



# CTS NPN HACKATHON

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## Project Title:

Hopecare A Predictive Healthcare ROI Platform

## Team Members:

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## Mentors :

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## College Guide:

Mrs. R. Deepa

## College Name:

Sri Manakula Vinayagar Engineering College

# Problem Statement

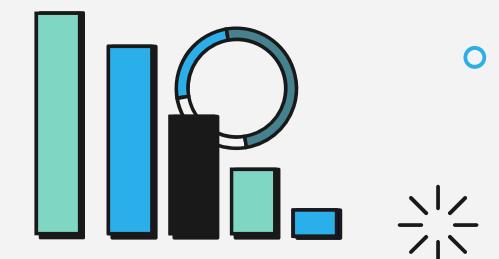
## Use Case 2: Member Risk Stratification and Care Management

- **Objective:**
  - Identify high-risk members early and deploy targeted interventions to prevent costly complications and hospitalizations.
- **Domain Challenge:**
  - 5% of Medicare members account for 50% of total costs, making accurate risk prediction crucial for effective care management.
- **Problem Statement:**
  - Develop a risk stratification platform that predicts member health deterioration with 85%+ accuracy and recommends personalized interventions.

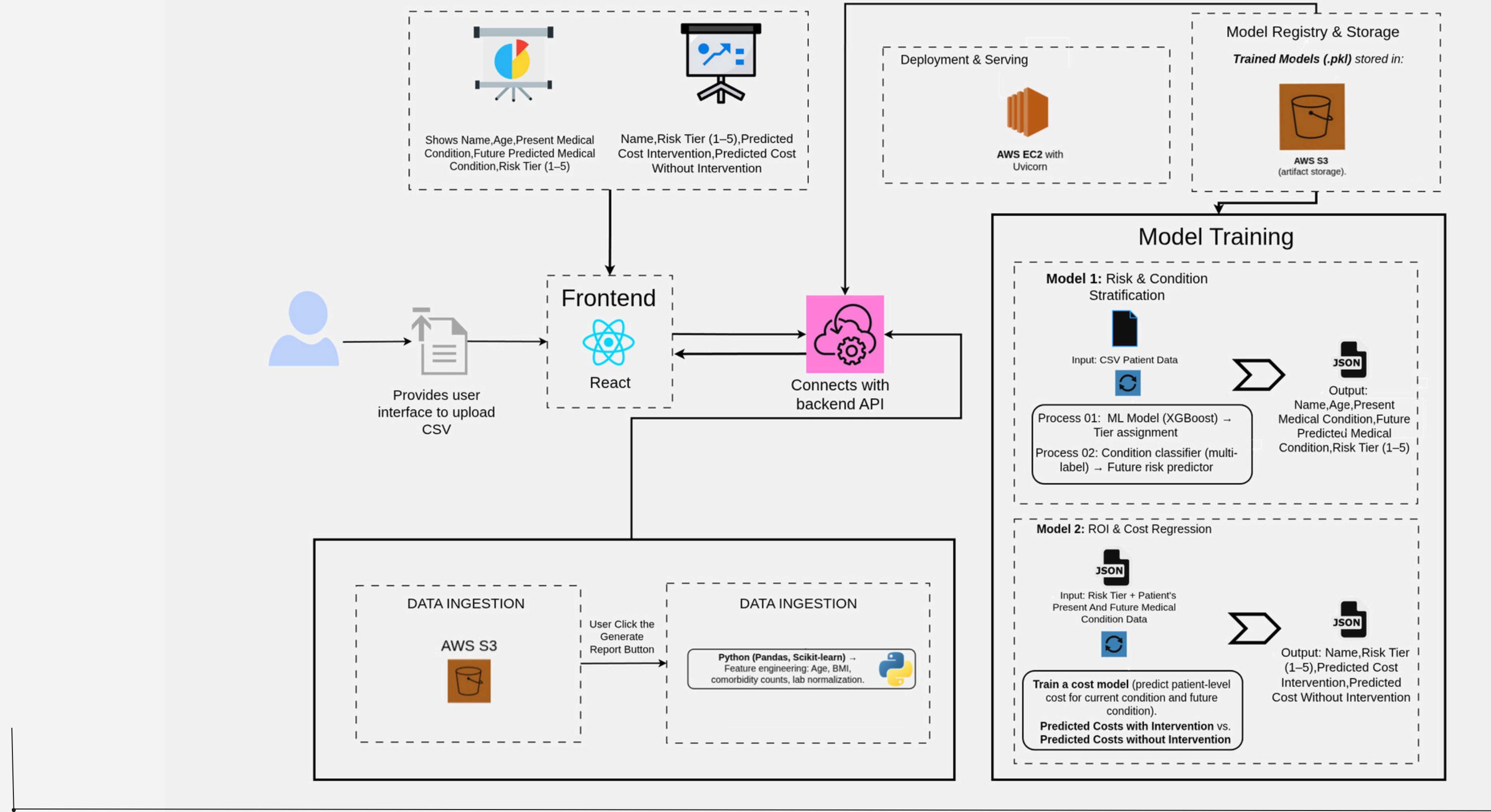


# Solution Overview:

- **Two-Stage ML Pipeline:**
  - **Risk Stratification Model:** Predicts patient risk for chronic conditions
  - **ROI Model:** Translates risk into financial terms.
- **Frontend (React + Vite):**
  - User-friendly interface for CSV upload.
  - Async API calls to backend for predictions.
  - Data visualization via tables and summary cards.
- **Backend (FastAPI):**
  - Secure API endpoint
  - Hosts and orchestrates risk + ROI models.
  - Formats results into structured JSON for the front-end.
- **Integrated Workflow:**
  - Upload patient data → Risk prediction → ROI cost analysis.
  - Returns proactive vs. reactive costs + savings in real-time.
- **Key Features:**
  - Clear, intuitive UI for stakeholders.
  - Scalable monorepo design (frontend + backend separation).
  - Full local run + AWS deployment readiness.



# Architecture



# Technologies Used



- **Frontend**
  - React.js → User interface for file uploads, dashboards, reports
- **Backend**
  - FastAPI → API layer for ML models and data processing
  - Python (Pandas, Scikit-learn, XGBoost) → Data cleaning, feature engineering, ML models
- **Models**
  - Risk Stratification Model → XGBoost for tiering
  - Condition Classifier → Multi-label classification
  - Cost Regression Model → Predicts intervention vs. non-intervention costs
  - Explainability (SHAP) → Interpretability of model predictions
- **Deployment**
  - AWS EC2 with Uvicorn → Model serving
  - AWS S3 → Model artifacts, CSV files
- **Cloud Infrastructure**
  - AWS EC2 → Scalable compute
  - AWS S3 → Object storage

# Risk Stratification Model



- **Input:**
  - Patient data provided as CSV files (including demographics, medical history, diagnoses, lab values, etc.)
- **Processes:**
  - **Process 01** – ML Model (XGBoost): Assigns each patient to a risk tier (e.g., Tier 1 = low risk, Tier 5 = very high risk)
  - **Process 02** – Condition Classifier (Multi-label): Predicts future medical conditions for patients, allowing proactive care planning
- **Output:**
  - Delivered as a JSON file containing:
    - Name & Age
    - Present Medical Condition(s)
    - Predicted Future Medical Condition(s)
    - Assigned Risk Tier (1–5)
- **Impact:**
  - Enables early identification of high-risk patients
  - Guides personalized interventions
  - Supports cost-effective care management

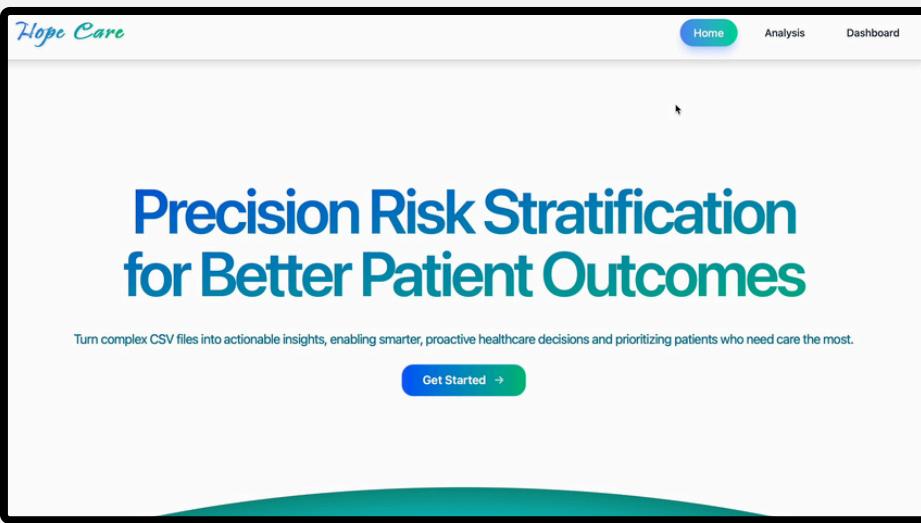
# ROI Model



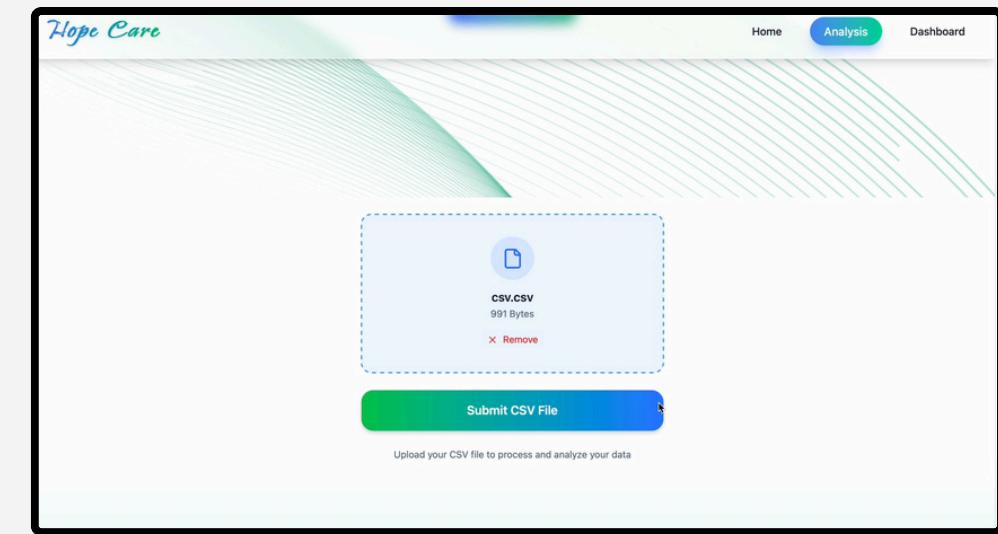
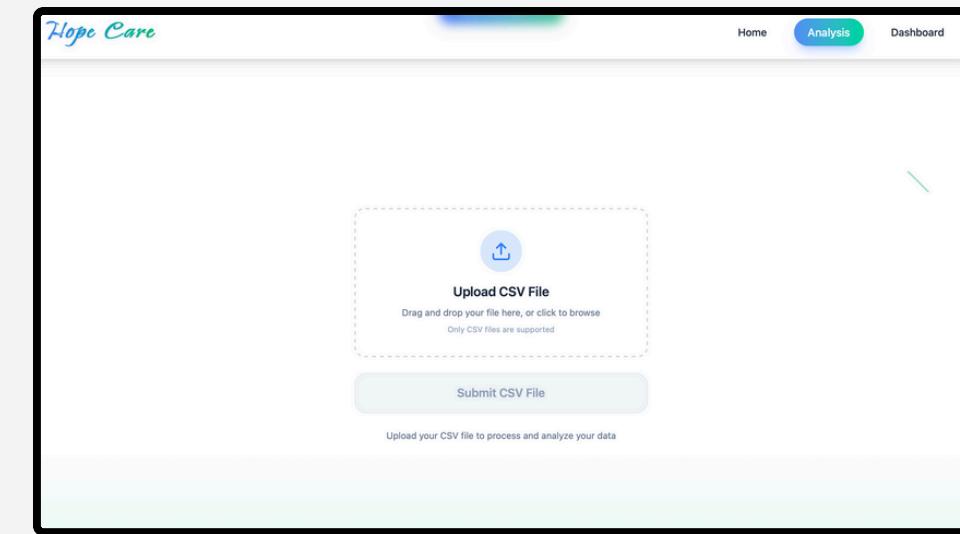
- **Input:**
  - Patient's Risk Tier + Present and Future Medical Condition Data (from previous model outputs)
- **Process:**
  - Train a Cost Model: Predicts patient-level cost for current and future conditions
- **Compares:**
  - Predicted Costs with Intervention
  - Predicted Costs without Intervention
- **Output:**
  - Delivered as a JSON file containing:
    - Name
    - Risk Tier (1–5)
    - Predicted Cost with Intervention
    - Predicted Cost without Intervention
- **Impact:**
  - Quantifies financial benefits of early intervention
  - Supports ROI analysis for healthcare providers
  - Enables cost-optimized decision-making in care management

# Application Interface:

## Home Page



## CSV Upload Section



# Final Output:

## Output Tables

## Dashboard

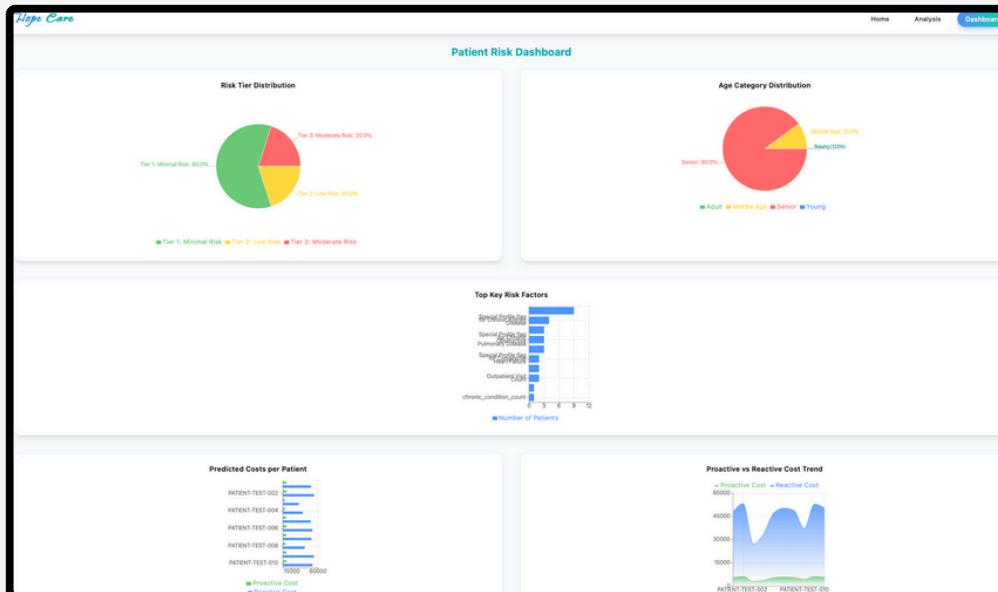
## Report PDF

**Hope Care**

**Prediction Results**

Patient ID	Age	Location	Income	Employment	Hospital Visits (2yr)	Primary Condition	Risk Score	Risk Tier	Key Risk Factor
PATIENT-TEST-001	67	CityH	80430	No	0	SEVERE HEART FAILURE	0.657	Tier 3: Moderate Risk	BENE_HI_CVRG
PATIENT-TEST-002	71	CityB	68249	No	0	SEVERE HEART FAILURE	0.611	Tier 3: Moderate Risk	Medicare Reimb.
PATIENT-TEST-003	82	CityF	65112	Yes	1	COPD EXACERBATION	0.142	Tier 1: Minimal Risk	Special Profile fa
PATIENT-TEST-004	78	CityA	118963	Yes	1	COPD EXACERBATION	0.293	Tier 2: Low Risk	Special Profile fa
PATIENT-TEST-005	85	CityD	130322	Yes	2	SEVERE KIDNEY INJURY	0.22	Tier 1: Minimal Risk	Special Profile fa
PATIENT-TEST-006	91	CityG	98341	No	3	SEVERE KIDNEY INJURY	0.091	Tier 1: Minimal Risk	Medicare Reimb.
PATIENT-TEST-007	76	CityG	108669	No	2	SEVERE KIDNEY INJURY	0.214	Tier 1: Minimal Risk	Special Profile fa
PATIENT-TEST-008	89	CityB	68677	Yes	5	COPD EXACERBATION	0.087	Tier 1: Minimal Risk	Special Profile fa
PATIENT-TEST-009	72	CityA	64808	No	1	SEVERE HEART FAILURE	0.476	Tier 2: Low Risk	Medicare Reimb.
PATIENT-TEST-010	94	CityD	102275	No	6	SEVERE KIDNEY INJURY	0.104	Tier 1: Minimal Risk	Special Profile fa

[Show ROI Analysis](#) [Generate PDF](#) [See Detailed Analysis](#)



**Analysis Report**

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**Patient Information**

Patient ID	Age	Primary Condition
PATIENT-TEST-001	78	SEVERE KIDNEY INJURY
PATIENT-TEST-002	68	COPD EXACERBATION
PATIENT-TEST-003	54	COPD EXACERBATION
PATIENT-TEST-004	82	SEVERE HEART FAILURE
PATIENT-TEST-005	47	COPD EXACERBATION
PATIENT-TEST-006	60	SEVERE KIDNEY INJURY
PATIENT-TEST-007	78	COPD EXACERBATION
PATIENT-TEST-008	58	SEVERE KIDNEY INJURY
PATIENT-TEST-009	62	SEVERE HEART FAILURE
PATIENT-TEST-010	50	COPD EXACERBATION

**Risk & Outcomes**

Condition	Risk Score	Risk Tier	Key Risk Factors
SEVERE KIDNEY INJURY	0.233	Tier 1: Minimal Risk	PLAN_CVRG_MOS_NUM, MEDREIMB_CAR, SP_CHRNKIDN
COPD EXACERBATION	0.299	Tier 2: Low Risk	SP_COPD, MEDREIMB_OP, BENRES_OP
COPD EXACERBATION	0.227	Tier 1: Minimal Risk	SP_COPD, MEDREIMB_OP, BENRES_OP
SEVERE HEART FAILURE	0.518	Tier 3: Moderate Risk	BENE_HI_CVRAGE_TOT_MONS, MEDREIMB_OP, chronic_condition_count
COPD EXACERBATION	0.273	Tier 2: Low Risk	SP_COPD, MEDREIMB_OP, BENRES_OP
SEVERE KIDNEY INJURY	0.235	Tier 1: Minimal Risk	SP_CHRNKIDN, MEDREIMB_OP, BENRES_OP

**ROI Analysis**

Early vs Late Treatment Cost Comparison

Patient ID	Conditions	Proactive Cost (\$)	Reactive Cost (\$)	Potential Savings (\$)
PATIENT-TEST-001	SEVERE HEART FAILURE	\$6,616.88	\$48,081.51	\$41,464.63
PATIENT-TEST-002	SEVERE HEART FAILURE	\$6,269.47	\$53,290.52	\$47,021.05
PATIENT-TEST-003	COPD EXACERBATION	\$3,206.86	\$27,258.34	\$24,051.48
PATIENT-TEST-004	COPD EXACERBATION	\$3,980.14	\$33,831.16	\$29,851.03
PATIENT-TEST-005	SEVERE KIDNEY INJURY	\$5,568.32	\$47,330.74	\$41,762.41
PATIENT-TEST-006	SEVERE KIDNEY INJURY	\$5,934.73	\$50,445.18	\$44,510.46
PATIENT-TEST-007	SEVERE KIDNEY INJURY	\$5,746.17	\$48,842.45	\$43,096.28
PATIENT-TEST-008	COPD EXACERBATION	\$4,385.5	\$37,276.71	\$32,891.22
PATIENT-TEST-009	SEVERE HEART FAILURE	\$6,236.16	\$53,007.33	\$46,771.17
PATIENT-TEST-010	SEVERE KIDNEY INJURY	\$5,934.73	\$50,445.18	\$44,510.46
<b>HOSPITAL TOTAL</b>		<b>\$52,918.06</b>	<b>\$449,811.12</b>	<b>\$396,892.16</b>

**Total Savings**: \$396,892.16 (Hospital-wide with early intervention)

**Cost Reduction**: 88.2% (Reduction in treatment costs)

**Risk Reduction**: 75% (Lower complication rates)

**Avg. Savings**: \$39,689 (Per patient with early intervention)

# Team Members



**Pradeep Kumar A**  
Team Lead &  
Backend Developer



**Jeyvanti S**  
Frontend Developer



**Suriya SK**  
Backend Developer



**Bala Mohanan M**  
Cloud Engineer



**Kishore R**  
Frontend Developer

**Thank You**