Stanford
MEDICINE

From Code to Bedside:

Implementing Artificial Intelligence Using Quality Improvement Methods

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HEA3RT
Stanford Healthcare AI Applied Research Team

Outline

- Introduction to Stanford Healthcare-AI Applied Research Team (HEA_3RT)
- Overview of artificial intelligence (AI)
- Quality improvement and AI
- Example HEA_3RT project
- Q & A

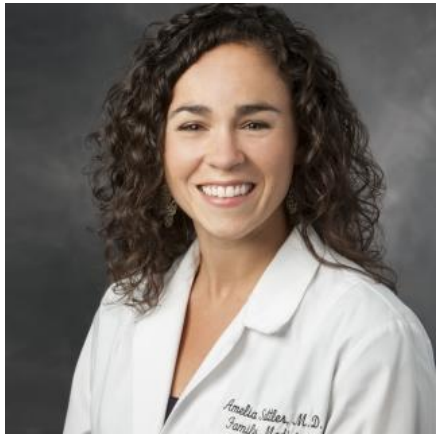
HEA$_3$RT

Stanford Healthcare AI Applied Research Team

Team Members

Dr. Steven Lin
Executive Medical Director

Margaret Smith, MBA
Director of Operations



Dr. Amelia Sattler
Associate Medical Director

Grace Hong, BA
Research Assistant

HEA$_3$RT
Stanford Healthcare AI Applied Research Team

Mission

To bring leading edge AI technologies from “code to bedside” in support of the Quadruple Aim.

How:

- Our work covers a broad range of aims centered on the development and integration of artificial intelligence technologies that solve important, practical problems for patients, providers and health systems.
- We work with clinical, operational, and technical teams to advance the development of clinically relevant models, leveraging quality improvement, implementation science, design thinking, and traditional research methods.

http://med.stanford.edu/healthcare-ai

What is the difference between AI and machine learning?

Artificial Intelligence

Any technique that enables computers to **mimic human intelligence**. It includes *machine learning.*

Machine Learning

A subset of AI that includes techniques that enable machines to **improve at tasks** with experience. It includes *deep learning.*

Deep Learning

A subset of machine learning based on neural networks that permit a machine to **train itself to perform a task**.

Our Projects

Falls Prediction

Clinical Deterioration

Remote Patient Monitoring and Risk Stratification

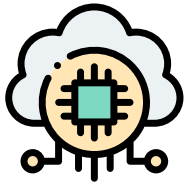
Care Planning

Mortality Prediction

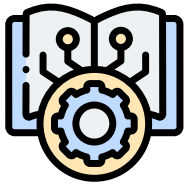
Computer Vision
Depression Screening

Dermatology

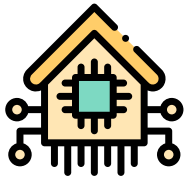
Why all the hype now?



1. More data and computing power available



2. Learning algorithms enable the creation of more accurate models

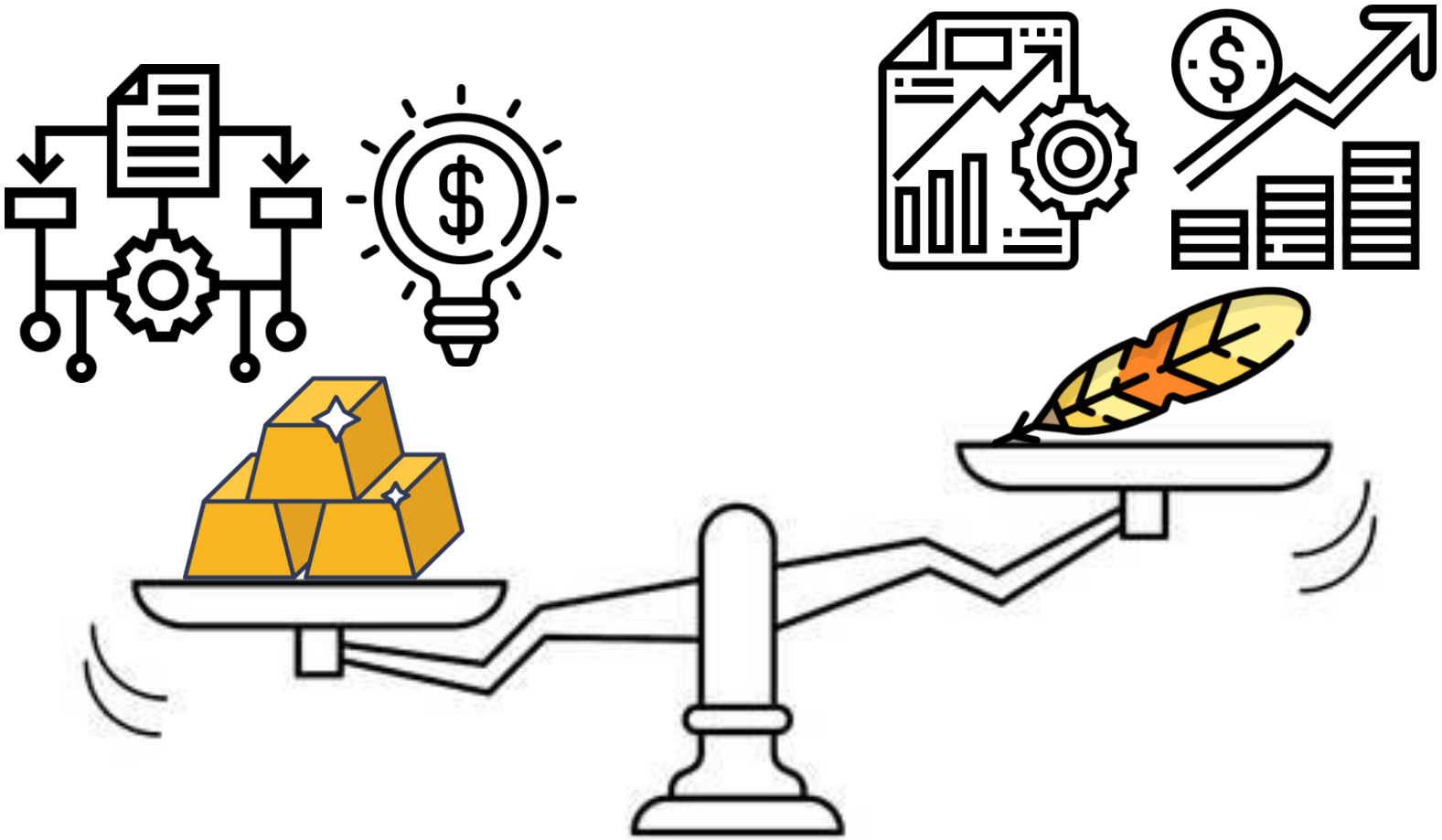


3. Hospitals and clinics more “wired” and capable of using advanced analytics in real time

Then, why are we not seeing the impact?

Funding and scholarly products focus on **algorithm development**

Implementation research and **revenue generation** are lacking



Paradigm Shift

From…

Ok, I have a machine learning **model**…now what?

To…

Ok, I have this **problem** I need to solve…how could machine learning enable the solution?

(1) Starting with a Problem

What:

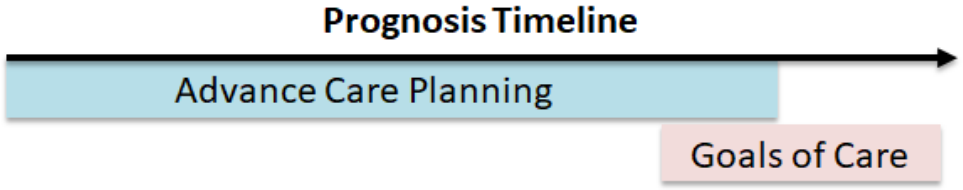
- Define the problem and why it is important to patients, providers, or health systems
- Ensure a clear link with organizational priorities and constructs

Why:

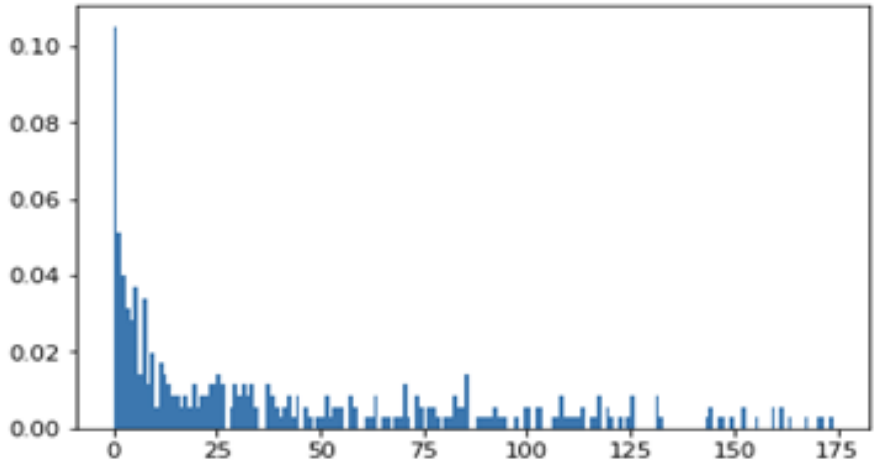
- Clarifies the potential use case for AI capabilities from the beginning
- Ensures organizational resourcing and support throughout development and implementation

Project Example

Advance care planning conversations occur infrequently and are initiated too late for patients with terminal illnesses, which contributes to end of life care that is not concordant with patient goals, moral distress for providers, and ineffective and inefficient utilization of health system resources.



Incidence of Goals of Care Conversations stratified by days prior to death



(2) Assembling the Team

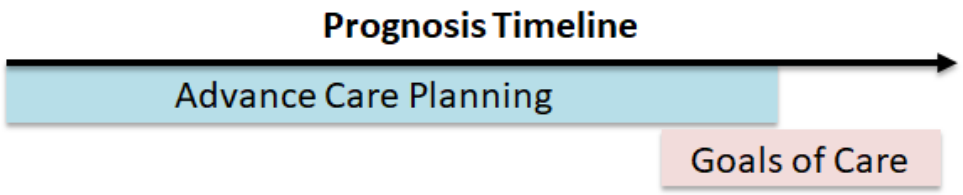
What:

- Identify sponsors, project manager, process owners, end users, and relevant subject matter experts
- Determine accountability vs. responsibility for project success

Why:

- The team should represent the technical and operational perspectives from the beginning – including sponsorship and project team composition
- Accountability (i.e. "yes-no" authority and veto power) should reside within operations

Project Example



Process Owners:
Physicians (4)
Nurses (2)
Social Workers (1)
Therapy (1)

Sponsorship:
Palliative (1)
Physician (2)
Informatics (2)

Subject Matter Experts:
Palliative (3)
Quality Improvement (1)

Technical Team Members:
MD informaticist (1)
Data Scientist (2)

(3) Analyzing Current System

What:

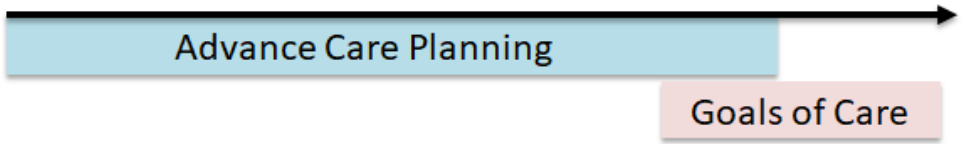
- Observe and map out the current processes, identify issues, and analyze and prioritize root causes
- Leverage implementation science and human factors engineering frameworks
- Articulate key features for success from list of prioritized root causes

Why:

- Assists in determining when and how an AI technology might be helpful in solving the problem
- Brings into focus the possible use cases for AI for various end users
- Broadens the possibilities for workflow design and increases the likelihood of a successful AI deployment

Project Example

Prognosis Timeline



Over the course of 2-3 months…

- (1) Conducted 15+ SSI interviews with front line staff
- (2) Mapped the current process, (3) identified root causes, and (4) prioritized theses issues by impact and frequency

KEY DRIVERS DERIVED FROM ROOT CAUSES:

- Shared mental model of prognosis and advance care planning
- Continuity with outpatient primary care providers
- Providers and have tools and skills to feel confident to ACP with patients/families
- Consistent identification and prioritization of patients that need ACP
- Ability to easily share ACP updates/info to and from any member of the team
- Decentralization of responsibility to have iterative ACP conversations

(4) Assessing the Utility of an AI-enabled Solution

What:

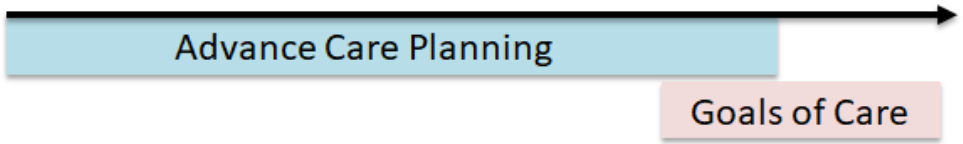
- Determine if AI could address any of the key features for success derived from the last phase
- Consider the following costs:
  - Time and cost to build the model
  - Capacity in the current system to act on the model output

Why:

- Identifies when AI is needed vs. situations where a non-AI solution is superior
- Encourages stewardship of technical resources
- Mitigates downstream surprises related to cost and feasibility

Project Example

Prognosis Timeline



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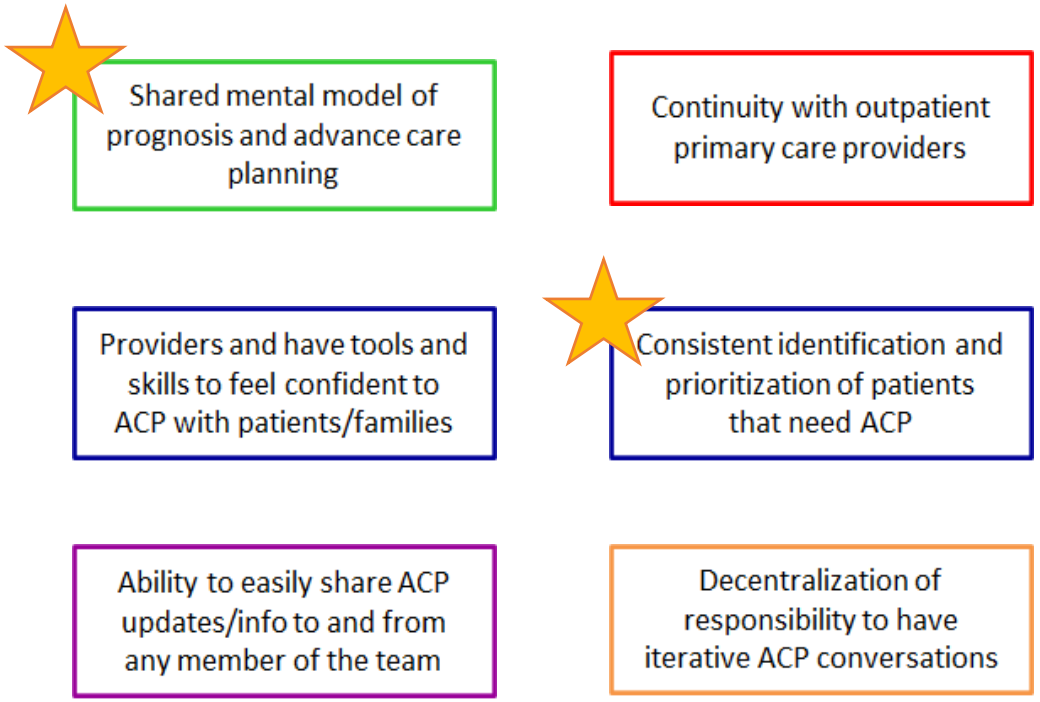


(5) Developing Clinical Integration Workflow(s)

What:

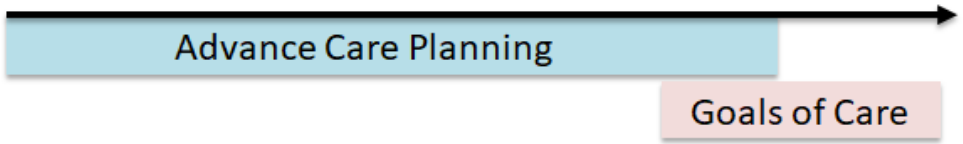
- Conduct future state process mapping sessions leveraging design thinking methods such as applying lenses and extremes to stimulate creativity
- Develop prototypes, and conduct body storming sessions using real scenarios in a simulated environment

Why:

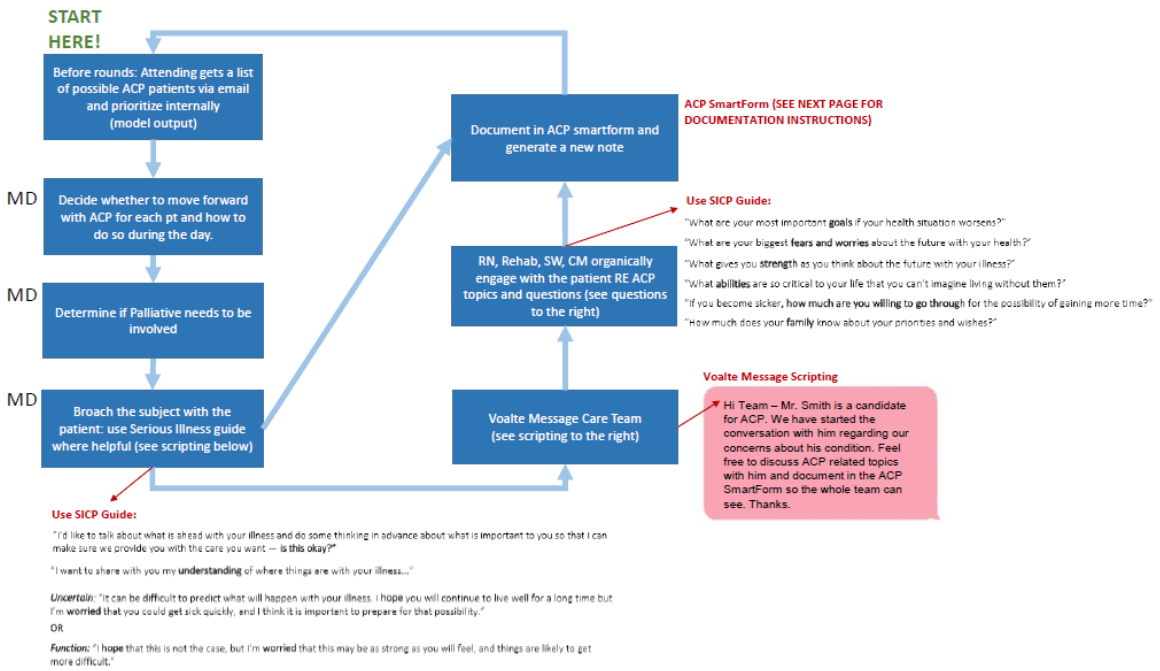
- Ensures clinical integration workflow design and AI delivery design that balance feasibility, acceptability, efficiency and effectiveness
- Design simulations allow for rapid testing of clinical integration workflows and AI model acceptability

Project Example

Prognosis Timeline



1st DRAFT OF THE CLINICAL INTEGRATION WORKFLOW:



(5) Plan, Do, Study, Adjust

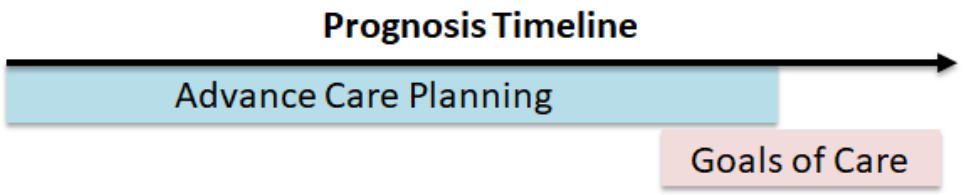
What:

- Organize and run iterative live clinical tests of the full intervention (model and workflows)
- After sufficient iteration, learning and success, the team can plan more widespread implementation and evaluation

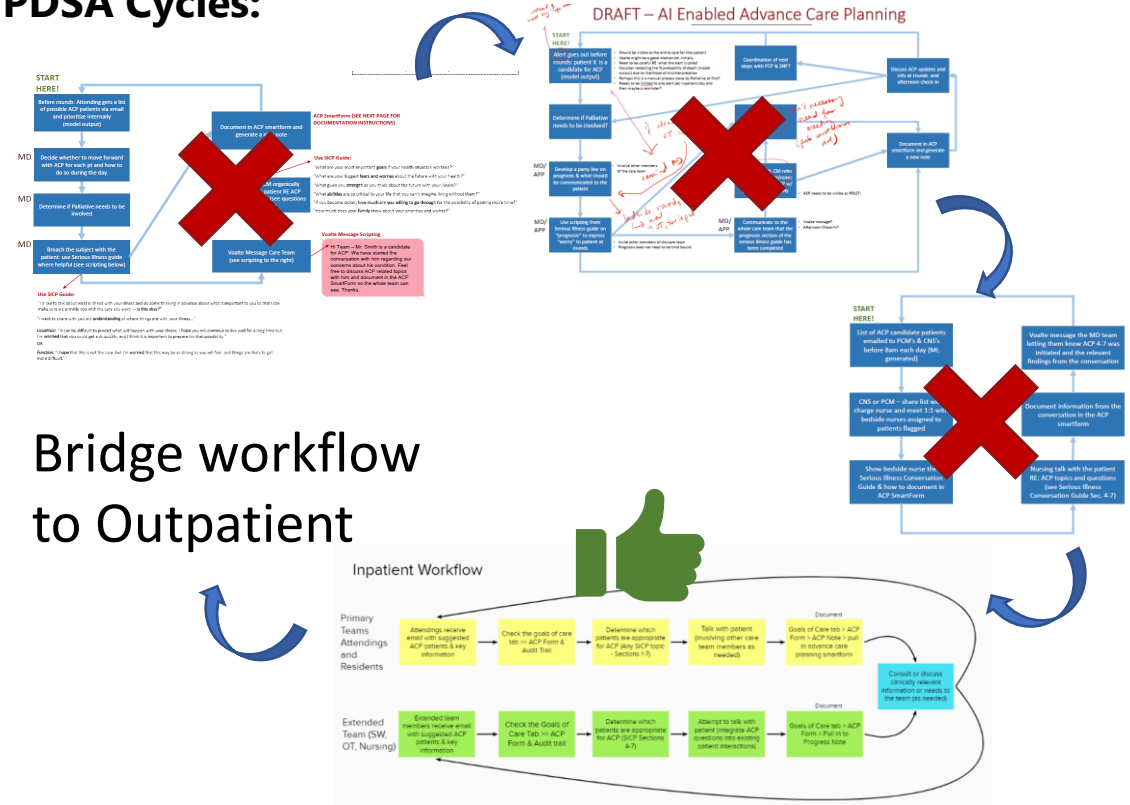
Why:

- Allows the technical and operational teams to observe, assess and adjust the model and workflow in usual clinical practice where variation is rife.
- Use of methods and frameworks, such as the unified theory of acceptance and use of technology (UTAUT) or SIEPS 2.0, enables an iterative data-driven to design of the intervention (model and workflow)

Project Example



PDSA Cycles:



Bridge workflow to Outpatient

What’s next?

(6) Broad Evaluation and Study

- Study Design – Randomization, Pre-Post, etc.

- For an AI implementation project you need to use a mixed methods approach:
  - Qualitative
    - How did the work system change?
  - Quantitative
    - Continued model performance analysis
    - Hard outcomes performance

Other Key Considerations

(3b,4b,5b) Model Validation:

- Model performance is relative
- Ideally occurs in parallel with steps (3) Analyzing the Current System, (4) Assessing the Utility of an AI-enabled Solution, and (5) Developing Clinical Integration Workflows
- Can take between 3-4 months to 2 years

Questions?

Do you know of any examples of how AI has been implemented effectively to solve a problem? Or poorly such that the model is not helpful?

How do we ensure that AI solutions don’t create or exacerbate existing disparities?

QI Scholarship Opportunities

Current program: **QI Scholar funding**

- Funding for quality improvement project
- Submit to Med Scholars and, if declined, submit to Drs. Lisa Shieh, Amelia Sattler and Anu Phadke

Coming soon: **Health Systems Improvement Fellowship**

- Understand landscape of system improvement in primary care
- Interact with clinical and operations leaders
- Conduct a relevant, mentored quality improvement project

THANK YOU

QUESTIONS?

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VISIT OUR WEBSITE!

http://med.stanford.edu/healthcare-ai