

AI-Powered Platform with Predictive Modeling



ClosedLoop.ai

Helping organizations redefine how data science moves healthcare forward.

Why ClosedLoop.ai?

- ClosedLoop makes it simple to import raw healthcare data sets, such as medical claims, prescriptions, EMR, and custom data, without the need for tedious data normalization and cleansing.
- ClosedLoop helps healthcare data scientists build models and features smarter and faster—freeing them to focus their time on discovery of new insights.
- ClosedLoop provides data scientists with the tools they need to build highly accurate models and to continuously improve those models as new data and insights are surfaced.
- ClosedLoop unpacks the "black box" of artificial intelligence allowing data scientists and clinicians to understand why and how factors impact a model's prediction, driving faster adoption and better clinical results.
- ClosedLoop allows data scientists and clinicians to create and iterate on predictive models together.
- ClosedLoop's makes it easy to operationalize a model and automatically update predictions as new data arrives.

Product overview

Getting the right answers starts with the right platform. ClosedLoop's data science platform combines leading-edge AI tools and automation capabilities with healthcare specific content and expertise enabling healthcare data scientists to build accurate and explainable predictive models with speed and ease.

ClosedLoop's end-to-end machine learning platform allows users to go from raw, messy EHR, claims, labs, Social Determinants of Health (SDoH), device, and other patient linkable data streams to production deployed predictive models in just 24 hours (e.g., Predicting Cost Bloomers/Rising Risk). The predicted outcome is the probability that person's healthcare costs in the next 12 months are 50% higher than this year's costs, and that they exceed \$10,000 in total. The algorithms were based on diagnosis and procedure data from medical claims and trained on a population of people at least 12 months of medical claims cost history.

Product features

Simplified Data Handling

Data adapters and auto-cleaners for all major codesets, and tools to integrate person-linkable data in a HIPAA-compliant, cloud-based environment. Automated Feature Engineering - 1000+ prebuilt, healthcare-specific features, with mappings to licensed ontologies, built-in social factors data, and custom generators for proprietary data.

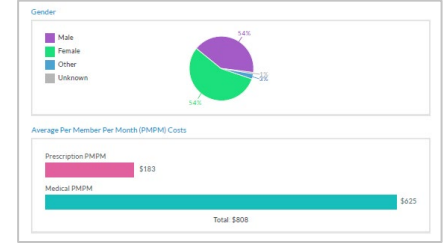
Precise & Explainable Predictions

Flexible cohort and endpoint definitions, automated ML and accuracy outputs, individualized predictions and explainability factors, and dynamic ROI impact estimates. Seamless Deployment & Management - Hosting, versioning, and automated drift and accuracy detection.

Capabilities

Data handling

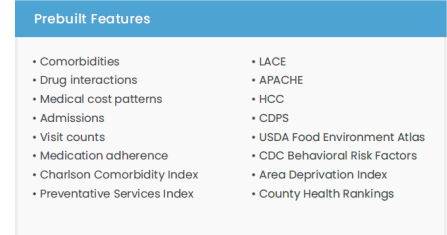
- HIPAA-compliant storage and data access
- Support for fixed snapshots and streaming data
- Automated data dictionary creation
- Auto-detection of data types
- Auto-clean support for common healthcare elements including diagnosis, procedure, and drug codes
- Support for all major coding systems (ICD 9/10, CPT, HCPCS, NDC, NPI, and SNOMED)
- Auto-generated summary statistics, e.g., per member per month cost, age and gender summary, etc.
- Automated quality checks for imported data



Auto-generated summary statistics

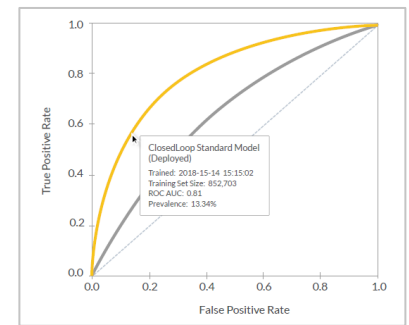
Automated feature engineering

- Over 800 prebuilt healthcare specific features
- Automatic mappings to licensed ontologies (GPI, RxNorm, CCS, BETOS, UMLS, and FHIR)
- Support for complex combinations of events, e.g., initiation of metformin within 60 days of an initial diabetes diagnosis
- Built-in support for social factors including USDA Food Environment Atlas, CDC Behavioral Risk Factors, Area Deprivation Index, and County Health Rankings
- Custom feature generators for incorporating novel and proprietary data sources
- Fully automated model training and evaluation process



Increased accuracy

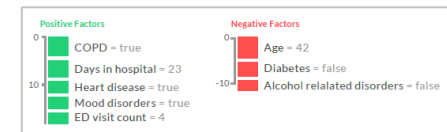
- Baseline model creation using automated features for any prediction in less than 24 hours
- Custom population and outcome definition to precisely tailor models
- Natural language processing to extract SNOMED terms from free-text notes
- Advanced machine learning algorithms utilizing neural network and tree-based ensemble methods
- Automated model tuning utilizing hyperparameter optimization and cross-validation
- Local population training support increases accuracy vs. pre-trained models
- Cross-training support leveraging licensed external data
- Model versioning to enable testing of new features and accuracy comparison
- Automated accuracy reporting including ROC and precision/recall curves, model calibration plots, and train and test set performance



ED Utilization | ROC curve comparison for model versions

Explainability enhancement

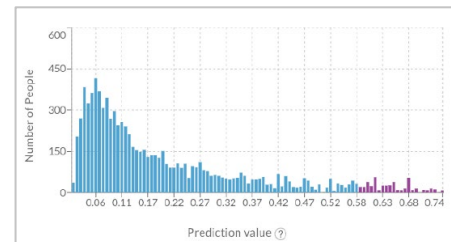
- Auto-computed top factors show which variables matter most across an entire population
- Weighted positive and negative factors for individual patients inform clinical and operational workflows
- Prediction trends over time show changes in risk for any given outcome as new data is received
- Factor visualizations help users understand the important factors underlying any prediction



Admission Risk | Weighted positive and negative factors

Deployment

- Pushbutton deployment puts new models into production with a single click
- Automatic update of predictions as new data streams in
- Built-in error handling for schema changes and data anomalies
- Automated quality checks on new predictions
- REST API or push notifications to retrieve predictions
- Model performance monitoring over time

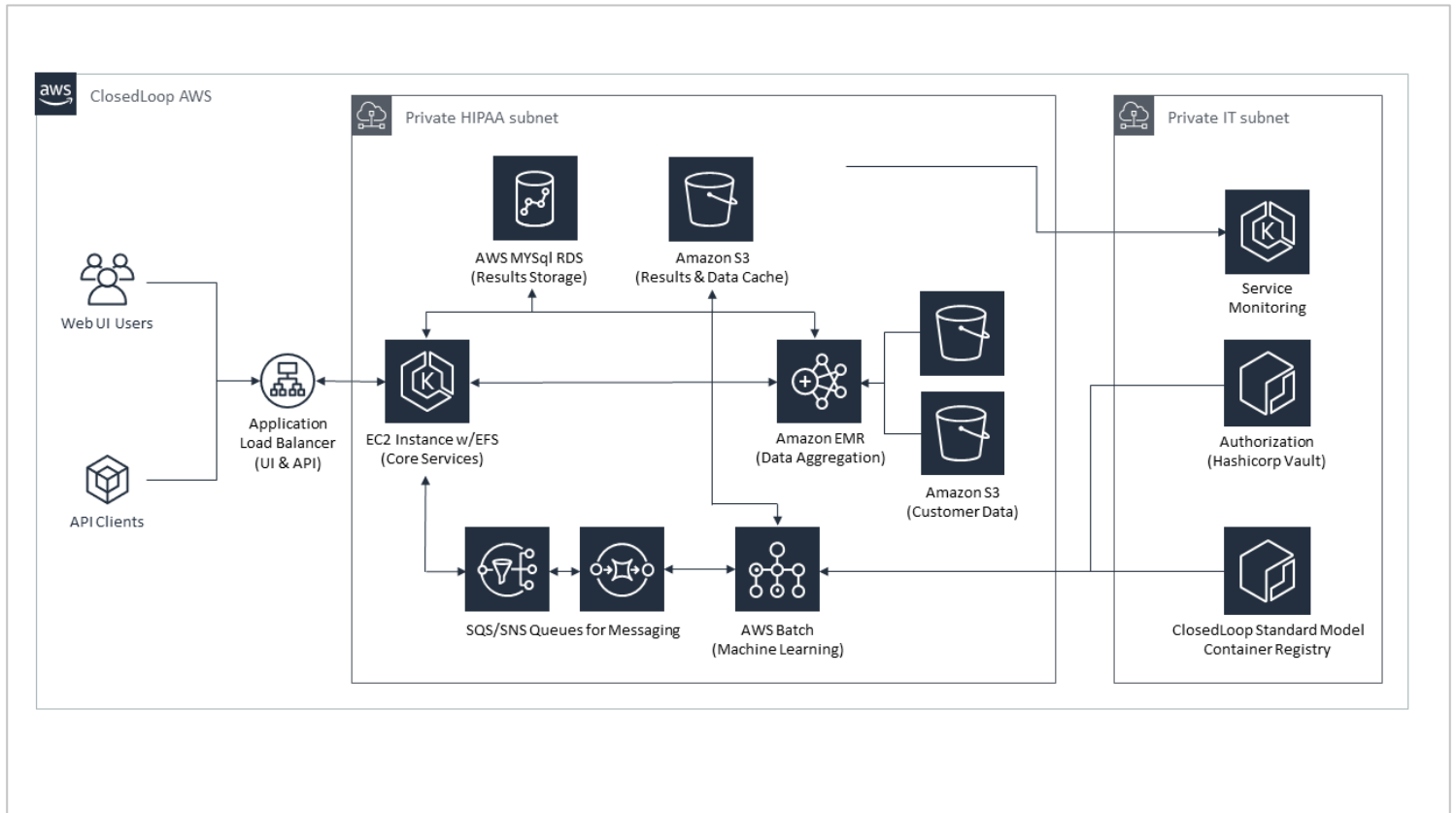


Readmission Risk | Population stratification

Collaboration

- Easy-to-use feature language understandable by data scientists and clinicians
- Feature and model catalogs support reuse of best practices
- Version-controlled repositories with data provenance tie predictions to the exact data and model that created them
- Easily understood visualizations for model accuracy, feature importance, and prediction results
- Straightforward model comparison supports iteration and testing of new features
- Python and REST APIs for easy integration with Jupyter notebooks and other data science tools

ClosedLoop architecture



ClosedLoop access requirements

- Data is all housed in customer account
- Provisioning is scripted through Terraform
- ClosedLoop requires admin level AWS access for deployment
- SSH access to EC2 servers is required for deployment/upgrades
- Some upgrades require reprovisioning through Terraform
- All AWS credentials are short lived and managed through Hashicorp vault
- ClosedLoop needs access to buckets containing log information for support