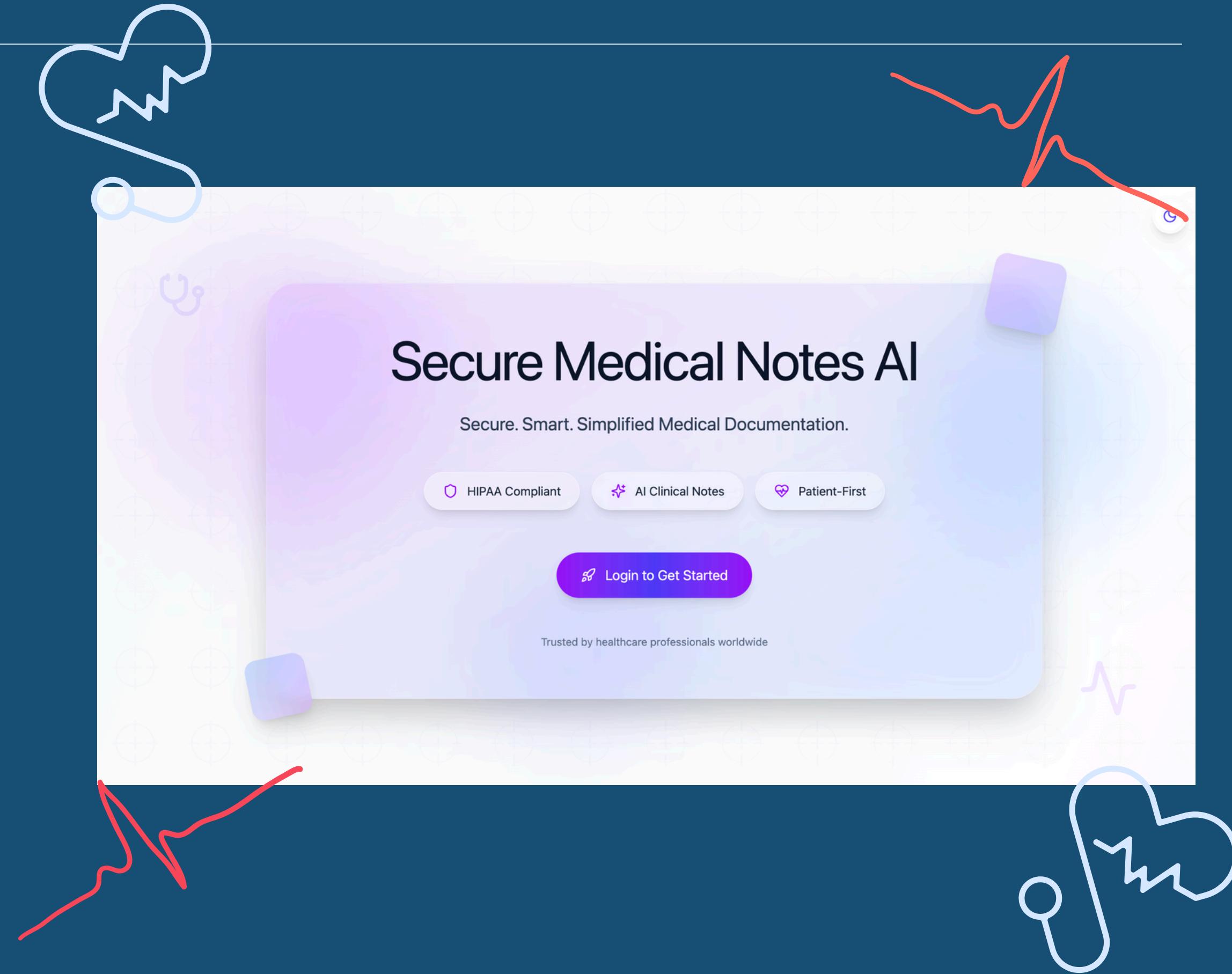


# Secure medical AI

## Intelligent Medical Documentation System

By: Sukriti Sehgal and Sakshi Asati



# Project Overview

- Cloud-native, HIPAA-aware medical notes platform
- AI-powered clinical note summarization, risk analysis, and search
- React + FastAPI + PostgreSQL + Redis + OpenAI + LangChain
- Fully deployed on \*Google Cloud Platform\*



# Project Goals

- Build a secure and scalable medical documentation system
- Provide AI-powered summarization, insights, and risk scoring
- Offer a clean UI for doctors and nurses
- Ensure reliable performance, async tasks, and real-time experience

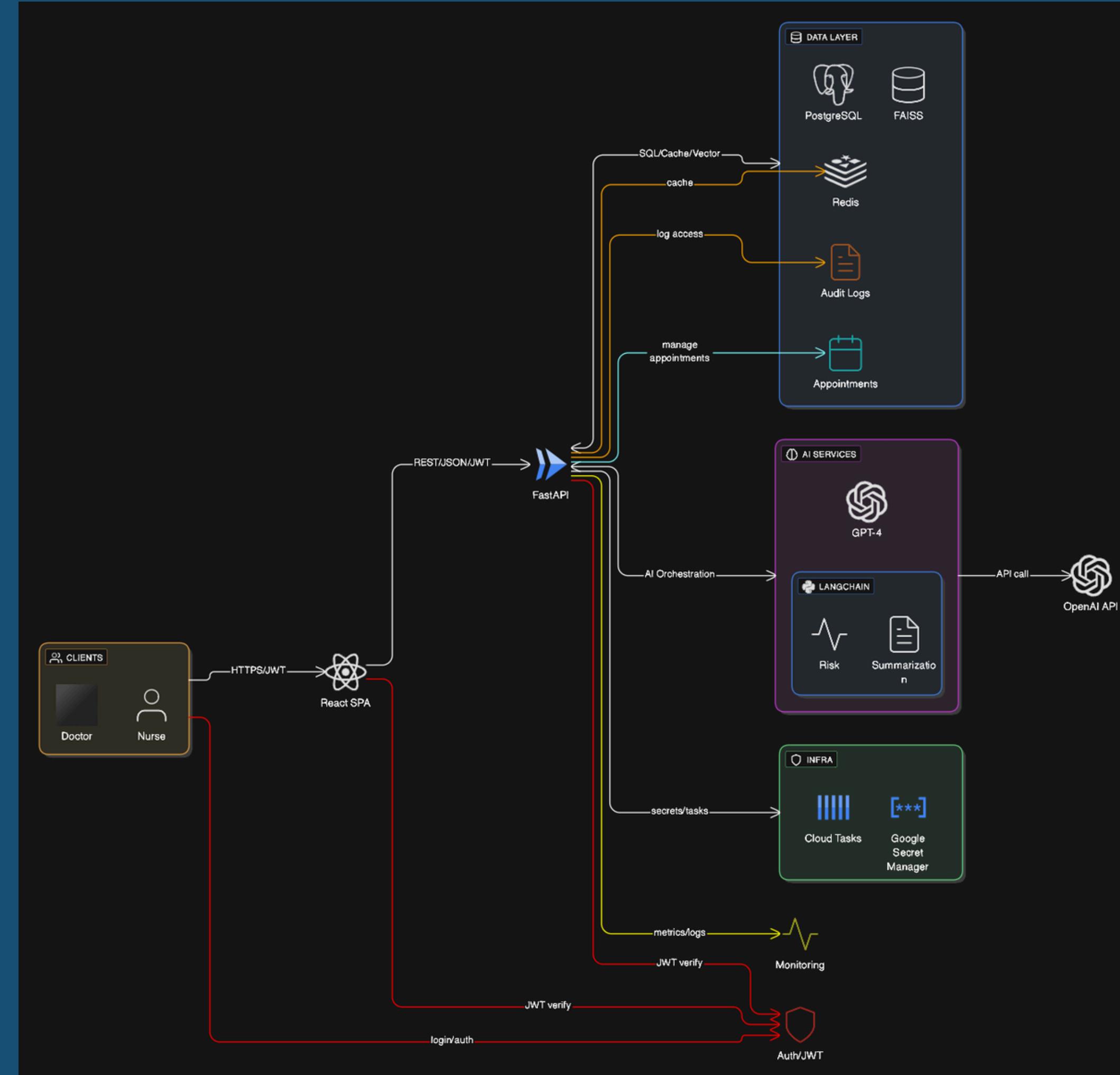


# Development Environment

- macOS/Linux local workstations
- 16GB RAM, multi-core CPU
- 50GB storage for Docker + datasets



# SYSTEM ARCHITECTURE



# Frontend Architecture

React 18 + TypeScript UI:

- Doctor Portal (patient mgmt, notes, AI insights)
- Nurse Portal (vitals, MAR, tasks)
- Tailwind, Framer Motion, Lucide Icons

# AI Layer

- GPT-4o/mini for: summarization, risk analysis, clinical insights
- Embeddings for semantic search
  - Function calling agents
  - LangChain orchestration (memory, prompts, tools)

# Backend Architecture

FastAPI Application Gateway Modules:

- Auth Routes
- Patient Routes
- Notes Routes
- AI Routes

# Data Layer

PostgreSQL Tables

- Users
- Patients
- Notes
- Clinical records

Also includes:

- Redis for sessions, pub/sub, async tasks

# Async & Queue Processing

- Redis task queues.
- Background workers.
- Pub/Sub notification.
- Offloading summarization and risk analysis to async layer.

# Debugging & Testing Approach

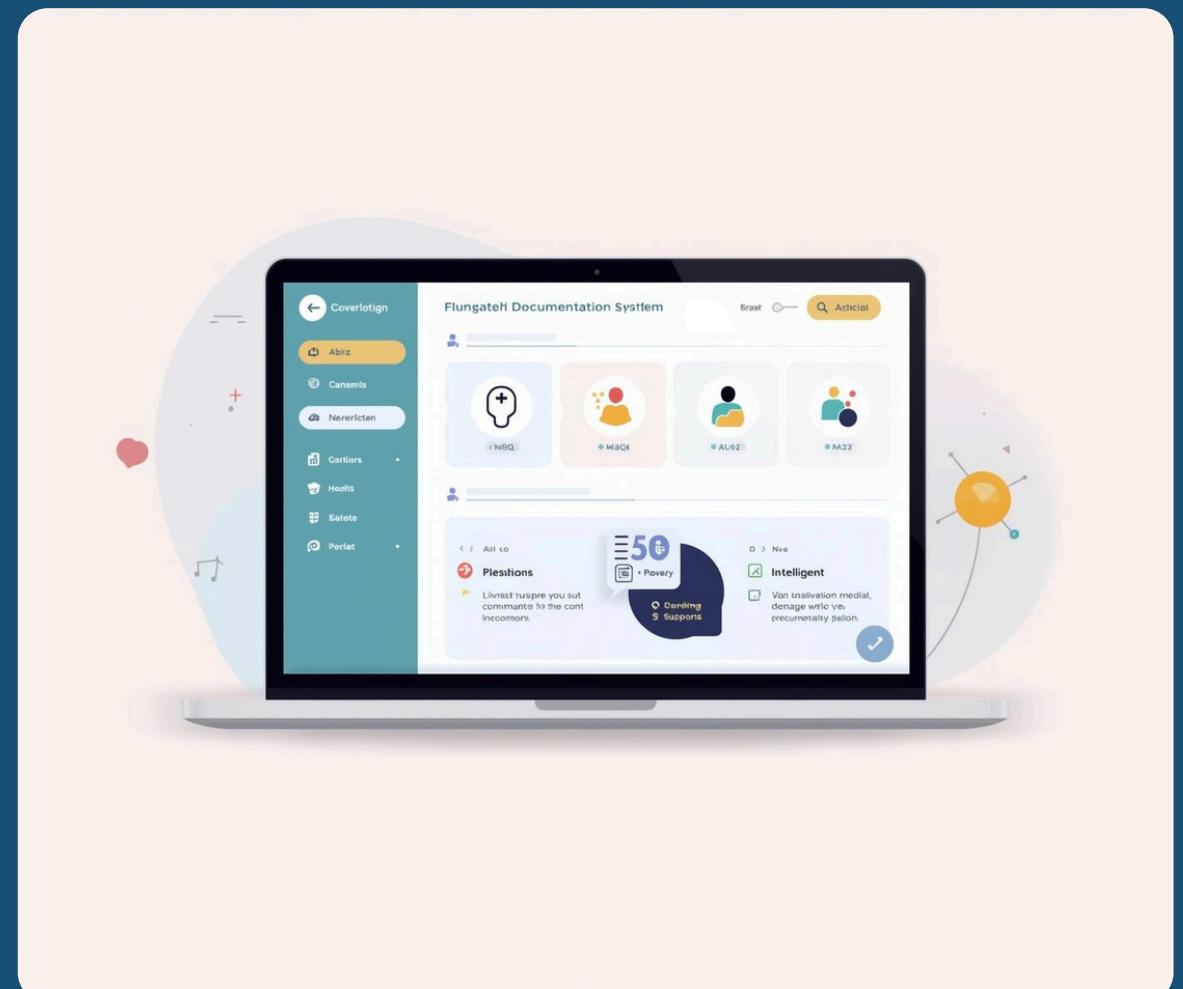
Use content from the report's testing description:

- Debugging JWT auth.
- Fixing CORS + environment variables.
- Testing load with 100+ concurrent users
- Validating summarization accuracy.
- Verifying GCP connectivity & API keys.
- Database connection pooling tests.



# System Limits

- Concurrent users: 100+ supported; bottleneck: DB connections
- Data storage: 100GB+ in Cloud SQL
- AI latency: 3–5 seconds per summarization
- Vector search scalability: thousands of notes; FAISS in-memory limits
- Cost considerations



# Doctor portal

Secure workspace - Doctor

Session Active

HIPAA Mode Nov 15, 10:46 PM Logout

Clinical Command Center

Real-time intelligence for your patient panel.

**Dashboard** Patients Clinical Notes Tasks AI & Analytics Calendar

**Total Patients** 5 +2 this week

**Active Notes** 73 +15 today

**High Risk** 2 Requires review

**Pending Reviews** 8 Due today

**Recent Notes**

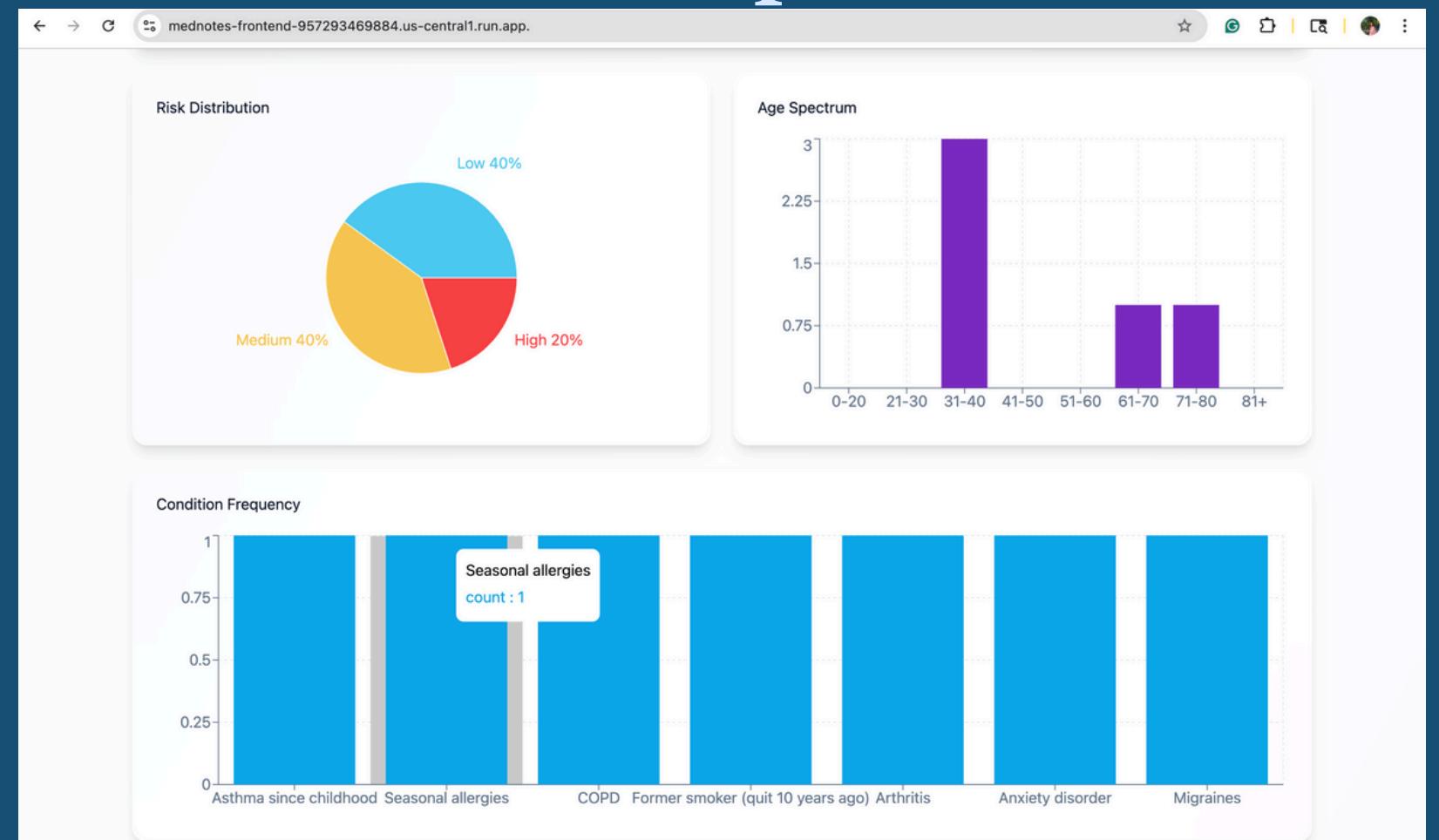
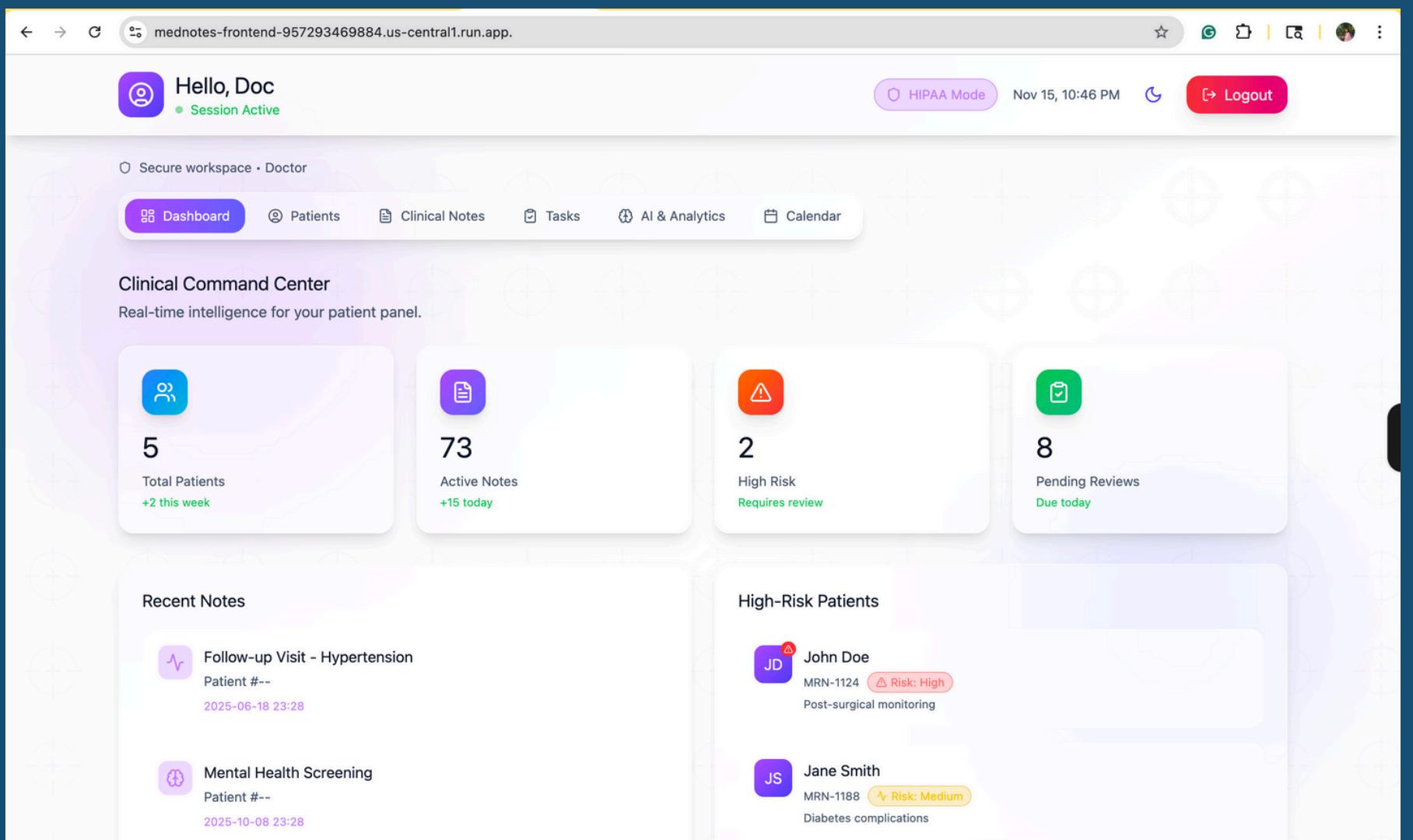
Follow-up Visit - Hypertension Patient #-- 2025-06-18 23:28

Mental Health Screening Patient #-- 2025-10-08 23:28

**High-Risk Patients**

John Doe MRN-1124 Risk: High Post-surgical monitoring

Jane Smith MRN-1188 Risk: Medium Diabetes complications



AI Analyzed Notes 38 100% of all notes

High-Risk Cases 4 Requires immediate attention

Total Patients 5 Under AI monitoring

AI Active System Status GPT-4 Enabled

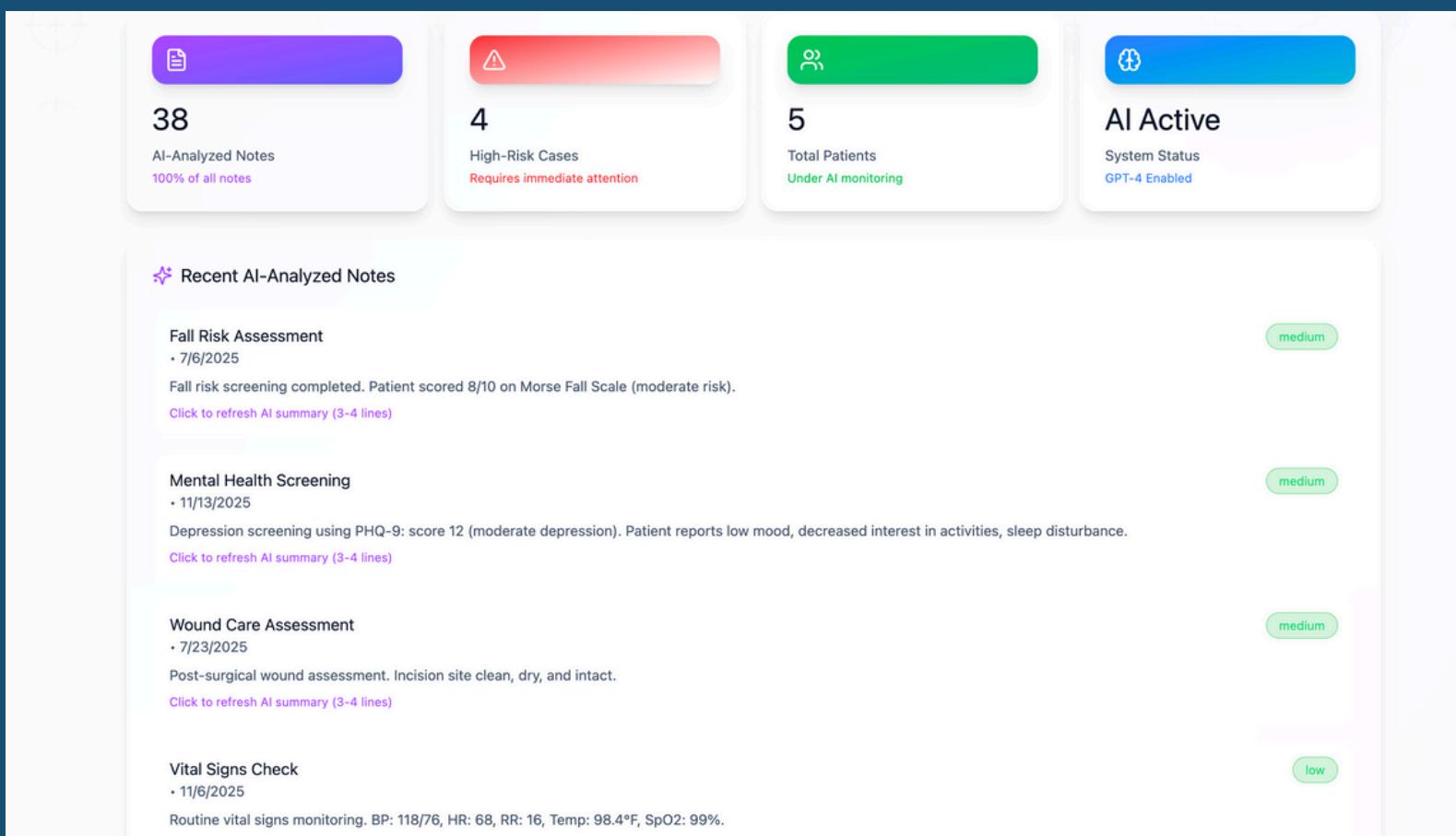
**Recent AI-Analyzed Notes**

Fall Risk Assessment • 7/6/2025 Fall risk screening completed. Patient scored 8/10 on Morse Fall Scale (moderate risk). Click to refresh AI summary (3-4 lines)

Mental Health Screening • 11/13/2025 Depression screening using PHQ-9: score 12 (moderate depression). Patient reports low mood, decreased interest in activities, sleep disturbance. Click to refresh AI summary (3-4 lines)

Wound Care Assessment • 7/23/2025 Post-surgical wound assessment. Incision site clean, dry, and intact. Click to refresh AI summary (3-4 lines)

Vital Signs Check • 11/6/2025 Routine vital signs monitoring. BP: 118/76, HR: 68, RR: 16, Temp: 98.4°F, SpO2: 99%. Click to refresh AI summary (3-4 lines)



Clinical Documentation Studio

Create structured notes, review prior encounters, and search your documentation.

Compose Note Notes Library Search

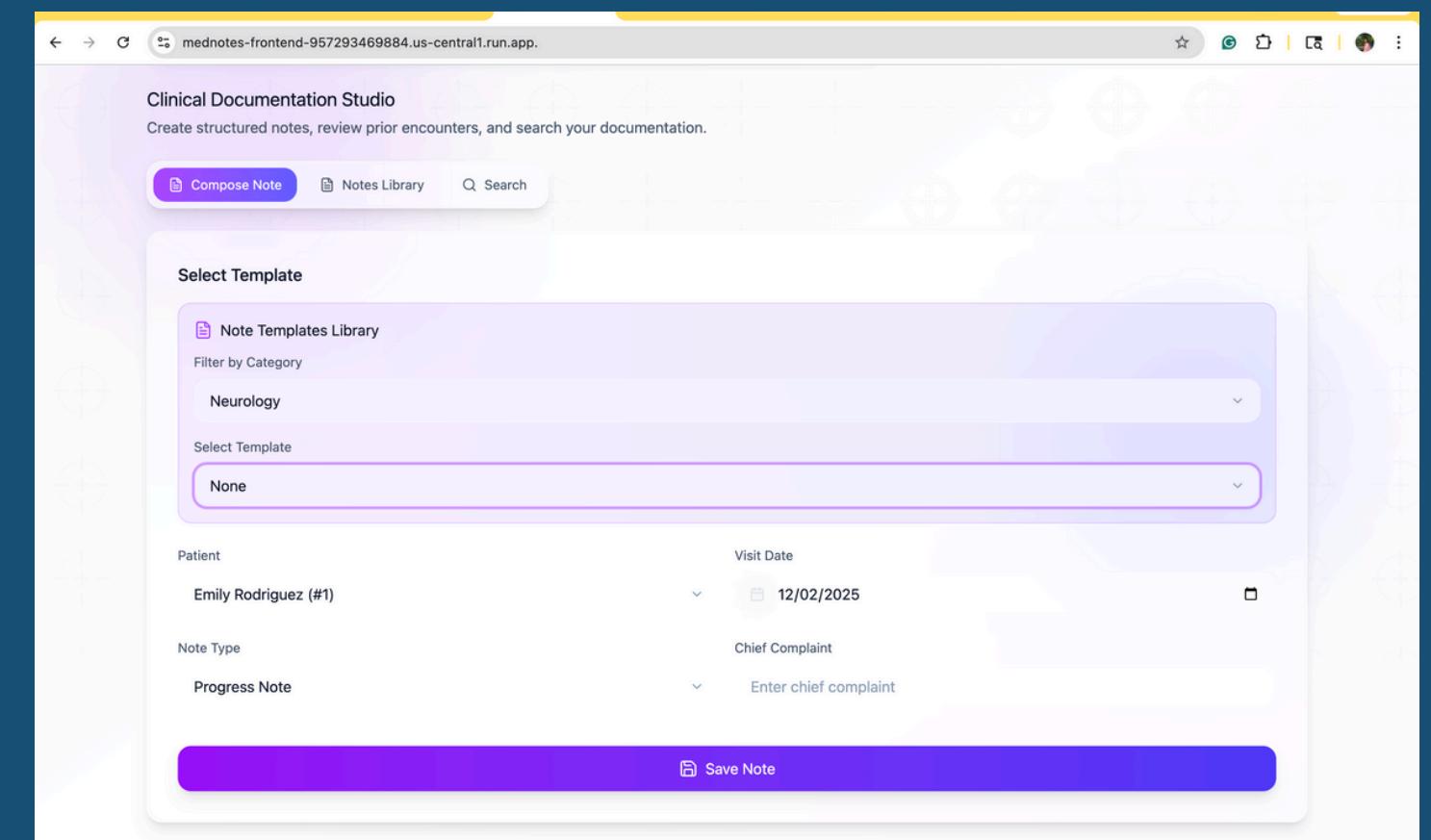
Select Template

Note Templates Library Filter by Category Neurology Select Template None

Patient Emily Rodriguez (#1) Visit Date 12/02/2025

Note Type Progress Note Chief Complaint Enter chief complaint

Save Note



← → ⌛ mednotes-frontend-957293469884.us-central1.run.app.

Hello, Nurse  
Session Active

HIPAA Mode Dec 2, 3:04 PM Logout

Secure workspace • Nurse

Dashboard Patient Care AI & Analytics Notes & Tasks Calendar

## Nurse Command Center

Monitor assignments, tasks, vitals, and medication schedules at a glance.

Assigned Patients: 12 (+3 today)

Tasks Pending: 3 (updated 5m ago)

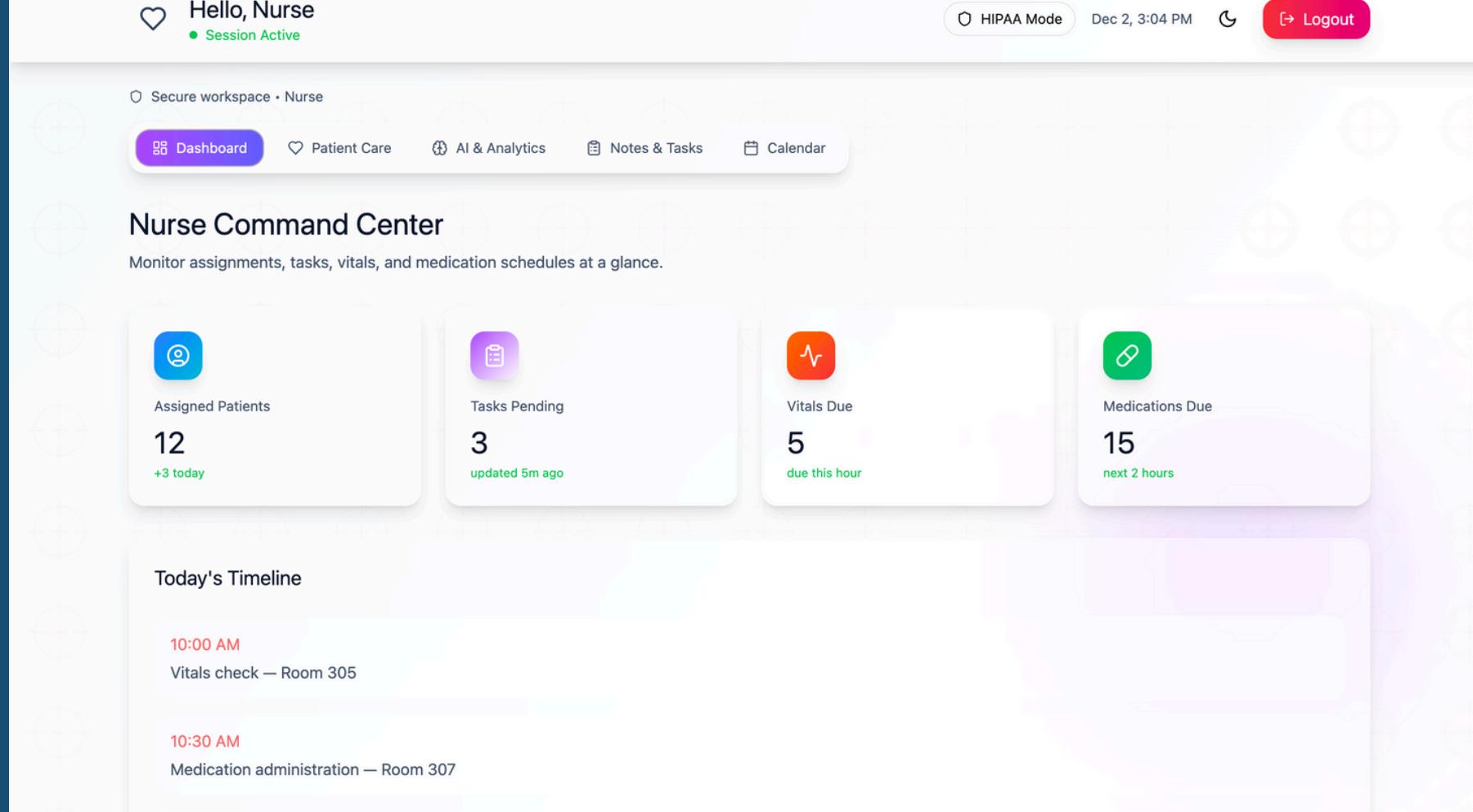
Vitals Due: 5 (due this hour)

Medications Due: 15 (next 2 hours)

Today's Timeline

10:00 AM Vitals check — Room 305

10:30 AM Medication administration — Room 307



Nurse Notes Task Management Vitals Records

Record Vitals Vitals History

### Record Vital Signs

Patient: Emily Rodriguez • MRN MRN004

BP Systolic: 120

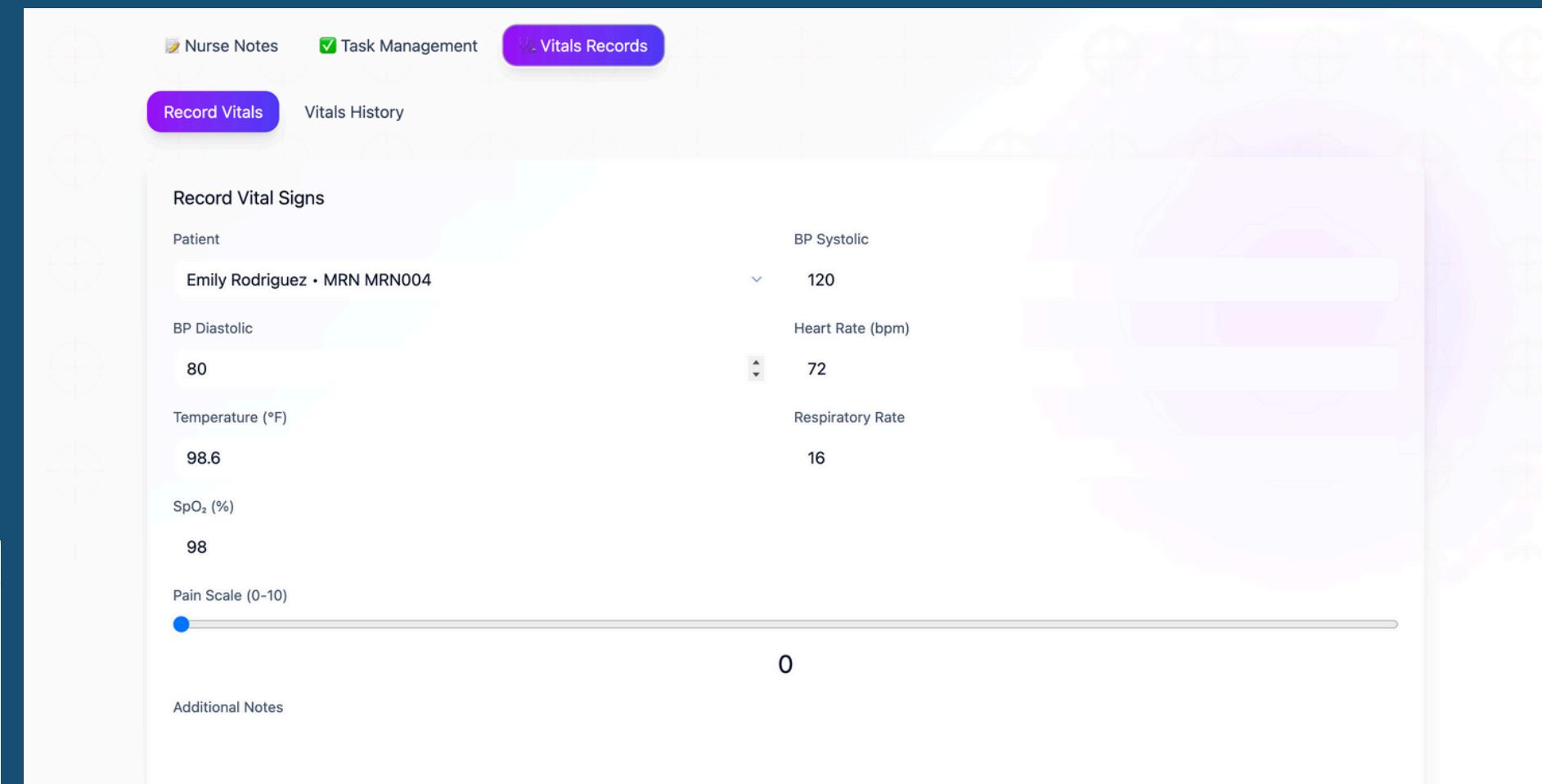
BP Diastolic: 80 Heart Rate (bpm): 72

Temperature (°F): 98.6 Respiratory Rate: 16

SpO<sub>2</sub> (%): 98

Pain Scale (0-10): 0

Additional Notes:



Vital Signs Check • 11/6/2025

Routine vital signs monitoring. BP: 118/76, HR: 68, RR: 16, Temp: 98.4°F, SpO<sub>2</sub>: 99%.

Click to refresh AI summary (3-4 lines)

Mental Health Screening • 7/5/2025

Depression screening using PHQ-9: score 12 (moderate depression). Patient reports low mood, decreased interest in activities, sleep disturbance.

Click to refresh AI summary (3-4 lines)

### Patient Visit History

Emily Rodriguez 0 visits

AI Summary ↗ Robert Anderson 0 visits

AI Summary ↗

Emily Rodriguez is a patient presenting with a chief complaint of headache and a history of moderate depression, currently managed with Sertraline 50mg daily. Vital signs are stable: BP 118/76, HR 68, RR 16, Temp 98.4°F, SpO<sub>2</sub> 99%. Blood work has been completed with no acute findings, and the patient is advised to increase Sertraline to 100mg and follow up in 2 weeks. Fall risk measures are in place due to a score of 8/10 on the Morse Fall Scale, and wound care is ongoing with no signs of infection.

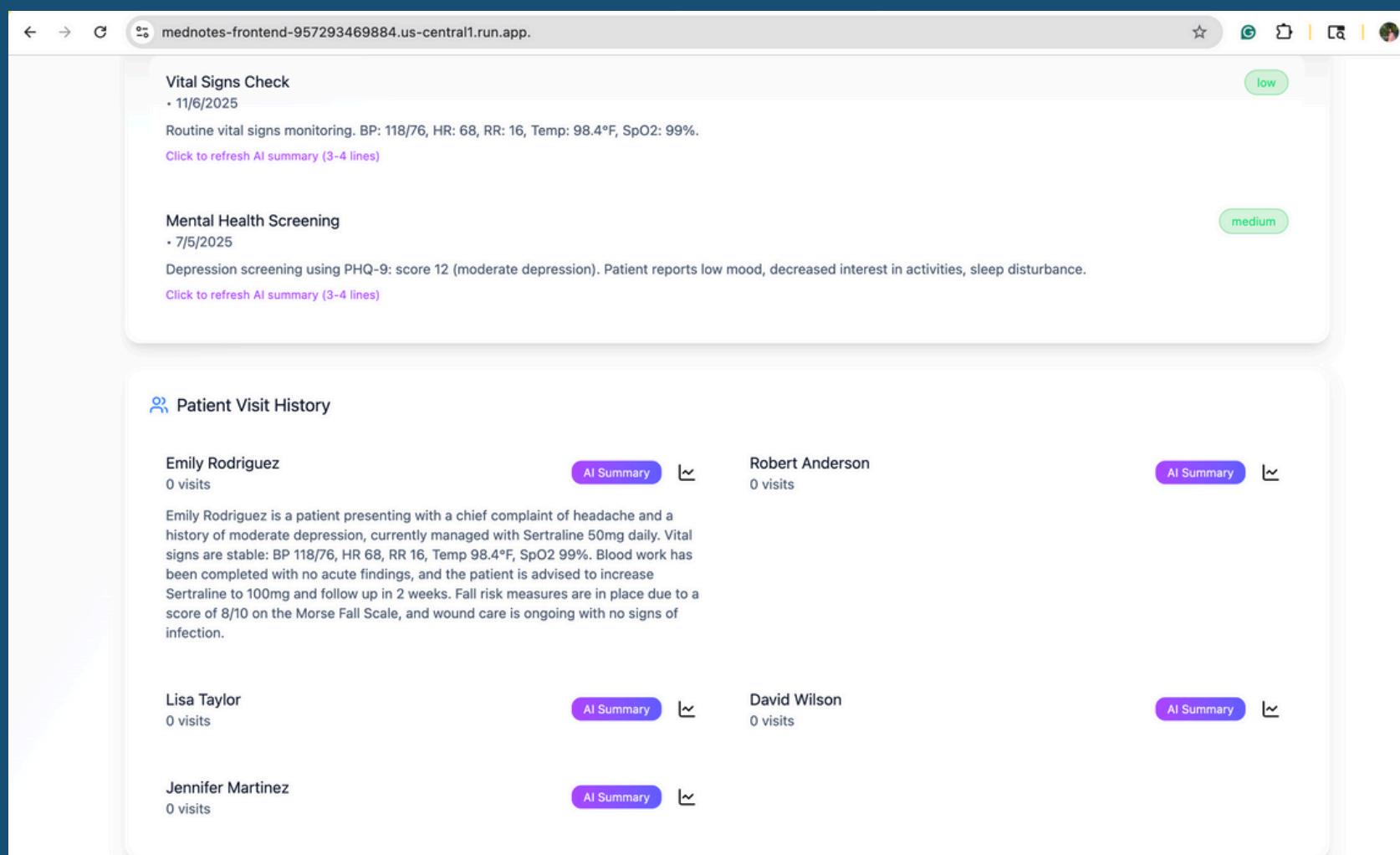
Lisa Taylor 0 visits

AI Summary ↗ David Wilson 0 visits

AI Summary ↗

Jennifer Martinez 0 visits

AI Summary ↗



# Nurse portal

# Deployed System

- Live App: <https://mednotes-frontend-957293469884.us-central1.run.app>
- GitHub: <https://github.com/cu-csci-4253-datacenter-fall-2025/final-project-sukritisehgal-28>

# Conclusion

The system demonstrates:

- Production-ready architecture
- Cloud-native deployment
- Full-stack + AI + distributed systems expertise

