



Center for
Digital Health
Innovation
at UCSF

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

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

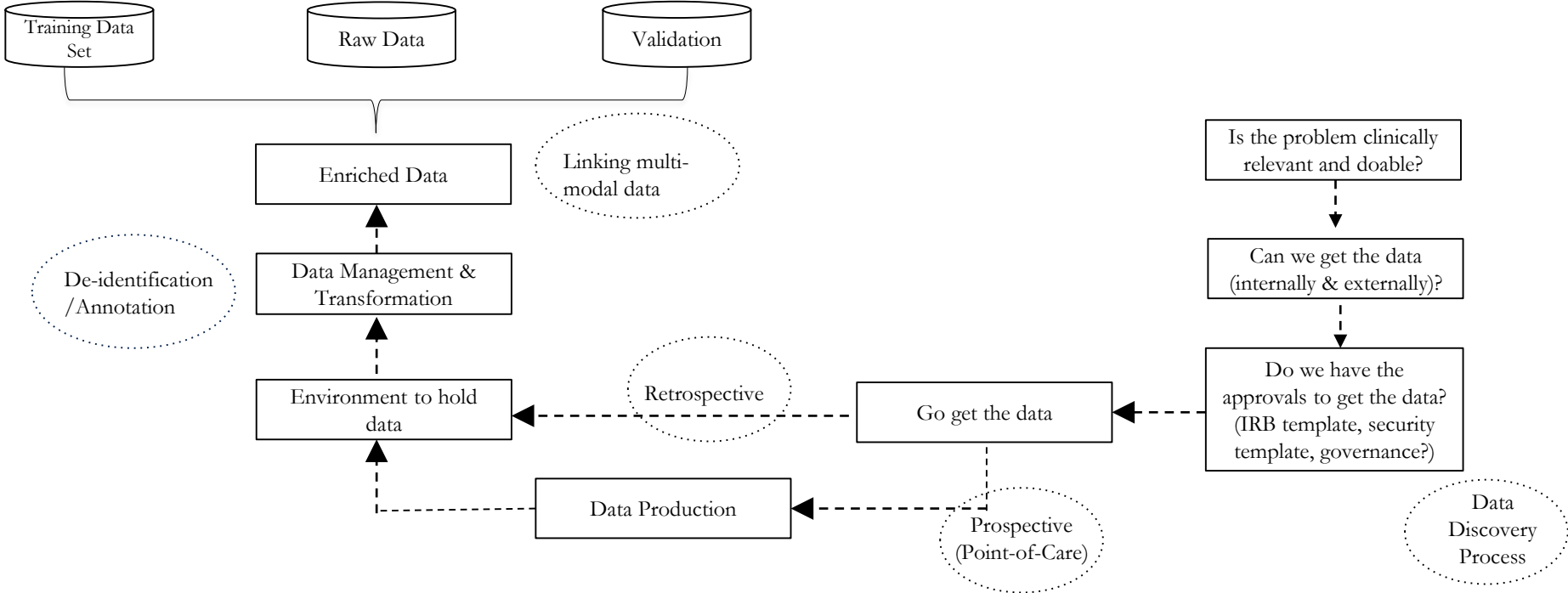
The Center for Digital
Health Innovation
collaborates with Industry
and UCSF Scientific
Innovators to envision and
realize new solutions to
improve the lives of
providers and patients.

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

Data Asset Management

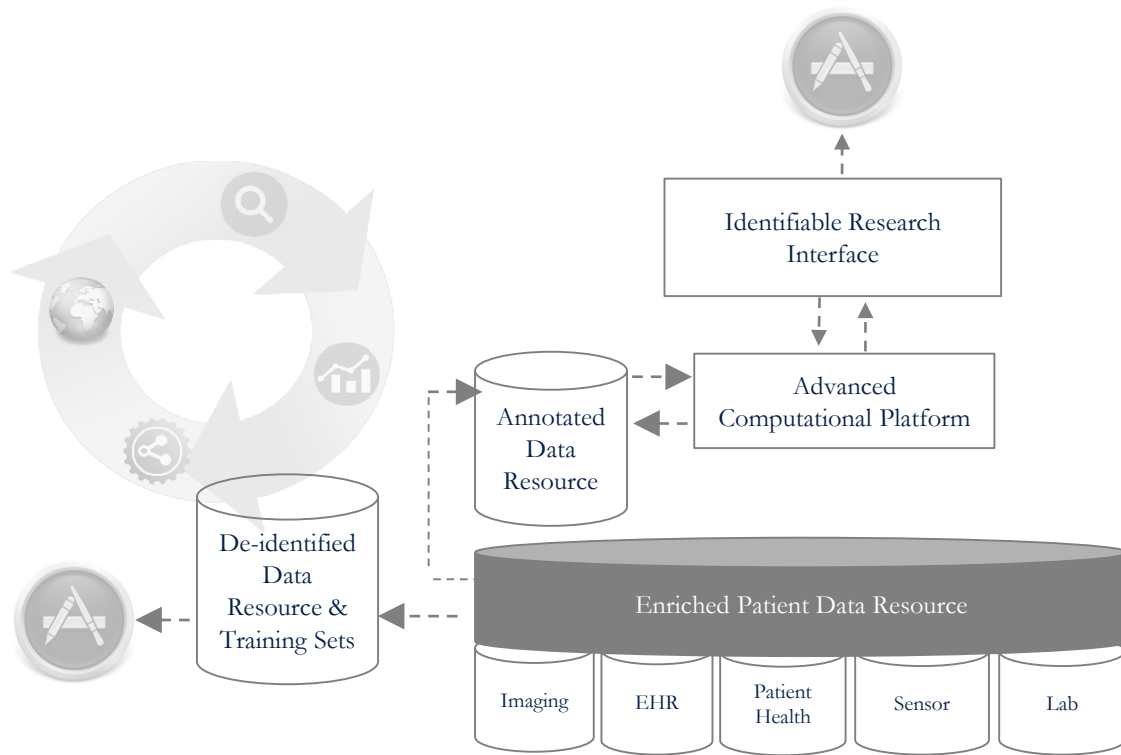


Collaborating with industry to create innovative platforms

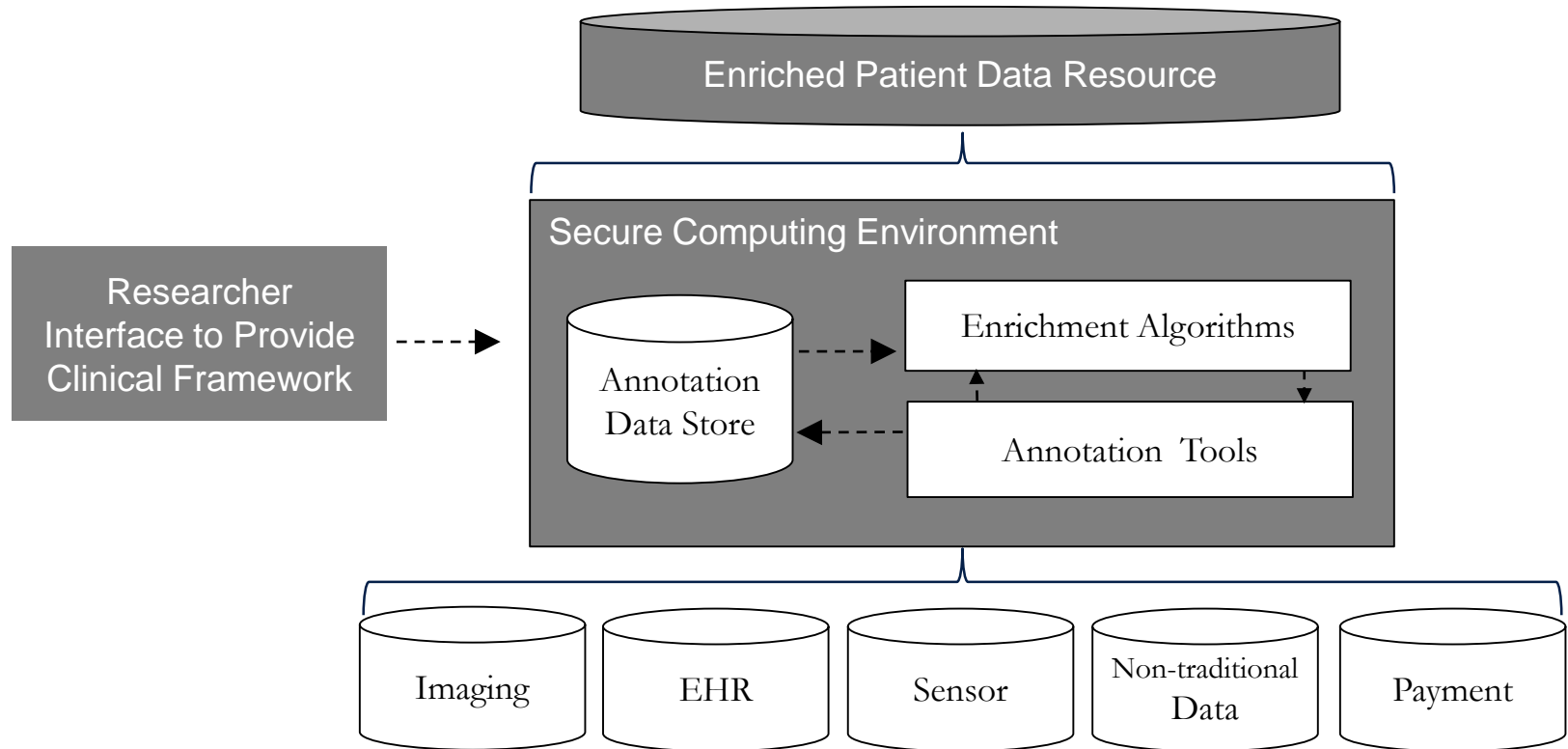
A historic computational platform built upon up-to-date data science methodologies and capacities that transcend traditional reductionism:

GE - Creates access to all health workflows throughout the world

Intel - Enables world wide scalability of advanced analytics and Artificial Intelligence in Medicine



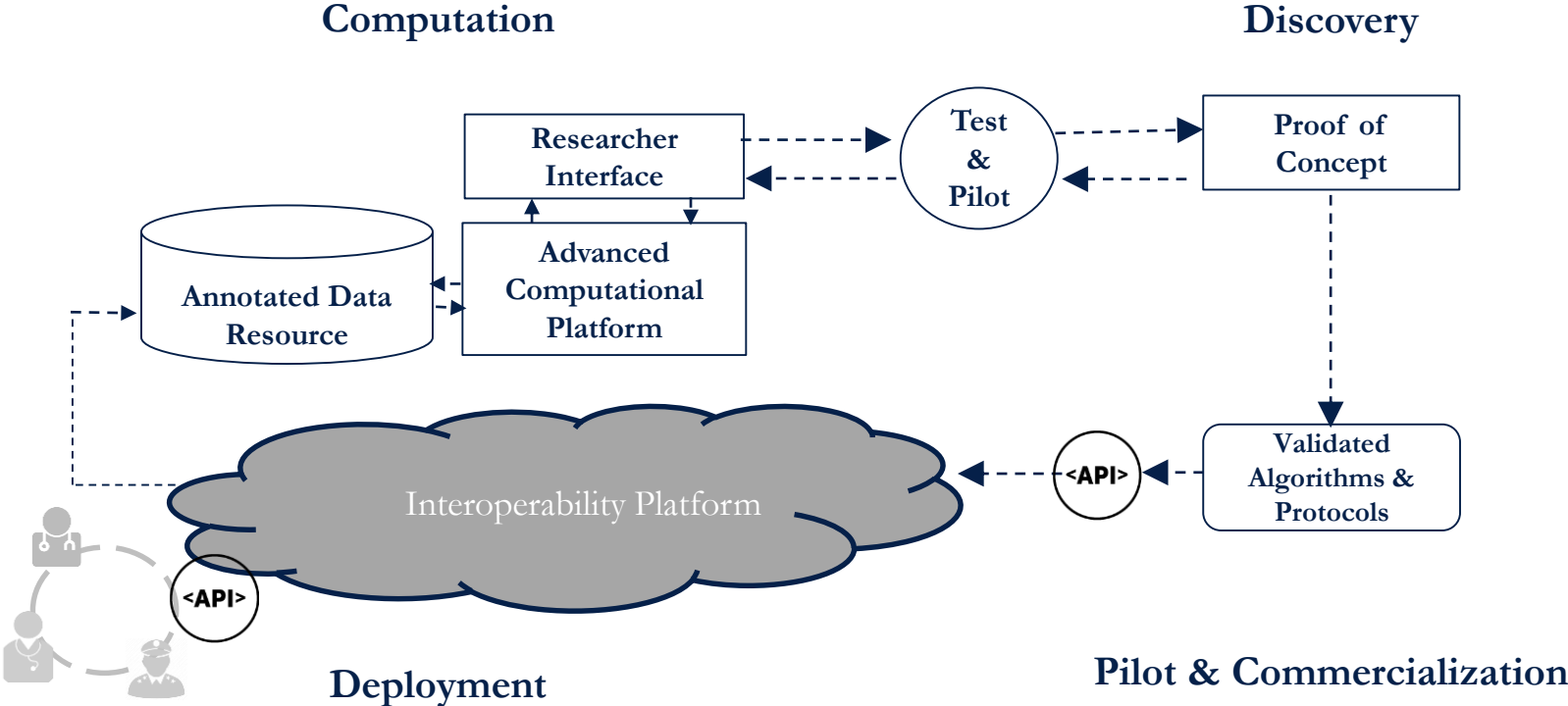
Challenges: Supporting Research at Scale with Infrastructure



- Allows integration of analysis tasks over images and metadata that can be automatically scaled across compute grids



Innovation platform



CDHI Advanced Analytic Environment –Target Capabilities

Analytic and Data Asset Stewardship

Clinical Model

Validation: stewardship of models and other data assets during validation activities including point-of-care.

Model / Algorithm

Pipeline: discovery, evaluation, refinement of clinically applicable analytic proposals.

Asset Catalog:

repository targeted to asset stewardship, discoverability, and improvement.

Process / Source Control: repository, versioning, sharing of methods / scripts / custom software / models in development.

Data & Analytic Asset Control: repository, versioning, secure access for models and derived data products.

Resource Allocation / Measurement: Storage quotas, cluster shares, billing / cost allocation, projections and capacity planning. approvals and reporting.

Unified Security and Privacy Model: Process, Policies, and Procedures; Identity Management; Authorization; Monitoring and Incident Response; Asset Tracking;

Analytics & Model Development

High Performance

Computing: traditional parallel processing environment.

Spark / HDFS:

scale-out analytics framework for machine learning, stream processing, big data.

Deep Learning:

BigDL, Tensorflow, Caffe, etc.

Data Enrichment & Transformation

Multi-Modality / Multi-Domain Data

Systems: data representation, structuring, semantics and management for multi-modality and multi-domain data integrations.

Annotation: Labels, grouping, graphical annotations, variants.

Quality Assurance / Linking:

data merges, multi-study cohorts, data quality assurance, identity mapping.

Enrichment: merging non-traditional data sources, novel transformations.

De-identification/Re-identification: Tools and patterns for de-identification, secure ID mapping / brokers, de-identified data linking, certification and documentation.

Data Storage & Sharing

Dataset Storage: secure data storage, versioning, backup, performance.

Dataset Sharing:

Authorizations and access controls. Logging and monitoring.

Dataset Delivery:

Efficient and secure data transfer to collaboration, analytic, and/or disaster recovery environments.

Data Acquisition & Production

Approvals / Ethics:

IRB, contracting, privacy.

Data Catalog:

information base of internal and external data sources, types, cohort characteristics, terms and conditions.

Digital Health / Streaming Data:

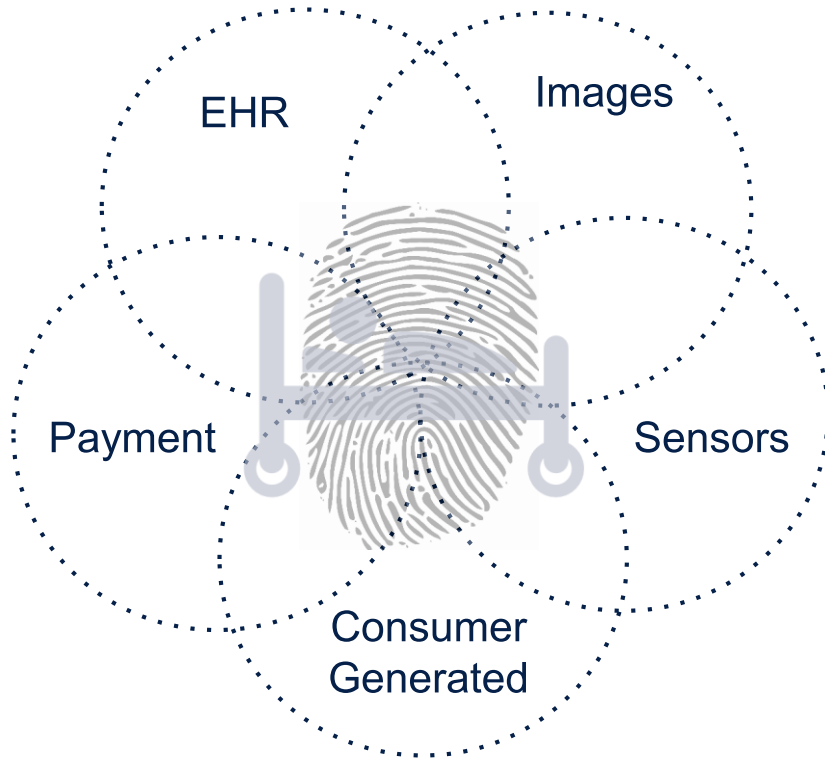
Data Hub / Brokers, data receipt / Ingestion framework

Imaging: DICOM Gateways; Image Repositories; Indexes / Databases

Clinical / EHR: EMR Extractions, Clinical Trials Management Systems, Study Databases

Omics: Sequencing, Genotyping, pathways, mechanisms

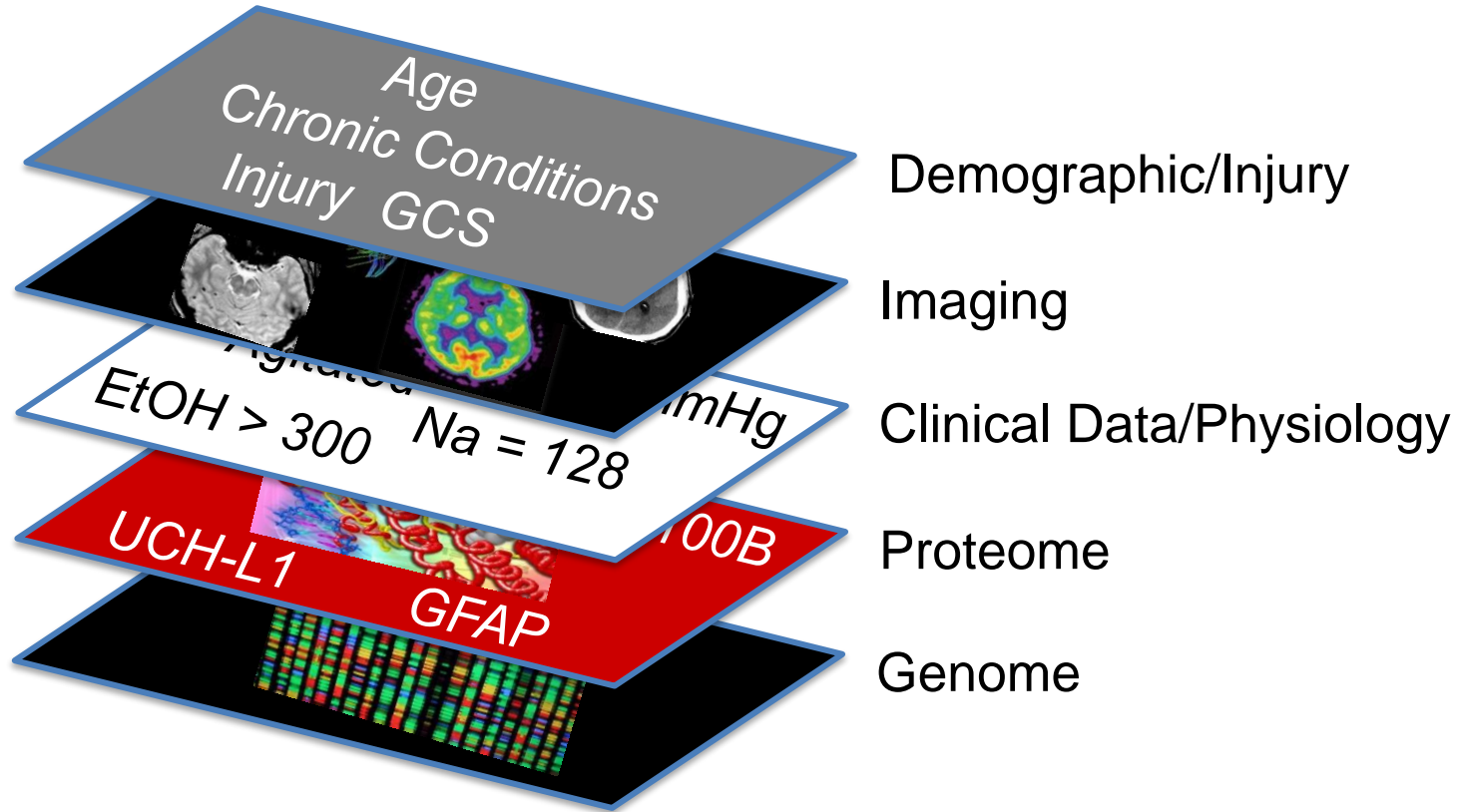
Leveraging Multi-modal Data



Machine-based algorithms can help to:

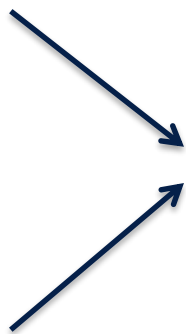
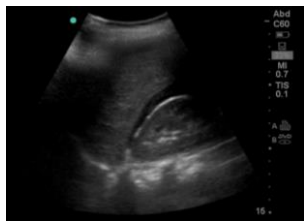
- Automate triage
- Predict disease trajectories
- Design therapies
- Expedite workflow
- Define next generation treatment paths
- Automate individual patient context

Trauma: a Precision Medicine Approach

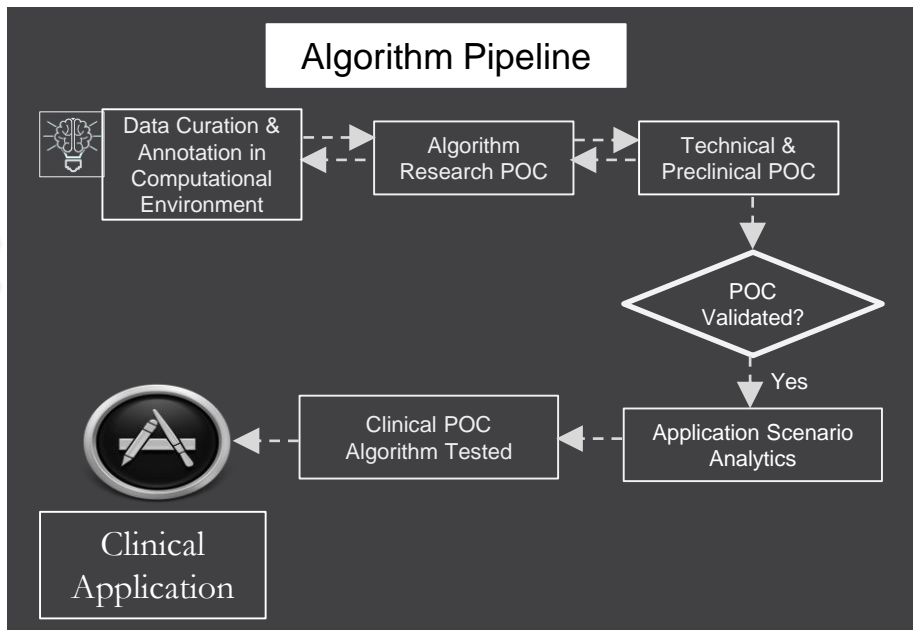
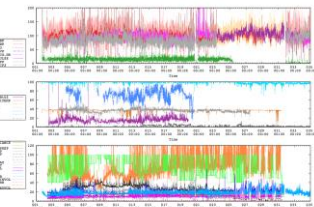


Crossing from CDS to Analytics as Devices:

Initial Use Case



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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