Artificial Intelligence (AI) Readiness at UCSF: Current State and Future Directions

Implementation and Evaluation of AI in Real-World Clinical Settings Seminar Series
January 12, 2024
Overview of Seminar Series

- Implementation and Evaluation of AI in Real-World Clinical Settings
- Website: https://ai.ucsf.edu/seminar
- Co-sponsors:
  - Department of Epidemiology and Biostatistics
  - Division of Clinical Informatics and Digital Transformation
  - Bakar Computational Health Sciences Institute
  - UCSF-UC Berkeley Computational Precision Health
  - UCSF K scholars Program
- Upcoming talks:
  - Jan – UCSF Panel on AI Readiness
  - "Feb" – Maryellen Giger, University of Chicago (ML in radiology)
  - March – Nigam Shah, Stanford University (Clinical informatics, LLMs)
  - And more to come!
Sara Murray, MD, MAS

Chief Health AI Officer
Associate CMIO, Inpatient Care
Associate Professor of Clinical Medicine, DoC-IT
Vision for the Use of AI at UCSF Health

*UCSF Health will be the national leader for the use of trustworthy AI at scale to address the most pressing problems in healthcare.*

1. **AI at scale:** Enterprise-wide AI implementations with wide engagement of clinical champions
2. **Ensuring trustworthy AI:**
   - Establish processes to ensure the best possible solutions are selected for problems that truly warrant an AI solution
   - Establish systems for longitudinal AI and impact monitoring
5 Year Horizon of AI at Scale at UCSF Health: High Impact, Increasing Complexity

- E.g. "keyboard liberation," automation to support clinicians working at top of license
- E.g. AI-based consults, clinical decision making
A Brief History of AI in the Health System
Many of the Initial Epic Models Failed to Deliver
A Brief History of AI in the Health System

Very Limited Deployment of research or custom health models
Ex. Vital sign de-escalation, delirium, post-op LOS
Health IT Platform for Advanced Computing (HIPAC)

ETL: Data Extract, Transform, and Load

Prediction Monitoring

Predictions & Feature Statistics

Prediction Service

Model Repository

Model Training

Feature Store

AWS – UCSF-IT, Secure Enterprise Cloud

Epic Hyperspace (Chronicles)

Epic Clarity

Historical

Real-time

Offline

Online
Increasing Focus on AI Fairness in Healthcare

Attorney General Bonta Launches Inquiry into Racial and Ethnic Bias in Healthcare Algorithms

Press Release  /  Attorney General Bonta Launches Inquiry into Racial and Ethn...

Wednesday, August 31, 2022

Contact: (916) 210-6000, agpressoffice@doj.ca.gov

Sends letters to 30 hospital CEOs across the state requesting information regarding the use of commercial healthcare decision-making tools
UCSF Health Adopted the HHS Trustworthy AI Guidelines

Fair / Impartial
AI applications should include checks from internal and external stakeholders to help ensure equitable application across all participants

Robust / Reliable
AI systems should have the ability to learn from humans and other systems and produce accurate and reliable outputs consistent with the original design

Transparent / Explainable
All relevant individuals should understand how their data is being used and how AI systems make decisions; algorithms, attributes, and correlations should be open to inspection

Privacy
Individual, group, or entity privacy should be respected, and their data should not be used beyond its intended and stated use; data used has been approved by the data owner or steward

Responsible / Accountable
Policies should outline governance and who is held responsible for all aspects of the AI solution (e.g., initiation, development, outputs, decommissioning)

Safe / Secure
AI systems should be protected from risks (including Cyber) that may directly or indirectly cause physical and/or digital harm to any individual, group, or entity

TAI principles are not mutually exclusive, and tradeoffs often exist when applying them.

https://www.hhs.gov/sites/default/files/hhs-trustworthy-ai-playbook.pdf
AI Governance Committee for UCSF Health

To guide UCSF in the evaluation and deployment of trustworthy and ethical Artificial Intelligence (AI) and Machine Learning (ML) tools in support of improved care delivery and health system operations, and ensure that all models that touch healthcare delivery are deployed in a responsible fashion

Unified Governance Regardless of AI Origin:
- Health System Development / Partnership
- Research / Academic Community
- Procured from Vendors
AI Governance at UCSF Health

**Discovery**
- Initial Consult
- Tech & Health System Discovery

**Dev and Eval**
- For Health System developed tools
- Model Development & Review
- Retrospective Evaluation

**Integration**
- Epic Integration
- Prospective Evaluation (Silent Study)

**Pilot / RCT**
- UI Development
- User Training
- RCT/Pilot

**Adoption**
- Broader User Training
- Monitoring & Maintenance
Challenges of Effective Governance

- Backlog of embedded AI tools needing review, most were acquired in a decentralized way (divisions, departments)
- Due to extensive time required for review, if we’re going to do this right, the oversight committee warrants increased resourcing (similar to an IRB)
- Expansion of ethical framework as we evaluate generative AI tools
A Paradigm Shift for AI in Healthcare
HIPAC + Versa in the health system

- 3 instances of GPT-4
- designed to support other LLMs
Initial Principles for Selecting Generative AI Tools

- High-impact potential over 1-2 years
- Adds value across many clinical settings
- Lower-risk
  - Generative AI tools remain largely experimental
  - Mistakes should be easily detected and corrected by humans
- Flexible and modifiable in response to feedback
- Measurable Key Performance Indicators
Mark Pletcher, MD MPH
Chair, Dept of Epidemiology and Biostatistics
Director, CTSI Informatics and Research Innovation Program
Need for clinical evaluation

- HIPAC prospective algorithm evaluation is first step
  - Does the AI predict like it should? As well as in retrospective analysis?
  - Does it predict differently for different sets of patients?

- But still need clinical evaluation
  - What happens when you deliver an AI algorithm's results to clinicians?
  - Will it result in benefit or harm? Will clinicians use it? Will it make their lives better? What will happen to costs?

- Evaluation after AI implementation is critical!
CTSI Informatics Program specializes in modifying APeX to improve healthcare delivery
  - APeX-Enabled Research (AER) Program
  - AI Pilots, Learning Health System Demonstration Projects

- We run RCTs of EHR interventions to make sure they are improving outcomes
  - LHS Oversight Committee
  - Unintended consequences are the rule, not the exception
  - Demonstration projects have supported evaluation and A/B testing, and often result in de-implementation
AI can generate amazing predictions and content...but:
- How do you design delivery of that content to clinicians?
- What do you nudge clinicians to do?
- Will clinicians do what the AI recommends?
- Will bias in the algorithm lead to worsening inequities?
My recommendations:

1) Equity-focused approach to AI implementation
   - We cannot get the bias out of the AI.
   - But we can design the way we USE the results of an algorithm to deliberately counteract AI bias

2) Use modeling studies to design for equity
   - Microsimulation modeling of our health system population

3) Use research methods to evaluate impact
   - Define outcomes we care about and measure them over time
   - Interrupted time series analyses
   - Randomized trials
Ida Sim, MD, PhD

Professor of Medicine and Computational Precision Health
Co-Director, UCSF UC Berkeley Joint Program in Computational Precision Health
UCSF Chief Research Informatics Officer
What is Computational Precision Health?

A new discipline at the intersection of machine learning, statistics, medicine, and population health

- Improved Healthcare
  - Diagnostic and therapeutic decision support
  - Tailored patient-facing communications
  - Optimized care processes

- Improved Health
  - Better Prevention
  - Earlier Detection
  - More Effective Interventions and Treatments

- Real-Time Precision Interventions

- Health Data
  - Electronic Health Record
  - Images
  - Notes
  - Sensors
  - Public Health

- Computational Methods
  - Artificial Intelligence
  - Machine Learning
  - Informatics
  - Data Science

- Clinic
- Hospital
- Community
- Population
Why Us?

Together, UCSF and UC Berkeley will create the unequivocal world leader in the development and application of computational methods to improve health.

Unique Bi-Campus Department-Equivalent

Singular entity spanning UCSF and UC Berkeley with one interwoven agenda, building a new interdisciplinary culture

Clinical and population health sciences, clinical care

Computer science, statistics, public health
**UCSF Health | UC Health | Partner care settings**

**UCSF Medical Campuses:**
- Parnassus
- Veterans Affairs
- ZSFGH
- Mt Zion

**Schools:**
- Medicine
- Nursing
- Pharmacy

**Designated Emphasis PhD Students**

**Newly Hired Joint Faculty:**
- Primary appointment in CPH

**Computational Precision Health PhD Students**

**UC Berkeley**

**Departments/Schools:**
- Electrical Engineering & Computer Sciences
- Statistics
- School of Public Health
- Haas School of Business
- School of Information
- Bioengineering (joint with UCSF)

**Designated Emphasis PhD Students**

**56 Total Faculty**
- 28 UCSF
- 24 UC Berkeley
- 4 UCSF/UCB

**3 students / year**
- 6-8 students / year
- 3 students / year

**UCSF**

**3 students / year**

**UC Berkeley**

**4 Primary Faculty**
CPH Innovation to Impact Pipeline
Generative AI at UCSF

UCSF Chief Research Informatics Officer
Ida Sim, MD, PhD

With thanks to Ki Lai, Chief Data Officer
Please use this form to register your interest in using Versa.

Versa is UCSF’s secure generative AI platform. It is now available in limited release featuring a chat user-interface and API gateway.

Please indicate which tool(s) you would like to request access to (you can choose both):

- Versa chat - the web user-interface for chatting with generative-AI tools.
- Versa API - the programmatic access tool for interacting with generative-AI model via API.
Greetings! I'm Versa, how may I assist you today?
Capabilities

✓ Comply with HIPAA
✓ Keep prompts and data within UCSF’s secure enterprise cloud
✓ Support multiple LLM providers, with OpenAI being the first (AWS Bedrock and Google Bard pending): GPT-3.5 Turbo and GPT-4 available, Llama2 pending
✓ Serve all mission areas
✓ Integrate with our enterprise data warehouse
✓ Two products Versa API and Versa Chat to cater to programmers and non-programmers, respectively.
  ✓ RAG Q1 2024
  ✓ Fine-tuning Q2 2024
Same question but different answer because it is in the context of our HR content such as benefits and leave of absence

Answer about pet insurance according to publicly available information

Answer is sourced from the new hire welcome kit, which is loaded into Versa Chat via vectorization
Versa users exploring use cases across themes

**Information Extraction**
- Extracting radiological findings from radiology reports and cancer staging from notes.
- Validating against data that has been annotated through manual chart reviews.
- Identifying adverse drug reactions from clinical notes.

**Knowledge Management**
- Simplifying nursing training materials into short, customized summaries for different job roles and situations.
- Making HR policies and guidelines easily accessible to employees through chat, saving them from long reading sessions.
- Loading verified medical literature into Versa and leveraging the repository as a trusted source for finding new knowledge.

**Writing and Coding Assistance**
- Generating content for research proposals, workshops, and interviews.
- Synthesizing scientific articles, assisting with literature reviews, and helping with presentation outlines and writing.
- Crafting easy-to-understand summaries for various audiences, such as patients, providers, and researchers.
- Providing commands for statistical analyses and assisting with coding tasks.
Coming February 2024!

- **New ai.ucsf.edu**

- **Versa Education Modules**
  - For Versa ChatGPT users:
    - Overview of LLMs
    - Basics of Prompt Engineering
    - Using Versa
  - For Versa API users:
    - Pointers to technical documentation and code
    - Best practices for LLM developers
  - Starting February, Versa users will have to complete SumTotal modules to gain Versa access

- **Active conversations with IRB on guidance**
Develop new AI methods
+ Train and Implement AI algorithms

- Develop new methods and frameworks for assessing and improving the safety, effectiveness, and equity of AI algorithms
- Train, evaluate, and deploy clinical AI algorithms for hospital quality improvement efforts
FDA Approval of AI algorithms


Figure 1: SaMD IMDRF risk categorization
AI algorithms present new methodological challenges

- **Interpretability**: AI algorithms are opaque. How can we know they are doing something reasonable?
- **ML is dynamic**: How can we anticipate the effects that AI algorithms will have on a system and detect potential feedback loops?
- **Fairness**: AI algorithms tend to perform well for the majority group. How can we detect subpopulations that an AI algorithm performs poorly for?
- **Causality**: How can we develop AI algorithms that go beyond learning correlations and can be interpreted causally?
- **Generalizability**: AI algorithms rely on patterns in the data from a given context, in a given time period. How can we check that an AI algorithm will generalize? How can we monitor AI algorithms to determine when they are outdated and need updating?
- **Evaluation for Generative AI**: How can we evaluate the performance of AI algorithms that can perform a wide variety of tasks?
- And more!
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Williamson and Feng, ICML 2020

The Mythos of Model Interpretability

In machine learning, the concept of interpretability is both important and slippery.

ZACHARY C. LIPTON

European Union General Data Protection Regulation (GDPR)
AI algorithms present new methodological challenges

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**Runaway Feedback Loops in Predictive Policing**

**How Algorithmic Confounding in Recommendation Systems Increases Homogeneity and Decreases Utility**

Feng et. al., NeurIPS Regulatable AI Workshop 2023
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Subgroup analysis for clinical trials

- Benefited from treatment
- Harmed by treatment
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Subgroup analysis for clinical trials

Subgroup analysis for ML algorithms

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Building effective AI solutions requires cross-disciplinary collaboration

- **Picking the right clinical problem**: Given the capabilities of ML, what clinical problems can it solve?

- **Extracting, cleaning, and understanding the data**: What limitations exist in the data (e.g. confounding, missing data, measurement error)?

- **Training and selecting a model**: Different ML algorithms make different tradeoffs between accuracy, interpretability, fairness, speed, cost, and more. What are the most appropriate tradeoffs?

- **Model deployment and evaluation**: How can we deploy the model in a way that is transparent, reliable, and accessible to all stakeholders?

- Healthcare providers
- Clinical informaticists
- ML developers
- Statisticians
- Patients
- ...
AI algorithms present new regulatory challenges