BioSymetrics

Augusta 2.0 Overview

How does AI ML benefit health systems and hospitals?

- Diagnose disease more accurately
- Improve care delivery and personalized medicine
- Align hospital reporting and administration to VBC incentives
- Effectively plan treatments

$5Bil

Value in preliminary diagnosis

$2.6Bil

Cost to bring a single drug to market

Estimated potential annual benefit for an application by 2026. Source: Accenture analysis, "AI: Healthcare's New Nervous Systems" (2017).

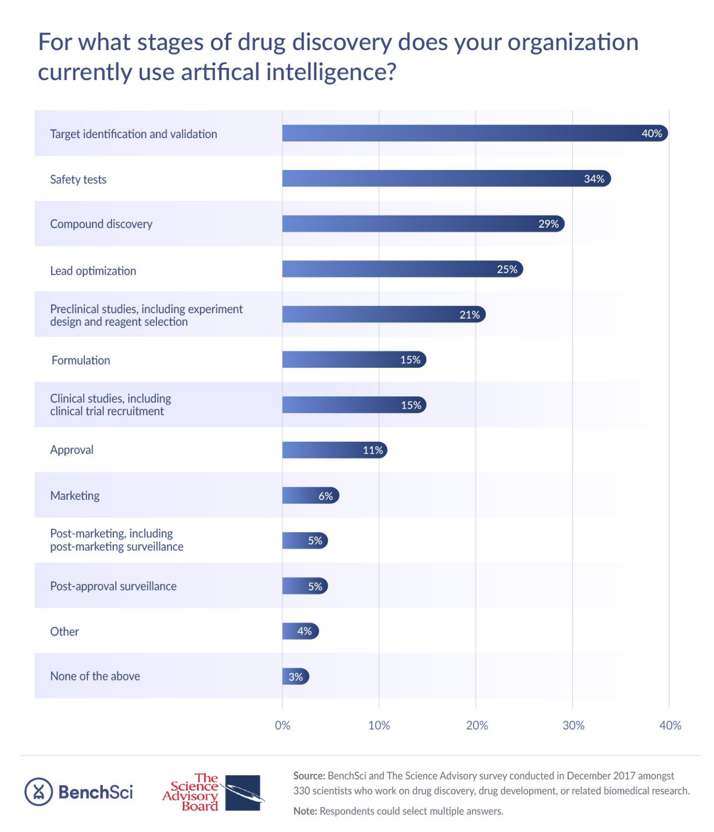
POTENTIAL BENEFITS

30 TO 40% IMPROVED DIAGNOSIS

- **Millions of Americans are misdiagnosed annually, e.g. ~12 million with incorrect diagnoses in outpatient clinics in 2014 (CBS News).**
- **Potential to improve diagnostic outcomes by 30% to 40%.**
- **Potential to reduce hospital stays, unnecessary readmissions and testing, and health care costs.**

Source: Frost & Sullivan, “AI & Cognitive Computing Systems in Healthcare" (December 2016). TM Capital Industry Spotlight, "The Next Generation of Medicine: AI and Machine Learning" (2017).

Current State of AI Adoption - Heavily Verticalized



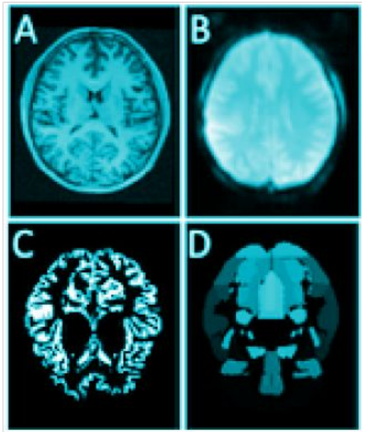
A recent survey of the Drug Discovery industry found that most current applications of AI are in areas you might expect (target identification, safety, discovery)

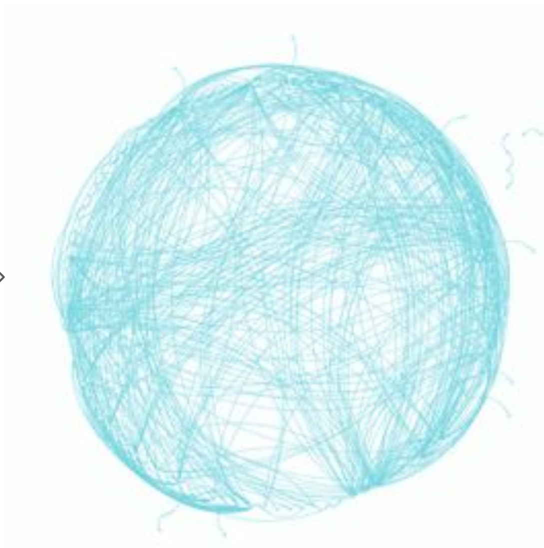
Most identified “Speed of Discovery” as the greatest motivating factor for using AI, however, **45% thought their application of AI would remain the same next year**

https://blog.benchsci.com/6-things-we-learned-about-artificial-intelligence-in-drug-discovery-from-330-scientists

The Problem With Verticalized Applications of AI

- Our initial model showed a marked difference between control and disease groups, however this was only due to an undetected bias in survey site





Control Patients (Avg)

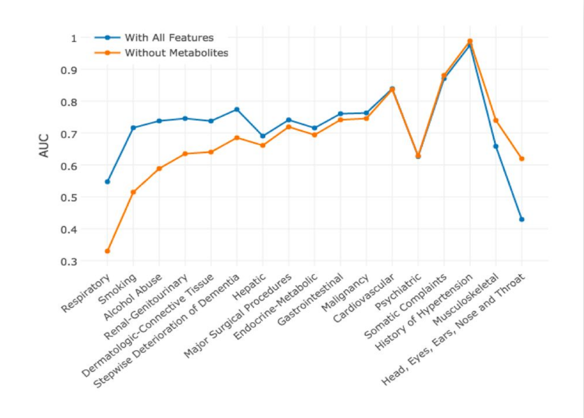
Autistic Patients (Avg)

Integrating Data for Better Accuracy

- Combining MRI with genomic features allowed **better prediction performance** than with either alone - Alzheimer's Disease Neuroimaging Initiative (ADNI) data

- This combination approach becomes more accurate as additional data types are included, and is **effective in precision medicine & drug discovery applications**

Evaluation Metric	MRI	Metabolomics	Genetics	All combined
True Positive Rate	0.73	0.73	0.77	0.83
False Positive Rate	0.66	0.63	0.5	0.39
AUC	0.56	0.55	0.68	0.73



What Limits the Widespread Application of AI in Biomedicine?

Data Variety/Heterogeneity

Different Data Types:
EHR/EMR, MRI/fMRI,
EEG, EKG, chemistry

Single framework for integration of diverse data types

Lack of Standards

No standards for processing or interpreting medical data

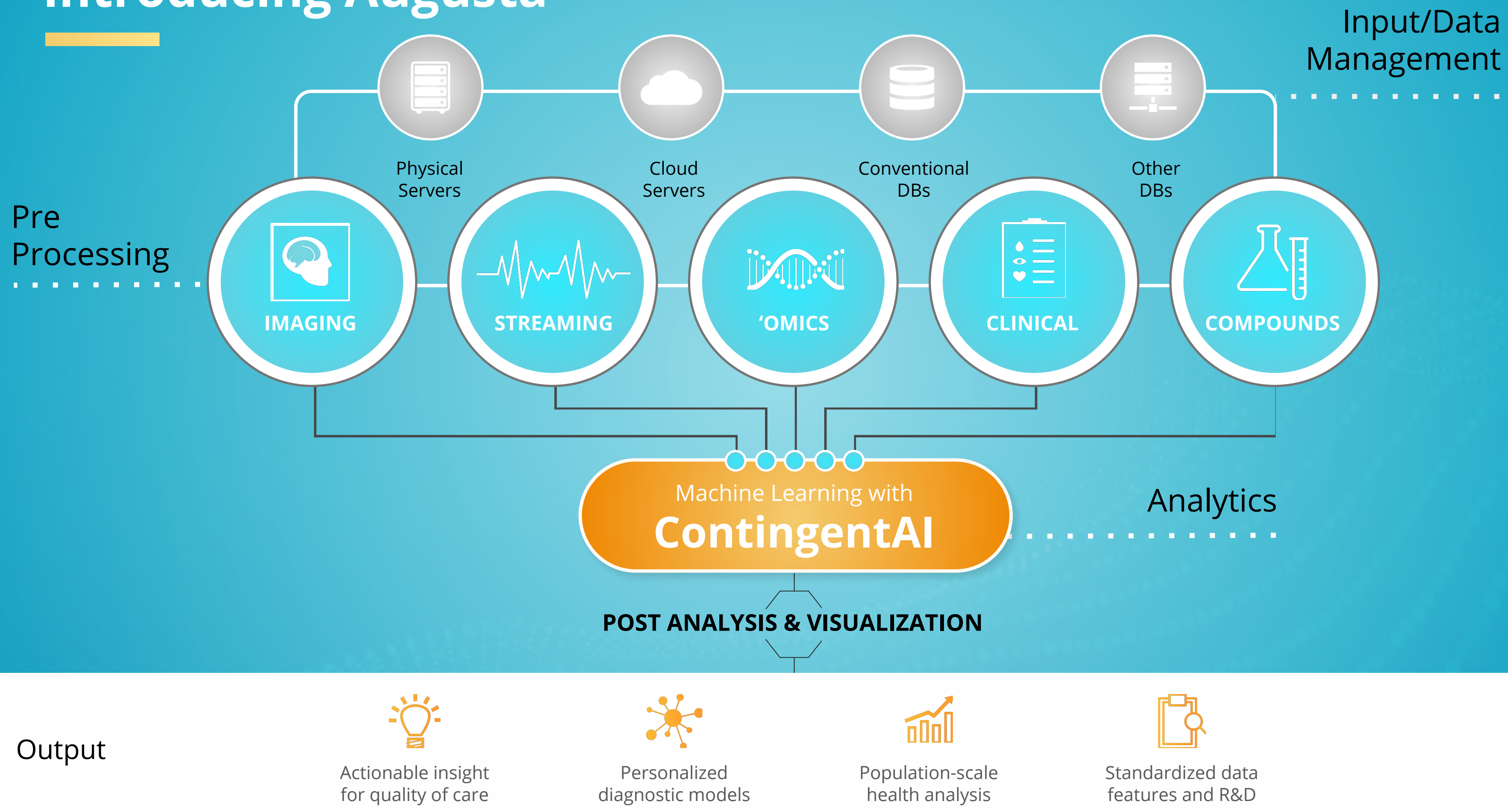
Dynamic, optimized pre-processing

Lack of Scalability

Challenges in pre-processing and machine learning using massive data

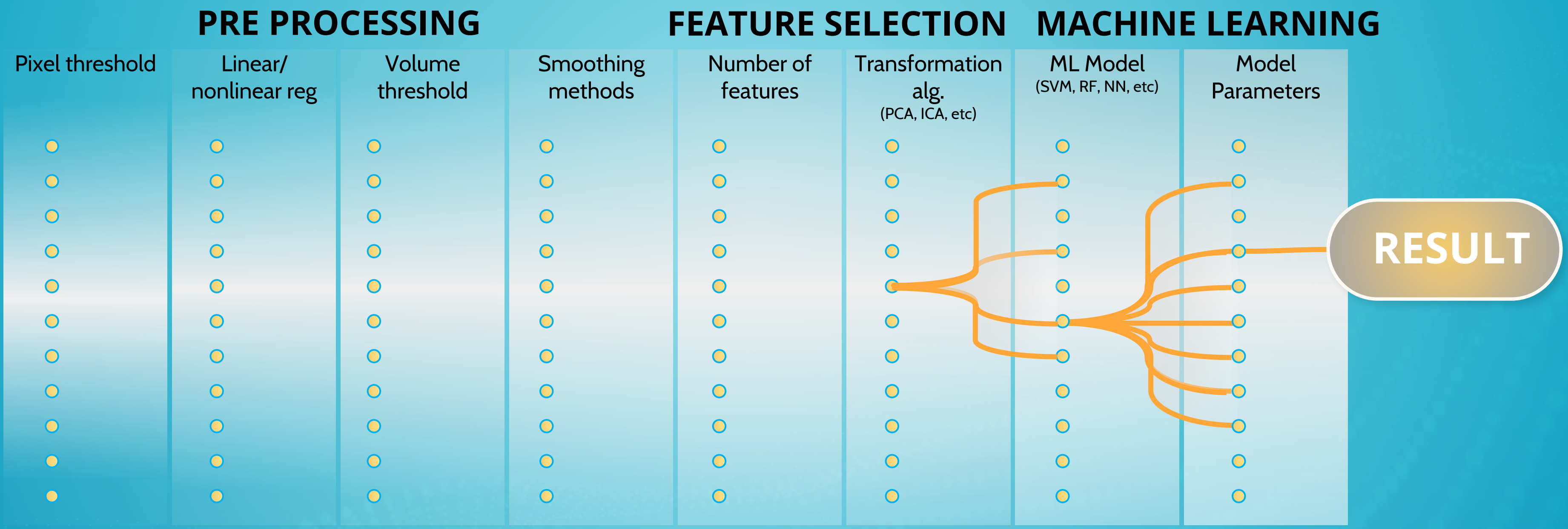
Deploy anywhere, on any architecture

Introducing Augusta



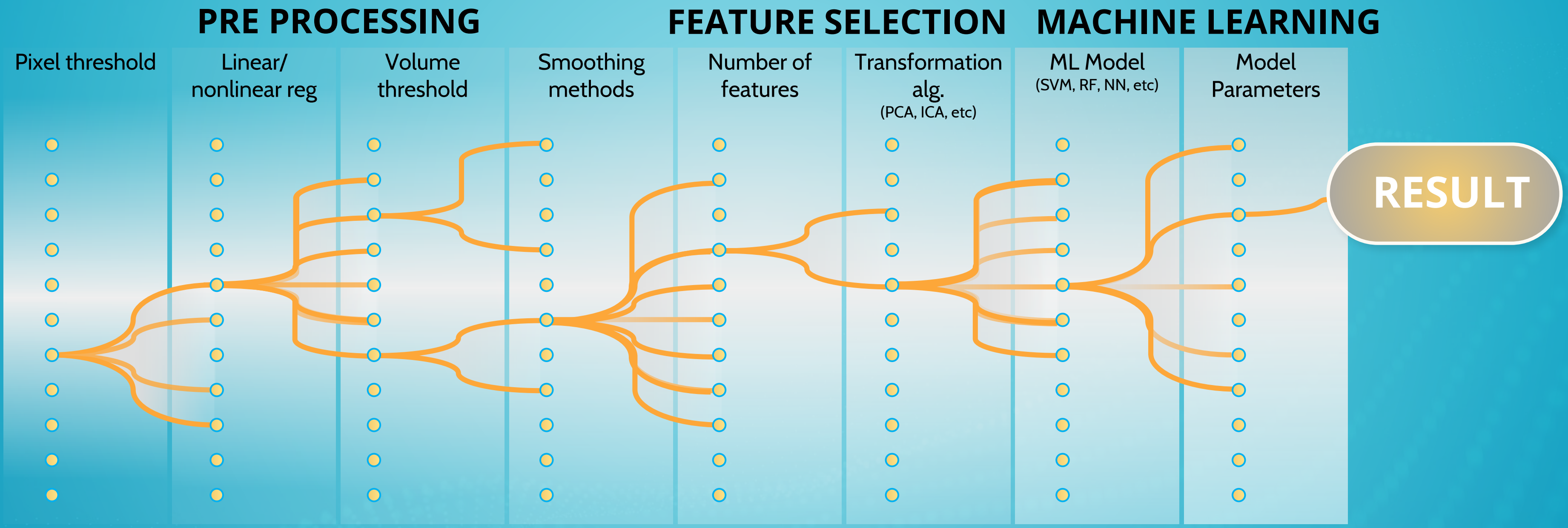
What Makes Augusta Unique?

Parameter optimization is typically performed after selecting an ML model



What Makes Augusta Unique?

Substantial bias can be introduced in pre-processing, optimization should begin much sooner



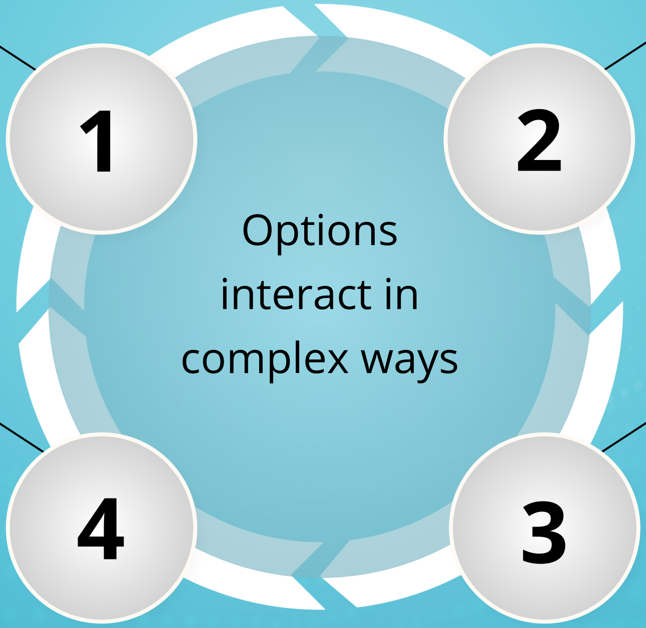
What Makes Augusta Unique?

Augusta is a single language that you can use to process and interpret biomedical data, allowing you to build automated AI workflows

PRE PROCESSING

Options/Parameters:

- Pixel threshold
- Linear/nonlinear reg
- Volume threshold
- Smoothing methods



FEATURE SELECTION

Options/Parameters:

- Number of features
- Transformation alg. (PCA, ICA, etc)
- Selection alg. (Backwards elim, MI)

EVALUATION

Options/Parameters:

- Criteria (AUC, sensitivity, specificity, network overlap, etc)

MACHINE LEARNING

Options/Parameters:

- ML model (SVM, RF, NN, etc.)
- Params of each

Augusta 2.0 - A Biomedical AI Language

All operations are treated as optimizable blocks:

Source - Data source (file, directory of files)

Transform - Data transformation, such as a preprocessing step for a specific datatype (e.g. skull subtraction for an MRI) or an operation (e.g. calculating a mean)

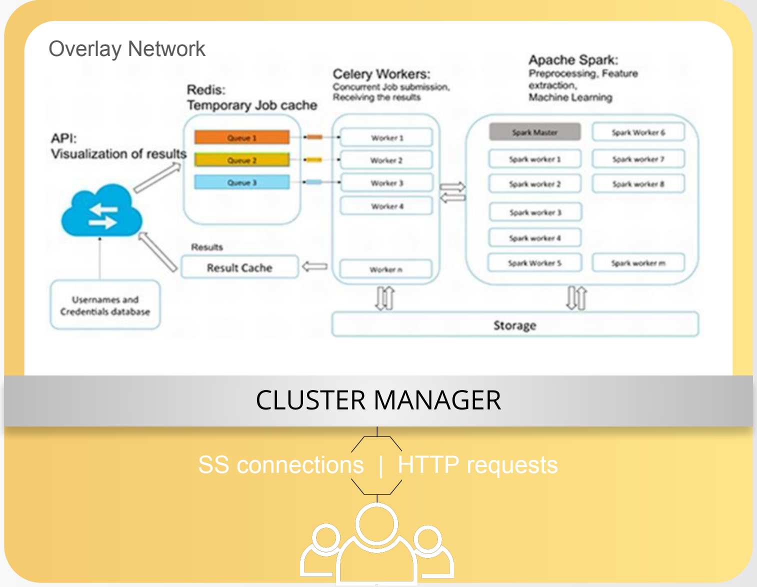
Model - Any number of machine learning models

Performance - Examine impact of transformation & model parameters

How the Augusta™ Platform Works

Augusta™ can start with siloed, complex, and raw data of multiple types:

- Integration of diverse and large-scale data types
- Data of any type, size, and dimensionality explored and modeled
- Biological, clinical, genomics, precision medicine, metabolomic, lab testing, drug compound data



- Accurate results and automated distribution
- Built for massive data architecture
- End-to-end machine learning
- Post-analysis & data visualization

Our Partners and Market Environment

GE Healthcare

Columbia University in the City of New York

NATO OTAN

PLUGANDPLAY

Harvard Medical School

NVIDIA

OrbCare

Microsoft Azure

sema4

DATAVANT

DRUG DISCOVERY

Reduction of Chemical Survey Space

Prediction of Molecular Mechanism

Experimental Data Integration

PRECISION MEDICINE

Genomic Risk Assessment

Improved Disease Diagnosis

Patient Data Integration

VALUE-BASED CARE

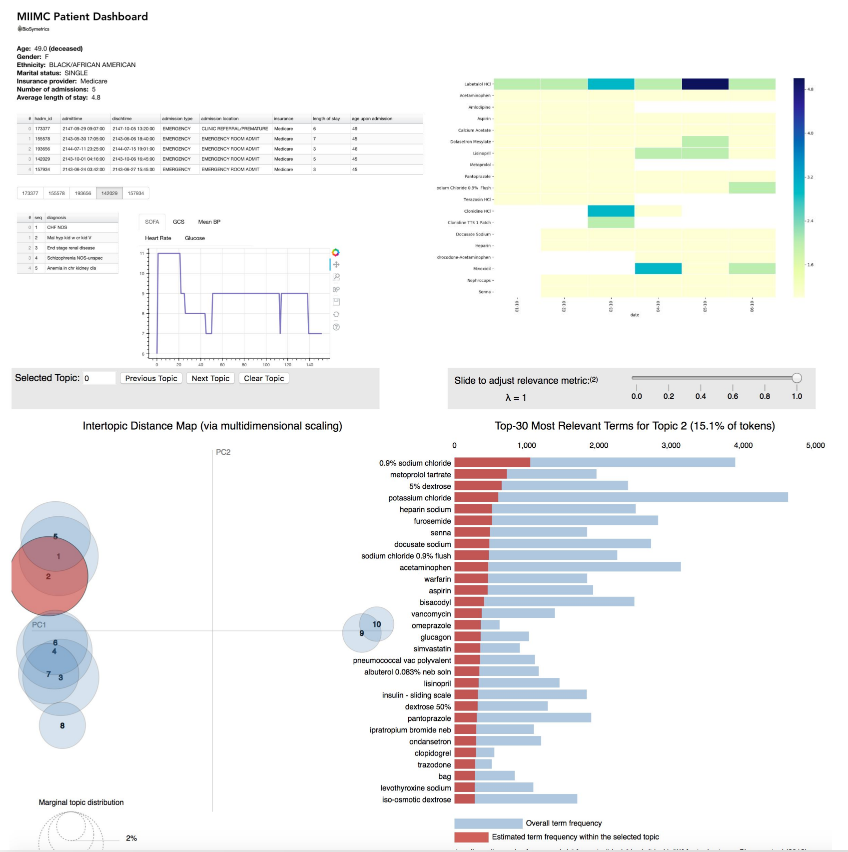
Patient stratification

Outcome & Event Prediction

Operational Analysis

Use Cases: Outcomes Prediction

- Continuously updated calculation of severity scores (including SOFA)
- Generate dynamic risk scoring for patients using time-based models
- Symptoms extracted from clinical notes
- Prescription names mapped to relevant MeSH terms, allowing systematic analysis of prescriptions by type

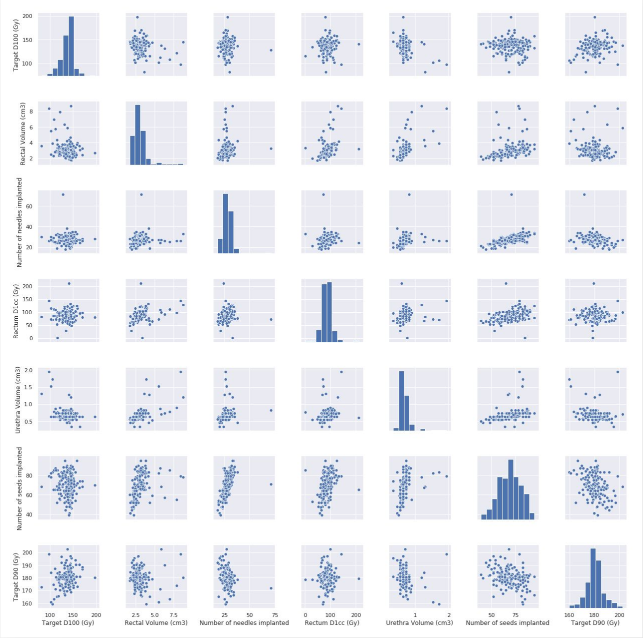


Use Cases: Value Based Care

- GE Healthcare (US) major initiative in value based care, predicting outcomes for patients with chronic conditions (NLP-based)

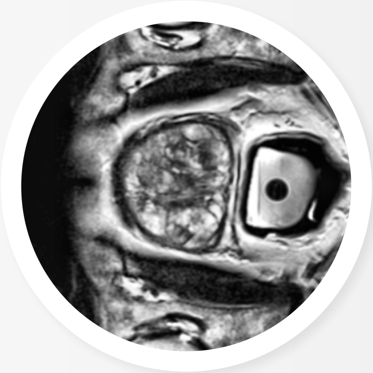
- OrbCare (Canada) analysis of clinical billing to identify diagnostic code over/under use

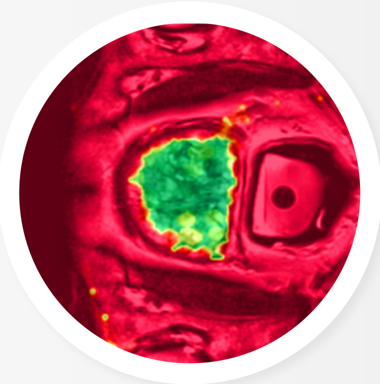
- Intacare (UK) homogenization of billing codes

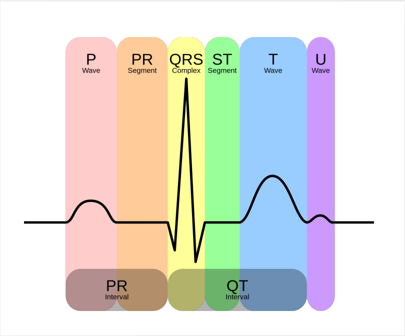


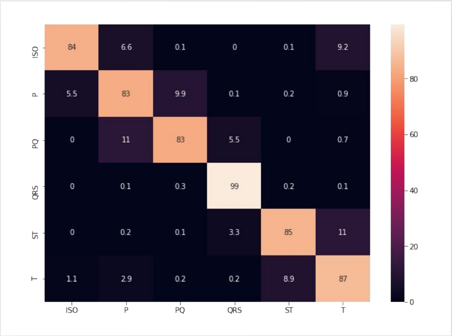
Use Cases: Precision Medicine

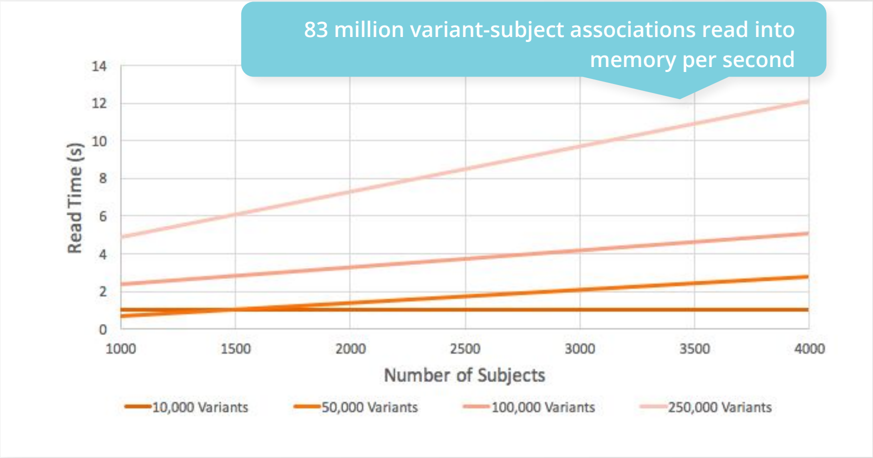
- Automatable, dynamic processing of medical images & streaming data from virtually any format
- Easy integration of multiple lines of clinical data
- Scalable model generation using cloud and conventional computing





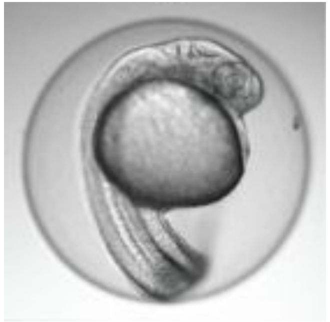


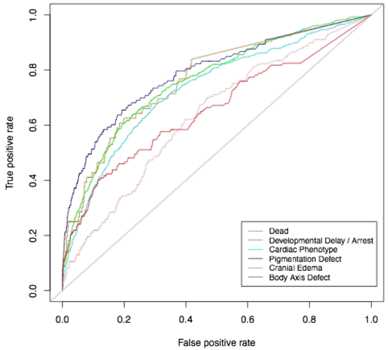


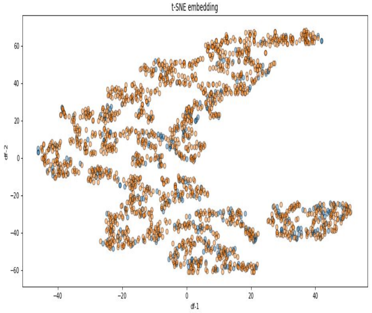


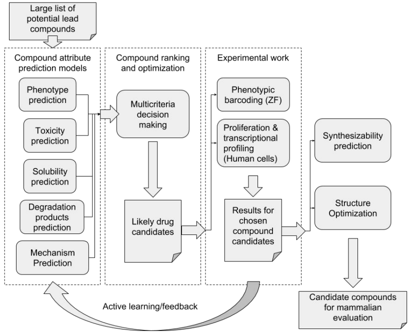
Use Cases: Drug Discovery & Building an Automated Platform

- Initial models focused on predicting zebrafish phenotypes
- Prioritized compounds showed correlates in clinical application
- In a collaborative effort, we included genomic, proteomic, and transcriptional data, generating predictions of molecular mechanism underlying phenotypes
- Currently working to automate this process:
  - Begin with prediction of phenotype
  - Automated phenotypic barcoding
  - Predict molecular mechanism & validate
  - Refine process









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