Towards Deployment of AI in Healthcare: Clinical Decision Support (CDS) Algorithms

Dr. Scott Hammond
Strategic Director Outlier Initiative/Smarter Health
UCSF CDHI Expert in Residence
Who is CDHI?

**UC System**: 430,000 Jobs  
14 Million Patient Records  
$46.3B Contribution to CA Economy

**Facilities**: 10+ Campuses  
5 Medical Centers  
3 National Laboratories

**Research**: Top in NIH  
Funding; Clinical + Research Data

**UCSF**: One of the Top Research Funded  
Academic Medical Centers:  
1600 Active UCSF Inventions  
1,000 Products From UCSF Technologies  
5 Nobel Laureates

The Center for Digital Health Innovation collaborates with Industry and UCSF Scientific Innovators to envision and realize new solutions to improve the lives of providers and patients.
CDHI Approach

- Finding value in data
- Scalable Research & Development Platform
- Robust set of tools
- Enhance information commons vision
- New paradigm for Academic & Industry collaboration

Right Treatment to the Right Patient at the Right Time
Training Data Set → Raw Data → Validation → Enriched Data

De-identification / Annotation → Data Management & Transformation

Environment to hold data → Linking multi-modal data

Data Production → Retrospective

Go get the data → Data Discovery Process

Is the problem clinically relevant and doable?

Can we get the data (internally & externally)?

Do we have the approvals to get the data? (IRB template, security template, governance?)

Prospective (Point-of-Care)
Collaborating with industry to create innovative platforms

A historic computational platform built upon up-to-date data science methodologies and capacities that transcend traditional reductionism:

**GE** - Creates access to all health workflows throughout the world

**Intel** - Enables world wide scalability of advanced analytics and Artificial Intelligence in Medicine
Challenges: Supporting Research at Scale with Infrastructure

Enriched Patient Data Resource

Secure Computing Environment

Annotation Data Store

Enrichment Algorithms

Annotation Tools

Imaging
EHR
Sensor
Non-traditional Data
Payment

Researcher Interface to Provide Clinical Framework
- Allows integration of analysis tasks over images and metadata that can be automatically scaled across compute grids
Innovation platform

Computation

- Annotated Data Resource
- Advanced Computational Platform
- Researcher Interface

Discovery

- Test & Pilot
- Proof of Concept
- Validated Algorithms & Protocols

Deployment

- Interoperability Platform

Pilot & Commercialization

Validated
Algorithms &
Protocols
Leveraging Multi-modal Data

Machine-based algorithms can help to:
- Automate triage
- Predict disease trajectories
- Design therapies
- Expedite workflow
- Define next generation treatment paths
- Automate individual patient context
Trauma: a Precision Medicine Approach

- Genome
- Proteome
- Clinical Data/Physiology
- Imaging
- Demographic/Injury
- Age
- Chronic Conditions
- Injury
- GCS
- EtOH > 300
- Na = 128
- UCH-L1
- GFAP
- mHg
Crossing from CDS to Analytics as Devices:

Initial Use Case

Algorithm Pipeline

Data Curation & Annotation in Computational Environment → Algorithm Research POC → Technical & Preclinical POC

POC Validated?

Yes → Clinical POC Algorithm Tested

Clinical POC Algorithm Tested → Application Scenario Analytics

Clinical Application

Additional Data Streams

Field Triage

Bleeding?

Intraop Resuscitation

CT?

ICU Bedside volume?

Remote Decision Support

Battlefield Triage & Treatment
Advantages of Our Approach

- Horizontal model that is not discipline or domain specific
- Modular proof of concept projects adhere to UCSF privacy and protection policies, creating a more flexible way to collect, analyze, and utilize data
- Multidisciplinary team of basic scientists and researchers, clinicians, data scientists, and forward-thinking business professionals
- Scalable infrastructure from storage and computational bandwidth and expertise
Creating Machine-based Algorithms is Now Possible

- Next generation data science techniques are providing powerful new capabilities
- Very large, curated clinical data sources provide unparalleled opportunity
- Availability of off-the-shelf, affordable tools is enabling scalable innovation
- New data sources are rapidly evolving

... but most development lacks the clinical content expertise within the context of the care delivery environment
Challenges & Promise:

- Devices as Analytics
- Data & Workflow Interoperability
- CDS Software
- Leveraging new technology to streamline the regulatory process

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