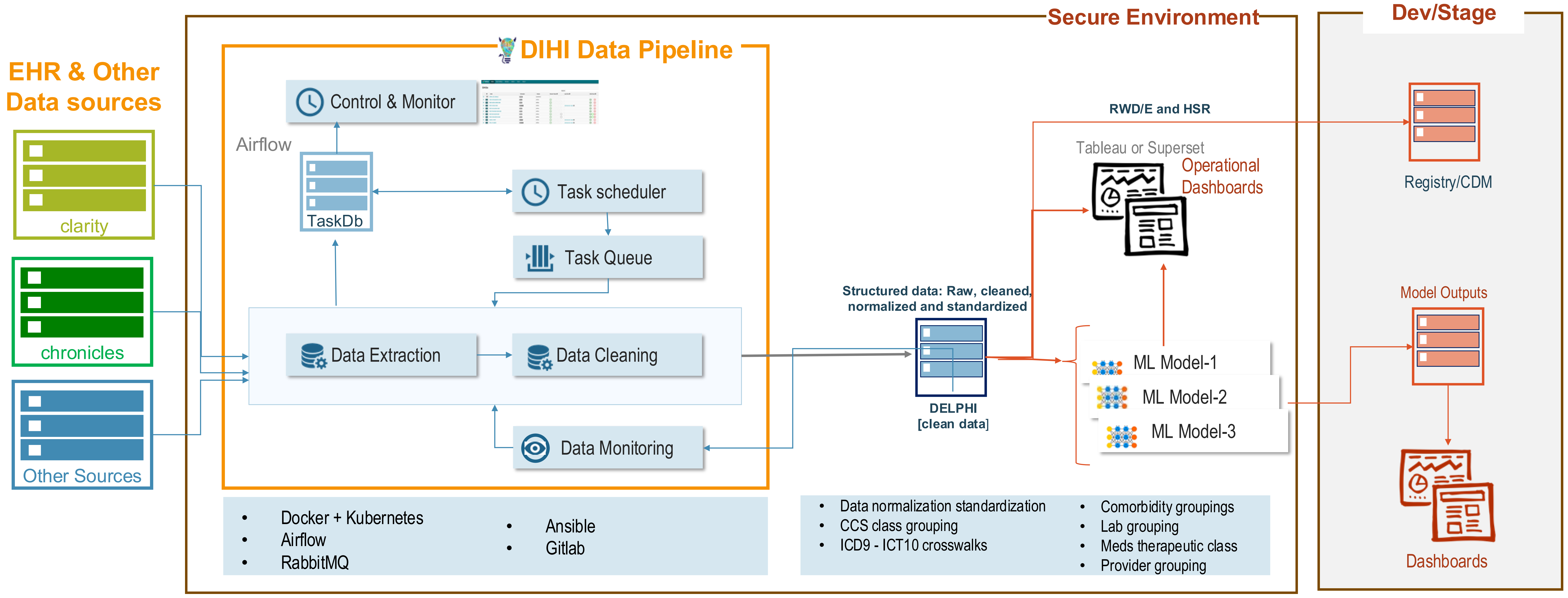
Retrained LSTM without layer normalization using the same hyperparameters

	AUROC	AUPRC
Retrospective test set (with layer normalization)	0.816	0.483
Temporal validation (with layer normalization)	0.862	0.386
Retrospective test set (without layer normalization)	0.782	0.01

Decision point 6

Problem Identification and Procurement	Development and Adaptation	Clinical Integration	Lifecycle Management
1 Identify and prioritize a problem	3 Develop measures of outcomes and success of the AI product	6 **Execute AI product roll out, workflow integration, communication, education, and scaling**	7 After operationalization, monitor and maintain the AI product and work environment
2 Identify requirements for an AI product as a viable component of the solution	4 Design a new optimal workflow to facilitate integration		8 Update or decommission the AI product and work environment
	5 Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use		

Build modular infrastructure to support many projects: Flexible data pipeline technology infrastructure



Create model facts labels and share with end users and affected stakeholders

DIHI "Model Facts" Labels

Purpose: To collate relevant, actionable information about AI tools to inform clinical end-users

Compliance with HTI-1 Final Rule: Mandates that health IT developers disclose algorithm information to purchasers

Sendak, M.P., Gao, M., Brajer, N. et al. Presenting machine learning model information to clinical end users with model facts labels. npj Digit. Med. 3, 41 (2020). https://doi.org/10.1038/s41746-020-0253-3

Model Facts **Model name:** Deep Sepsis **Locale:** Duke University Hospital

Approval Date: 09/22/2019 **Last Update:** 01/13/2020 **Version:** 1.0

Summary

This model uses EHR input data collected from a patient's current inpatient encounter to estimate the probability that the patient will meet sepsis criteria within the next 4 hours. It was developed in 2016-2019 by the Duke Institute for Health Innovation. The model was licensed to Cohere Med in July 2019.

Mechanism

- **Outcome** .... sepsis within the next 4 hours, see outcome definition in "Other Information"
- **Output** .... 0% - 100% probability of sepsis occurring in the next 4 hours
- **Target population** .... all adult patients >18 y.o. presenting to DUH ED
- **Time of prediction** .... every hour of a patient's encounter
- **Input data source** .... electronic health record (EHR)
- **Input data type** .... demographics, analytes, vitals, medication administrations
- **Training data location and time-period** .... DUH, diagnostic cohort, 10/2014 – 12/2015
- **Model type** .... Recurrent Neural Network

Validation and performance

	Prevalence	AUC	PPV @ Sensitivity of 60%	Sensitivity @ PPV of 20%	Cohort Type	Cohort URL / DOI
Local Retrospective	18.9%	0.88	0.14	0.50	Diagnostic	arxiv.org/abs/1708.05894
Local Temporal	6.4%	0.94	0.20	0.66	Diagnostic	jmir.org/preprint/15182
Local Prospective	TBD	TBD	TBD	TBD	TBD	TBD
External	TBD	TBD	TBD	TBD	TBD	TBD
Target Population	6.4%	0.94	0.20	0.66	Diagnostic	jmir.org/preprint/15182

Uses and directions

- **Benefits:** Early identification and prompt treatment of sepsis can improve patient morbidity and mortality.
- **Target population and use case:** Every hour, data is pulled from the EHR to calculate risk of sepsis for every patient at the DUH ED. A rapid response team nurse reviews every high-risk patient with a physician in the ED to confirm whether or not to initiate treatment for sepsis.
- **General use:** This model is intended to be used to by clinicians to identify patients for further assessment for sepsis. The model is not a diagnostic for sepsis and is not meant to guide or drive clinical care. This model is intended to complement other pieces of patient information related to sepsis as well as a physical evaluation to determine the need for sepsis treatment.
- **Appropriate decision support:** The model identifies patient X as at a high risk of sepsis. A rapid response team nurse discusses the patient with the ED physician caring for the patient and they agree the patient does not require treatment for sepsis.
- **Before using this model:** Test the model retrospectively and prospectively on a diagnostic cohort that reflects the target population that the model will be used upon to confirm validity of the model within a local setting.
- **Safety and efficacy evaluation:** Analysis of data from clinical trial (NCT03655626) is underway. Preliminary data shows rapid response team, nurse-driven workflow was effective at improving sepsis treatment bundle compliance.

Warnings

- **Risks:** Even if used appropriately, clinicians using this model can misdiagnose sepsis. Delays in a sepsis diagnosis can lead to morbidity and mortality. Patients who are incorrectly treated for sepsis can be exposed to risks associated with unnecessary antibiotics and intravenous fluids.
- **Inappropriate Settings:** This model was not trained or evaluated on patients receiving care in the ICU. Do not use this model in the ICU setting without further evaluation. This model was trained to identify the first episode of sepsis during an inpatient encounter. Do not use this model after an initial sepsis episode without further evaluation.
- **Clinical Rationale:** The model is not interpretable and does not provide rationale for high risk scores. Clinical end users are expected to place model output in context with other clinical information to make final determination of diagnosis.
- **Inappropriate decision support:** This model may not be accurate outside of the target population, primarily adults in the non-ICU setting. This model is not a diagnostic and is not designed to guide clinical diagnosis and treatment for sepsis.
- **Generalizability:** This model was primarily evaluated within the local setting of Duke University Hospital. Do not use this model in an external setting without further evaluation.
- **Discontinue use if:** Clinical staff raise concerns about utility of the model for the indicated use case or large, systematic changes occur at the data level that necessitates re-training of the model.

Other information:

- **Outcome Definition:** https://doi.org/10.1101/648907
- **Related model:** http://doi.org/10.1001/jama.2016.0288
- **Model development & validation:** arxiv.org/abs/1708.05894
- **Model implementation:** jmir.org/preprint/15182
- **Clinical trial:** clinicaltrials.gov/ct2/show/NCT03655626
- **Clinical impact evaluation:** TBD
- **For inquiries and additional information:** please email mark.sendak@duke.edu

Model Facts

Model name: Deep Sepsis **Locale:** Duke University Hospital

Approval Date: 09/22/2019 **Last Update:** 09/24/2019. **Version:** 1.0

Summary

This model uses EHR input data collected from a patient's current inpatient encounter to estimate the probability that the patient will meet sepsis criteria within the next 4 hours. It was developed in 2016-2019 by the Duke Institute for Health Innovation. The model was licensed to Cohere Med in July 2019.

Mechanism

- **Outcome** ....sepsis within the next 4 hours, see (1) for sepsis criteria
- **Output** ....0% - 100% probability of sepsis occurring in the next 4 hours
- **Patient population** ....all adult patients >18 y.o. presenting to DUH ED and admitted
- **Time of prediction** ....every hour of a patient's encounter
- **Input data source**........electronic health record (EHR)
- **Input data type** ....demographics, analytes, vitals, medication administrations
- **Training data location and time-period** ....DUH, 10/2014 – 12/2015
- **Model type**........ Recurrent Neural Network

Validation and performance

	Prevalence	AUC	PPV @ Sensitivity of 60%	Sensitivity @ PPV of 20%
Local Retrospective	18.9%	0.88	0.14	0.50
Local Temporal	6.4%	0.94	0.20	0.66
Local Prospective	**TBD**	**TBD**	**TBD**	**TBD**
External	**TBD**	**TBD**	**TBD**	**TBD**

Uses and directions

- **Operational use case(s):** Every hour, data is pulled from the EHR to calculate risk of sepsis for every patient at the DUH ED. A rapid response team nurse reviews every high-risk patient with a physician in the ED to confirm whether or not to initiate treatment for sepsis.
- **General use:** This model is intended to be used to by clinicians to identify patients for further assessment for sepsis. The model is not a diagnostic for sepsis and is not meant to guide or drive clinical care. This model is intended to complement other pieces of patient information related to sepsis as well as a physical evaluation to determine the need for sepsis treatment.
- **Examples of appropriate decisions to support:** Patient X has a high risk of sepsis according to the model. A rapid response team nurse discusses the patient with the ED physician caring for the patient and they agree the patient does not require treatment for sepsis.
- **Before using this model:** Test the model retrospectively and prospectively on local data to confirm generalizability of the model to the local setting.
- **Safety and efficacy evaluation:** Analysis of data from clinical trial (NCT03655626) underway. Preliminary data shows rapid response team, nurse-driven workflow was effective at improving sepsis treatment bundle compliance.

Comment | Open Access | Published: 23 March 2020

Presenting machine learning model information to clinical end users with model facts labels

Mark P. Sendak, Michael Gao, Nathan Brajer & Suresh Balu

npj Digital Medicine **3**, Article number: 41 (2020) | Cite this article

Warnings

- **General warnings:** This model was not trained or evaluated on patients receiving care in the ICU. Do not use this model in the ICU setting without further evaluation. This model was trained to identify the first episode of sepsis during an inpatient encounter. During long inpatient stays with multiple sepsis episodes, model accuracy needs to be further evaluated. The model is not interpretable and does not provide rationale for high risk scores. Clinical end users are expected to place model output in context with other clinical information to make final determination of diagnosis.
- **Examples of inappropriate decisions to support:** This model may not be accurate outside of the target population, primarily adults in the non-ICU setting. This model is not a diagnostic and is not designed to guide clinical diagnosis and treatment for sepsis.
- **Discontinue use if:** Clinical staff raise concerns about utility of the model for the indicated use case or large, systematic changes occur at the data level that necessitates re-training of the model.

Other information:

- **Outcome Definition:** https://doi.org/10.1101/648907
- **Related model:** http://doi.org/10.1001/jama.2016.0288
- **Model development & validation:** arxiv.org/abs/1708.05894
- **Model implementation:** jmir.org/preprint/15182
- **Clinical trial:** clinicaltrials.gov/ct2/show/NCT03655626
- **Clinical impact evaluation:** TBD
- **For inquiries and additional information:** please email mark.sendak@duke.edu

DIHI “Model Facts” Labels

Primary audience: Frontline clinicians

- The primary purpose of the model
- How and when to use it
- When not to use it
- How the model performs
- Warnings and limitations (risk communication)

Sendak, M.P., Gao, M., Brajer, N. et al. Presenting machine learning model information to clinical end users with model facts labels. npj Digit. Med. 3, 41 (2020). https://doi.org/10.1038/s41746-020-0253-3

Access the free template!

Decision point 7

Problem Identification and Procurement	Development and Adaptation	Clinical Integration	Lifecycle Management
1 Identify and prioritize a problem	3 Develop measures of outcomes and success of the AI product	6 Execute AI product roll out, workflow integration, communication, education, and scaling	7 **After operationalization, monitor and maintain the AI product and work environment**
2 Identify requirements for an AI product as a viable component of the solution	4 Design a new optimal workflow to facilitate integration		8 Update or decommission the AI product and work environment
	5 Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use		

Monitor AI system at DIHI

Effective monitoring of AI/ML solutions also requires multidisciplinary combination of technical and human capabilities, including expertise in engineering, data analysis, AI/ML, and clinical domain knowledge employed during the solution development phase.

Model Monitoring

- Data quality monitoring
  - Input data accurate, complete, and up-to-date
  - Entity/grouper monitoring
  - Continuous monitoring
- Performance comparison
  - auroc, auprc wrt. training
  - Analysis cadence: M/Q/Y
- Output drift monitoring
  - Data distribution
  - Category distribution

Solution Monitoring

- Outcome monitoring
  - Project specific measures
  - Bi-annual for most solutions
- Workflow changes
  - Observation / documentation
- Usage monitoring
  - UI tools/dashboard usage
  - Secondary data analysis
- User feedback
  - Survey for model & solution usability and refinements

Operations Monitoring

- Alerting & notification
  - Flexible rules-based engine for alerting
  - Used in clinical workflow
  - Email/page/spok/sms etc.
- Technical monitoring
  - Model run times, failures etc.
  - Service level monitoring
- Regulatory & Policy
  - Compliance monitoring for regulation & Duke policies
  - Ethical and legal standards

Decision point 8

Problem Identification and Procurement	Development and Adaptation	Clinical Integration	Lifecycle Management
1 Identify and prioritize a problem	3 Develop measures of outcomes and success of the AI product	6 Execute AI product roll out, workflow integration, communication, education, and scaling	7 After operationalization, monitor and maintain the AI product and work environment
2 Identify requirements for an AI product as a viable component of the solution	4 Design a new optimal workflow to facilitate integration		**8 Update or decommission the AI product and work environment**
	5 Evaluate safety, effectiveness, and equity concerns of the AI product in the intended setting prior to clinical use		

Manage lifecycle of AI after clinical integration

Sepsis Watch post-integration lifecycle management

	Monitoring & Evaluation	Update	Operational Management
Event based	• Debug issues that arise (e.g., data endpoint unexpectedly goes down)	• Customize the UI for different user groups • Train new versions of the model for new clinical settings	• Update user access • Update reporting functionalities to support clinician management
Recurring	• Monitor technical elements of the model and source data in pipeline • Monitor changes that affects work environment and use of model	• Regularly scheduled maintenance (e.g., update groupers every 6 months)	• Conduct bi-annual end user training to ensure baseline knowledge of AI system
Semi-Recurring	• Audit the solution for impact on clinical and operational outcomes and impact on work environment	• Improve the UI (e.g., add comment feature, automatically check boxes) • Scale to different use cases	• Convene governance committee monthly • Secure ongoing funding for AI system use
One-off	• Create channels for end users to report issues and provide user support services	• Create process and criteria to scope responses to user requests	• Determine ownership of model (e.g., clinical lead, technical lead)

Takeaways: HAIP 8 Key Decision Points Framework

Primary audience: Health Delivery Org. Leaders

- Define the pivotal decision points in the AI adoption lifecycle
- Step-by-step guidance documents
- Informed by the community of experts
- Developed to be pragmatic and easily applicable for informed decision-making
- A HAIP Free resource!

Access the free resource here!

Kim JY, Boag W, Gulamali F, Hasan A, Hogg HD, Lifson M, Mulligan D, Patel M, Raji ID, Sehgal A, Shaw K. Organizational Governance of Emerging Technologies: AI Adoption in Healthcare. In Proceedings of the 2023 ACM Conference on Fairness, Accountability, and Transparency 2023 Jun 12 (pp. 1396-1417).

Supporting Safety Net & FQHC AI Readiness through Technical Assistance & Peer Learning

AI Adoption Acceleration Program

Need for Addressing AI Readiness Gap

Capacity Gaps
Many providers lack in-house data/IT teams for AI adoption and governance.

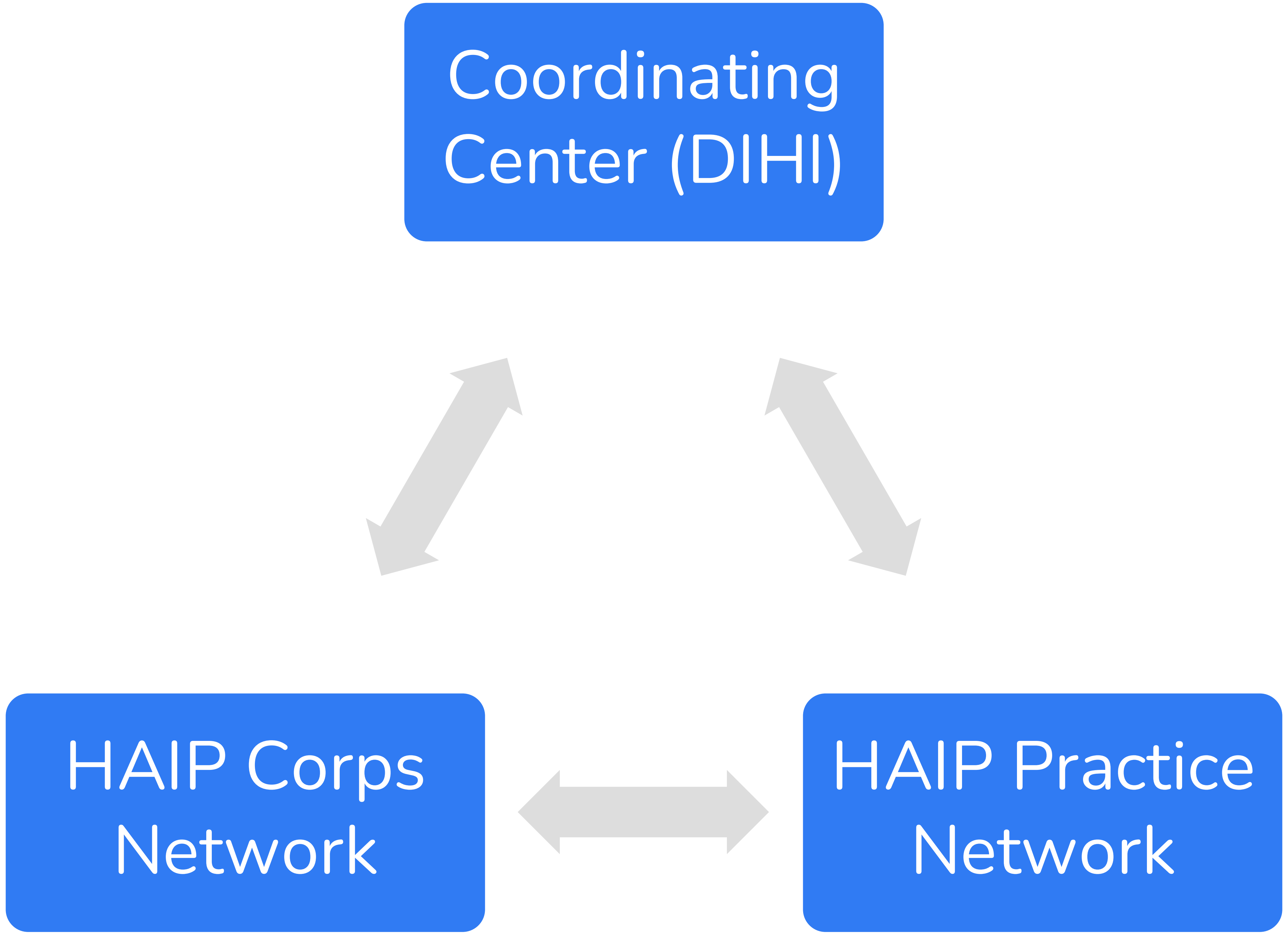
Guidelines ≠ Readiness
National best practices often assume technical capacity that small clinics don't have.

Co-Design with Front-Line Innovators
Local input ensures tools are relevant, effective, and trusted.

Avoiding an AI "Digital Divide"
Without support, AI could deepen disparities between well-resourced and under-resourced systems.

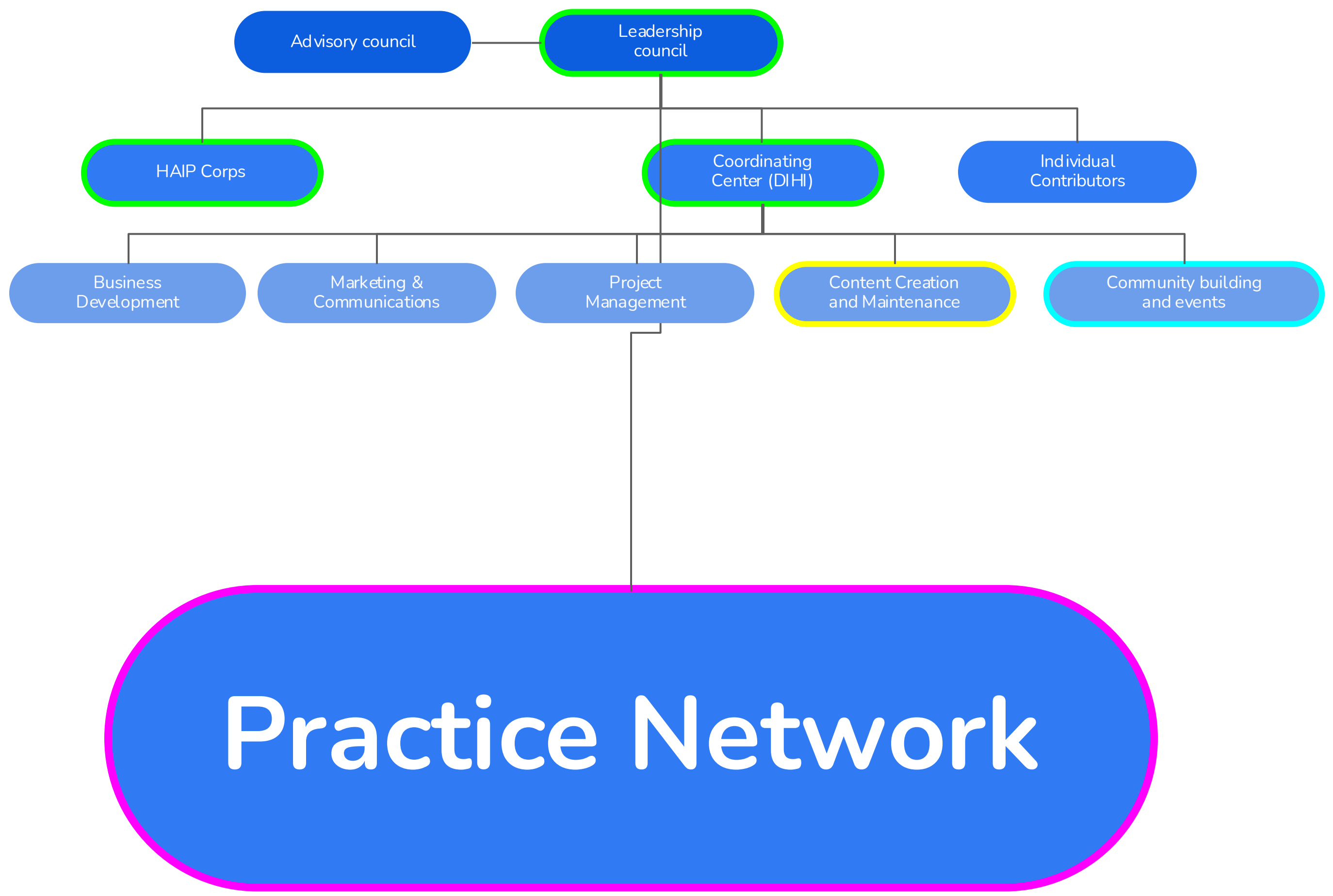
Building Implementation Pathways
Requires infrastructure, training, expert access, and peer learning networks

HAIP Best Practice Exchange



HAIP Practice Network

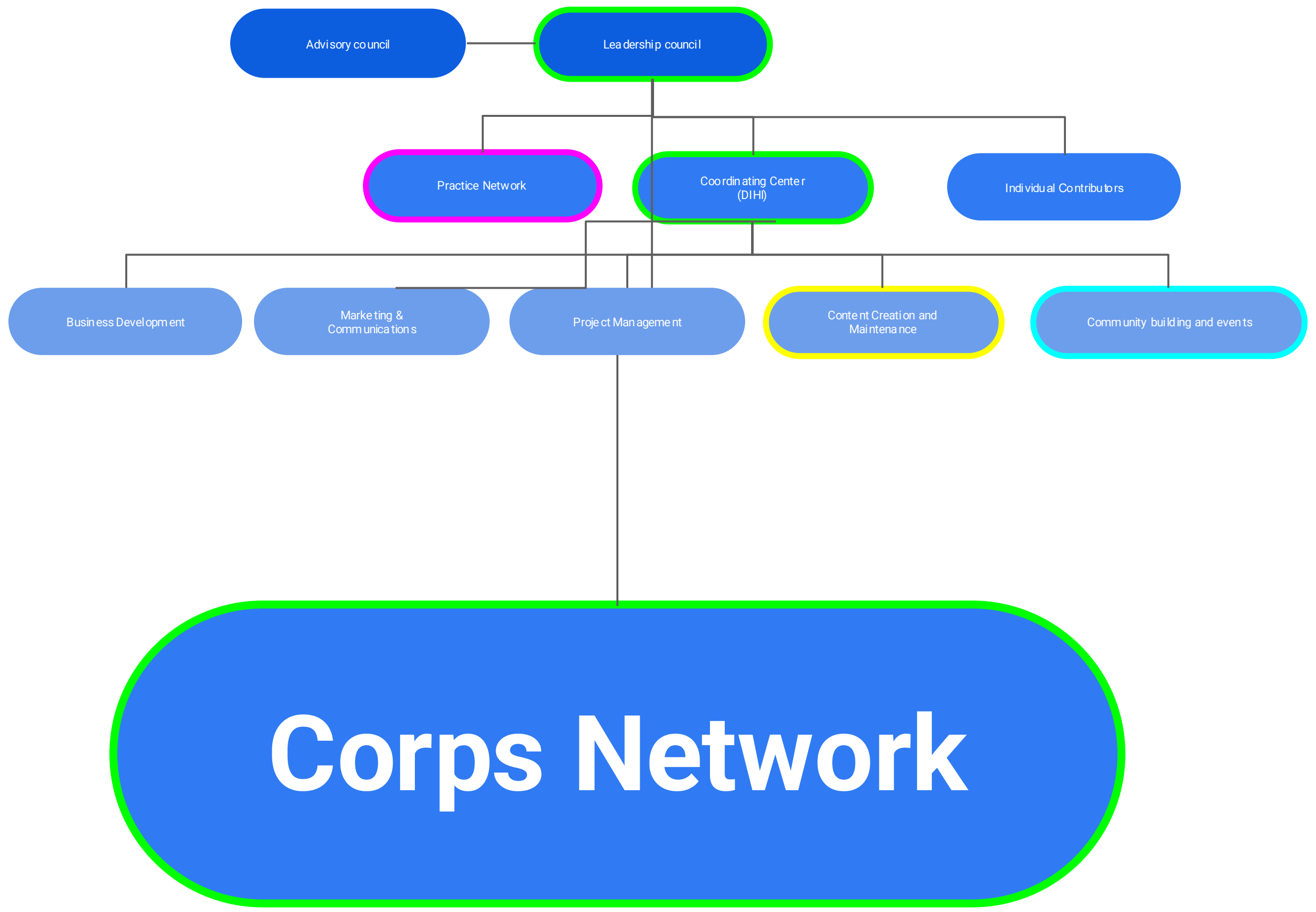
An HAIP AI Adoption Acceleration Program



Healthcare organizations interested in adopting AI solutions through implementing AI best practices in collaboration with the HAIP Corps Network and Coordinating Center

- **Implement best practices** by locally implementing a selected AI solution in the clinical care setting
- **Disseminate knowledge** by sharing the learnings that can improve and update the best practices
- Collective **advocacy for resources** required for scaling responsible AI adoption across settings
- **Promote peer learning** network by gaining experience in AI adoption and helping other institutions via future programs

HAIP Corps Network



Healthcare organizations that are source of AI best practices on lifecycle management and guidance on governance policies

- **Optimize best practices** by sharing the learnings from the implementation of AI systems
- **Disseminate knowledge** by collaborating in content development
- Collective **advocacy for resources** required for scaling responsible AI adoption across settings.

Quick Overview of Practice Network

HAIP Community enrolled 5 healthcare organizations into the Practice Network.

- Organizations interested in implementing an AI solution using HAIP best practices were enrolled to the program.

51

- **Program**: Get access to one-on-one guidance, expert consultation, peer learning community, educational materials, and other resources.
- **Cost**: Free to participate
- **Timeline**: August 2024 - August 2025 (12 months)
- **Application deadline**: June 30, 2024
- **Notification:** ~August 16, 2024

HAIP Practice Network - 2024-25 Cohort

COMMUNITY-UNIVERSITY HEALTH CARE CENTER
UNIVERSITY OF MINNESOTA
Driven to Discover®

Minneapolis, MN
CDS | Epic No-show Algorithm

NORTH COUNTRY HEALTHCARE

Flagstaff, AZ
LLM | Ambient Scribe

SAN YSIDRO HEALTH

San Diego, CA
FDA Approved | Diabetic Retinopathy Screening

HEALTH CENTER OF SOUTHEAST TEXAS
YOUR CARE IN OUR HANDS

Cleveland, TX
LLM | Ambient Scribe

WakeMed

Raleigh, NC
CDS | Epic Sepsis V2

Practice Network Mentor Assignments

Community-University Health Care Center, University of Minnesota, Driven to Discover®	MetroHealth; UCSF University of California San Francisco
Health Center of Southeast Texas – Your Care in Our Hands	SCAN Health Plan; BJC HealthCare; Washington University School of Medicine in St. Louis
San Ysidro Health	Mayo Clinic; PCCI
North Country Healthcare	Kaiser Permanente®; Duke Health
WakeMed	Duke Health; MetroHealth

Practice Network Office Hours

DLA PIPER	Education on regulatory matters, product testing, product liability, and vendor contracts
MAYO CLINIC	Education and support on regulatory matters, AI enablement, governance and Quality Management Systems (QMS)
Community Representative	One-on-one education on questions around community engagement
CCI CENTER FOR CARE INNOVATIONS	Guidance on data governance, digital transformation in SNOs, innovation to promote equity, and prepare to pilot
Epic	Education on the Epic seismometer, an open-source tool for evaluating models and advice of support services offered by Epic for AI tools

Practice Network - Curated Resource Library

Building a common resource library for the AI lifecycle management tools and templates

Resources

This is a collaborative space where we gather useful resources for AI implementation and AI governance. We encourage you to share resources that have been valuable to you or that you believe would benefit others.

Table

Vendor Assessments

Name	Description	URL	File Att.
Health Care Artificial Intelligence Vendor Evaluation Checklist	Developed by the California Telehealth Resource Center, "This checklist provides a set of questions for a health care provider to ask AI tool developers/vendors."	caltrc.org/wp-... ns.pdf	
HAIP Vendor Disclosure Assessment Form	Working draft of a guide from HAIP to enhance transparency and align expectations between healthcare delivery organizations (HDOs) and vendors. Outlines the minimum information we think vendors should disclose (though they may not always disclose this information)		HAIP PN V...

+ New page

Table

Ambient AI Scribes

Name	Description	URL	File At
Elion: AI Ambient Scribes	Curated library of AI scribes, allowing users to easily compare features and prices. Does not include simple dictation tools or virtual/remote scribes here	elion.health/cat ...oducts	
Avia Marketplace	A platform for searching for digital health solutions. This platform was pilot tested by CCI with safety net providers and found to be useful, though some additional modifications are in progress to improve its utility	marketplace.avia health.com/	
(Press release) Cambridge Health Alliance Chooses Abridge to Improve Equitable Care for Multilingual Patient Population	Describes Abridge's partnership with CHA, an academic community health system, and the scribe's language capabilities	abridge.com/pre ...cement	
Ambient Artificial Intelligence Scribes to Alleviate the Burden of Clinical	Study from Kaiser Permanente; suggests AI scribes yield a reduction in time spent on note taking	catalyst.nejm.or g/doi...3.0404	

Practice Network 2024... / Home Page

+13 Share

Clinical and Technical Workflows

Name	Description	URL	File Att...
Real-World Integration of a Sepsis Deep Learning Technology Into Routine Clinical Care: Implementation Study	Creating swimlane diagrams	pmc.ncbi.nlm.nih.gov/art... 91165/	
Design and test workflows fo OPEN clinicians	HAIP guidance from key decision point 4	healthaipartnership.org/gui... icians	

+ New page

Table

Liability

Name	Description	URL	File Att...
Assess legal risks	HAIP guidance on assessing legal risks from KDP 2	healthaipartnership.org/gui...-risks	
Manatt Health: Health AI Policy Tracker	Published quarterly by Manatt Health, this report summarizes laws relevant to the use of AI in healthcare as well as activity at both the federal and state levels	manatt.com/ins ...racker	

+ New page

Table

AI and Data Governance

Name	Description	URL	File Attac...
AI Governance in Healthcare in a Learning Health System: Case Study of a Canadian Hospital System	Describes the capabilities required for establishing a local AI governance system across People, Process, Technology, and Operations domains. Additional details coming in paper pending publication		MLHC 2024...
Scaling Artificial Intelligence Governance Across a Large Healthcare	Overview of UNC Health's approach to AI Governance from their 2024 HIMSS presentation		2025-01-...

Practice Network - Customized Project Plans

Customized project plans and milestone mapping across the 8 Key Decision Points

CUHCC Project Plan and Milestones

I. Identify and prioritize a problem

Problem statement

CUHCC wants to reduce their no-show rates in medical, behavioral health, and dental departments. Depending on the department, the visit type (new vs. return), and other factors, the no-show rate ranges from 15-30%. New patient visits and psychiatric assessments tend to have more no-shows than other visit types. CUHCC's Governing Board identified reducing no-shows as a priority for improving patient access, quality of care, and financial sustainability. When no-shows happen, patients miss out on care or treatment, the opportunity to provide care to other patients is missed, additional strain is placed on the scheduling team, and there is a negative impact on financial sustainability. Many social and environmental risk factors lead to no-shows, including limited access to transportation, lack of child or elder care, and unsupportive employment situations

- Goal: reduce no-show rate (higher for new patients and psych assessments)
- Impacts:
  - Patients miss out on care (both scheduled and not)
  - Strain on scheduling
  - Negative material impacts
- Many social and environmental risk factors for the vulnerable patient population

II. Define AI product scope and intended use

Intended use statement

The AI product will calculate the risk of no-shows for patients with upcoming appointments; it will be a report or tool turned on within the EHR (OCHIN EPIC). The AI product would be initially implemented in the OB department, then scaled up to all of medical and behavioral health, and eventually, dental. Patient Service Representatives (PSRs) will incorporate these scores into new and existing workflows that could include phone calls, text message reminders, warm hand-offs to community health workers or care coordination teams, or conversion to virtual appointments.

CUHCC is considering having a second patient on stand-by for in-person appointments for patients at high risk of no-show. Alternatively, they are considering implementing walk-in appointments and telling high-risk patients with a history of no-shows that they can only have walk-in appointments. CUHCC does have concerns about the long-term impact on patient-physician relationships, its functionality for all subsets of CUHCC patients, and the potential to create equity issues.

- AI product, a part of OCHIN's EPIC, will calculate the risk of a no-show
- Piloted in OB, then medical and behavioral, then dental
- Impacts:
  - PSRs will incorporate notifications into new and existing workflows to reduce rates
  - Could schedule a stand-by patient or make high-risk patients walk-in only

KDP	Timeline	Milestones
Pre-adoption 1: *Understand patient characteristics*	December-January	• **Identify subset of patients to focus efforts** • Build personas of patients who no-show • Interviews with patients who no-show to understand barriers to care/determinants • Interview frontline workers familiar with patients who no-show (e.g, MAs, scheduling, case workers) • Identify which patients are engaged with wraparound services and opportunities for augmentation • Identify department(s) to pilot with
Pre-adoption 2: *Specify intervention population for pilot*	January-February	• **Trial Epic's no-show algorithm** • Evaluate existing data on patients who no-show • Turn on the algorithm with OCHIN • Gather model prediction data • Assess model accuracy (actual to predicted attendance) • **Define all possible interventions (including non-AI)** • Telehealth, comm options other than phone (Whatsapp, etc) • Engaging wrap-around services
KDP 2: *Define AI product scope and intended use*	February-April	• **Identify top required features/capabilities** • Patient population demographics and eligibility (e.g., translation capabilities) • User demographics and eligibility • **Assess feasibility of technical integration** • Conducting retrospective and prospective evals of model performance • Storing data • **Vendor assessments for solution components (obtain quotes and product/service information)** • Key AI vendor metrics to assess: budget, additional services, customizations • Other vendors: transportation, communications, home visits, mobile healthcare, etc. • **Trial AI products** • **Outline the procurement process and considerations for contracting** • Secondary data use and use for training models • How long is data stored
KDP 3: *Develop success measures*	February-March	• **Define key adoption metrics (satisfaction, operation, outcome), including model performance metrics and indicators of successful use** • Obtain historical data for metrics • Set targets for each metric at appropriate time intervals
KDP 4: *Design AI solution workflow*	March-April	• **Create detailed technical and clinical workflow maps for validation** • See https://pmc.ncbi.nlm.nih.gov/articles/PMC7391165/ • **Identify changes to be made to existing workflows** • Privacy and security concerns • Additional requirements for independence from EHR • Consent and disclosure processes
KDP 5: *Generate evidence of safety, efficacy, and effectiveness*	May-August	• **Outline the pilot study** • Train pilot end users • **Establish a governance committee** • **Outline product rollout strategy** • Start developing preliminary educational and training resources for end users

Challenges/Opportunities

Foundational Capacity Gaps

Need: Tools for vendor assessment, patient disclosure, and capabilities for monitoring, maintenance
Opportunity: Local hub-and-spoke models to share resources and guidance

Limited Specialized Expertise

Need: Access to legal, ethical, and technical experts
Opportunity: Partner with ecosystem players via networks like HAIP

AI Governance Systems

Need: Clear structures for oversight and accountability
Opportunity: Scale existing data governance and compliance processes; share best practices

Resource Constraints

Need: Sustainable financial and technical support
Opportunity: Advocate collectively for public and philanthropic funding

Impact of HAIP

“The **tools and resources have been instrumental** in building our own core framework and structure for evaluating AI and its use in our system. This work has really **helped us begin the process of governance around AI.”**

“It's been nice to have other individuals in the space to exchange ideas with and understand where their organizations are in the AI life cycle. **Seeing what other groups are focusing on gives us a sense of where the high value applications are**. We have been put in contact with experts who have experience with specific use cases we are interested in and used the learnings from meetups and presentations to guide our next steps”

Q: What is Unique about HAIP ?
“It is a wonderful community that is well-led.”

“Inclusion of safety net healthcare centers”

“Commitment to low-resourced institutions”

“Collectively these **resources** have **helped us improve** our data and clinical decision support governance. **Our team has more confidence too**.”

“Each [HAIP] check-in yields a **tremendous amount of useful** information concerning industry trends and regulatory change.”

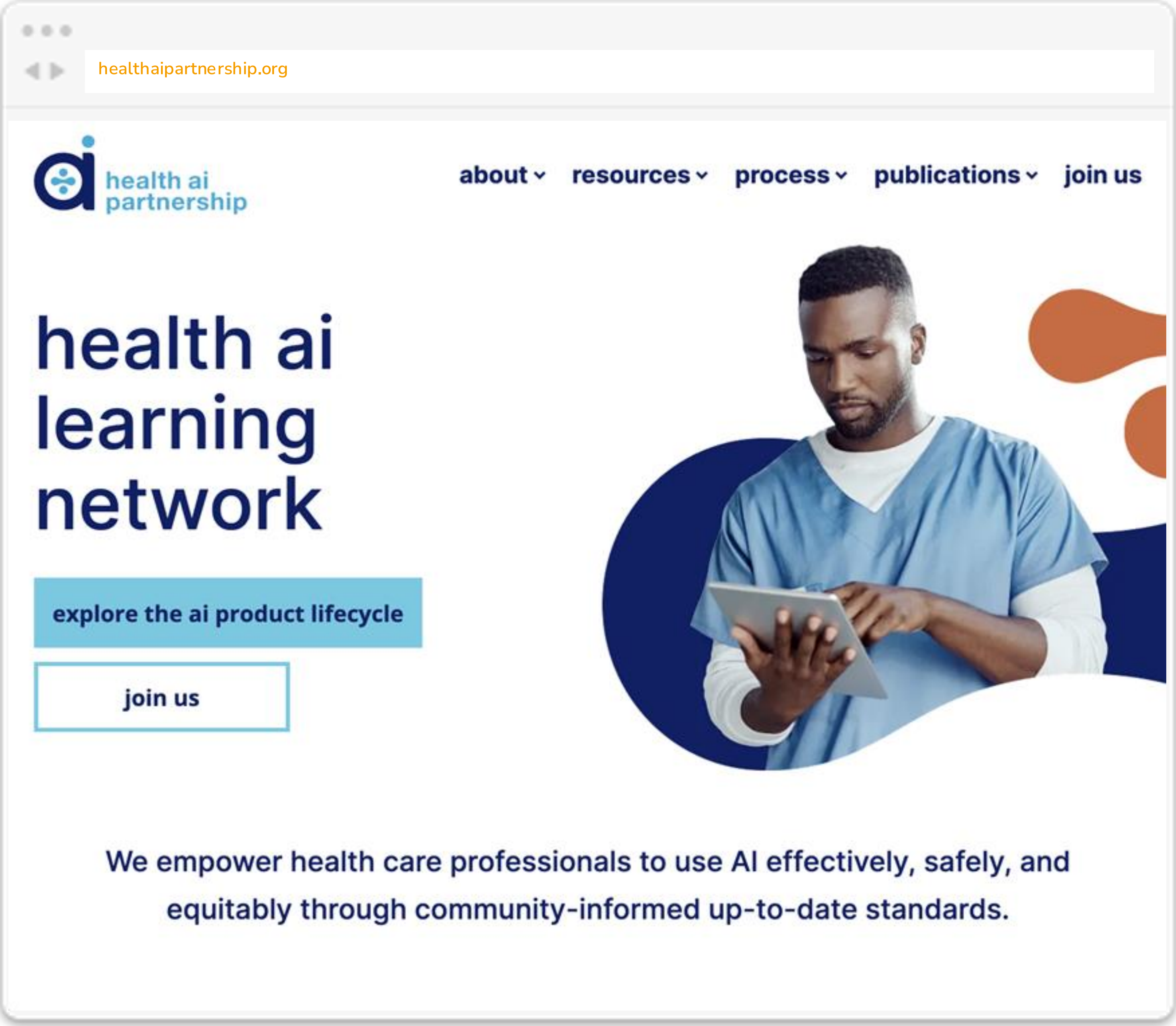
Takeaways and Future Direction

- **Many Health Systems Need Support for Safe AI Adoption**
  We need to build local capacity for implementation and governance.

- **Collaboration Drives Impact**
  Networks that co-create and share tools, templates, and governance guides accelerate responsible use of AI across healthcare.

- **HAIP Practice Network**
  Empowers safety net providers, like FQHCs and public hospitals, with tailored technical assistance for responsible AI deployment.

- **Scaling of Responsible AI Adoption Acceleration Programs is Essential**
  To address demand, bridge capability gaps, and ensure equitable access to AI benefits across all health systems.



Engage with Us!

- Join our community of practice @https://healthaipartnership.org/
- Collaborate to organize state-level iterations of AI Adoption Acceleration Programs
- Engage in educational events @ https://healthaipartnership.org

Thank You!

Suresh Balu, MS, MBA

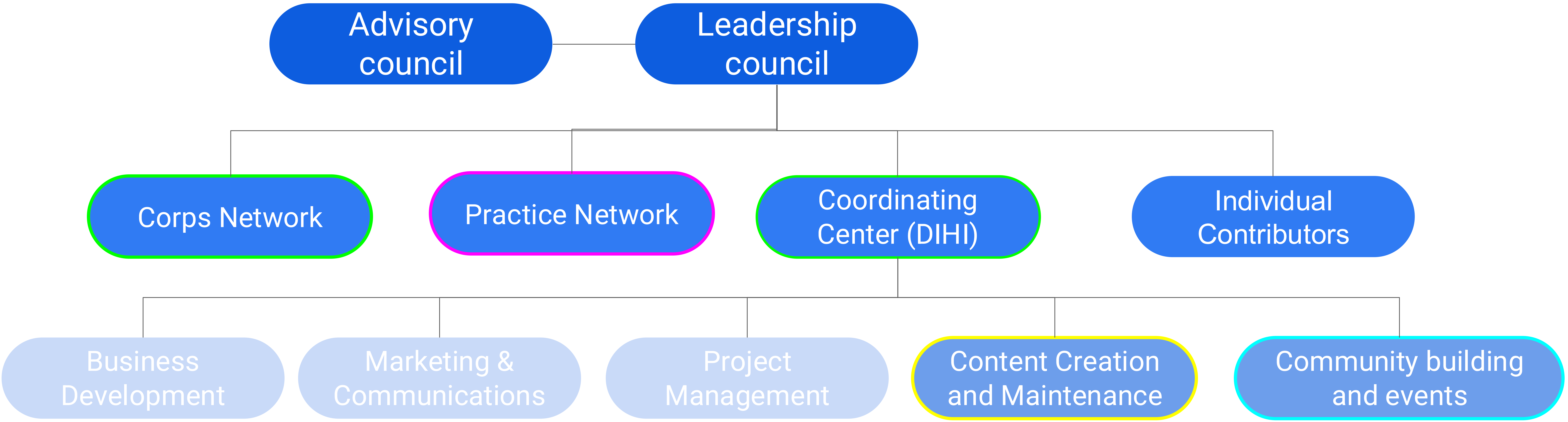
suresh.balu@duke.edu

Alifia Hasan, B Pharm, MBA

alifia.hasan@duke.edu

@alifia-hasan/

Structure of HAIP



Thank You!

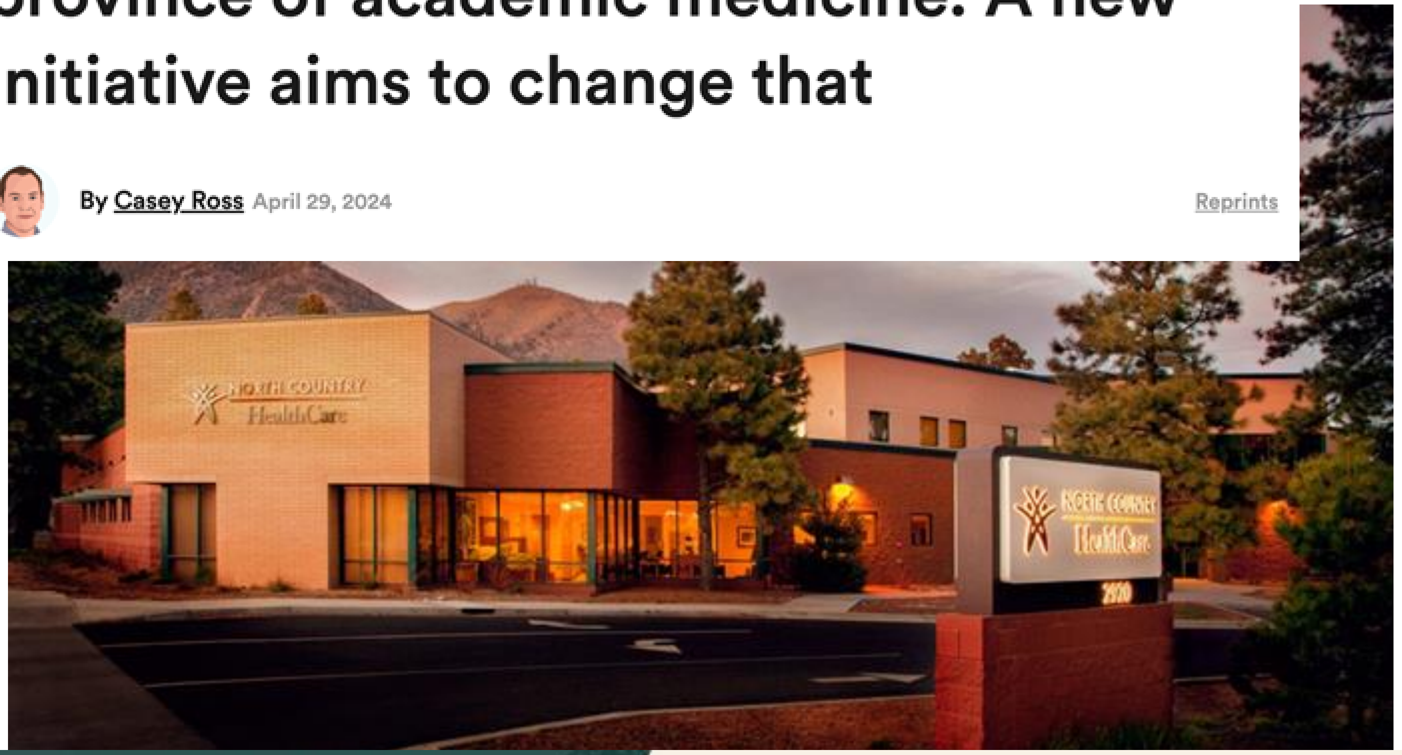
HEALTH TECH

STAT+

AI is becoming the exclusive province of academic medicine. A new initiative aims to change that

By Casey Ross April 29, 2024

Reprints



'I wish we could be more optimistic': A look at AI implementation at an Arizona FQHC

By Emma Beavins · Apr 11, 2025 3:00pm

Artificial Intelligence | Rural Healthcare | staffing | infrastructure

SPECIAL REPORT

A research team airs the messy truth about AI in medicine — and gives hospitals a guide to fix it

FIRST OPINION

Oversight of health AI must be democratic, not done by the big tech companies

By Julie Yoo June 17, 2024

Reprints

UNITED STATES SENATE
COMMITTEE ON FINANCE

ABOUT HEARINGS LEGISLATION NEWSROOM NOMINATIONS LIBRARY

HOME / HEARINGS

Full Committee Hearing

Artificial Intelligence and Health Care: Promise and Pitfalls

Date: Thursday, February 8, 2024
Time: 10:00 AM
Location: 215 Dirksen Senate Office Building

Healthcare IT News

TOPIC

AI & ML Intelligence Global Edition

Can government and industry solve racial bias in AI?

Leaders at ONC's annual meeting were asked whether they're confident that federal agencies and the private sector can work together to foster innovation while protecting against bias and safety risks. Here's what they had to say.

By Andrea Fox | December 20, 2023 | 11:02 AM