RapidCare – Team# 25
- Smart EHR System

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March 29th , 2025

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Our Team

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Agenda

- Problem Overview
- What Could We Do?
- Solution Overview
- Demo
- Key Components
- Design and Architecture
- Impact Of The Solution
- What Next?
- Q/A

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Problem Overview

- **Extreme shortage** of family doctors in Ontario [1]
  - Number of patients without one will rise from **600,000 to 2.5 million** [2]

- **Massive wait times in ERs**
  - With average length of stay 22.7 hours [3]
  - Patients leaving without being seen

- Healthcare professionals have a **massive documentation overhead** in their day to day
  - Solutions exist, with **complex UI**
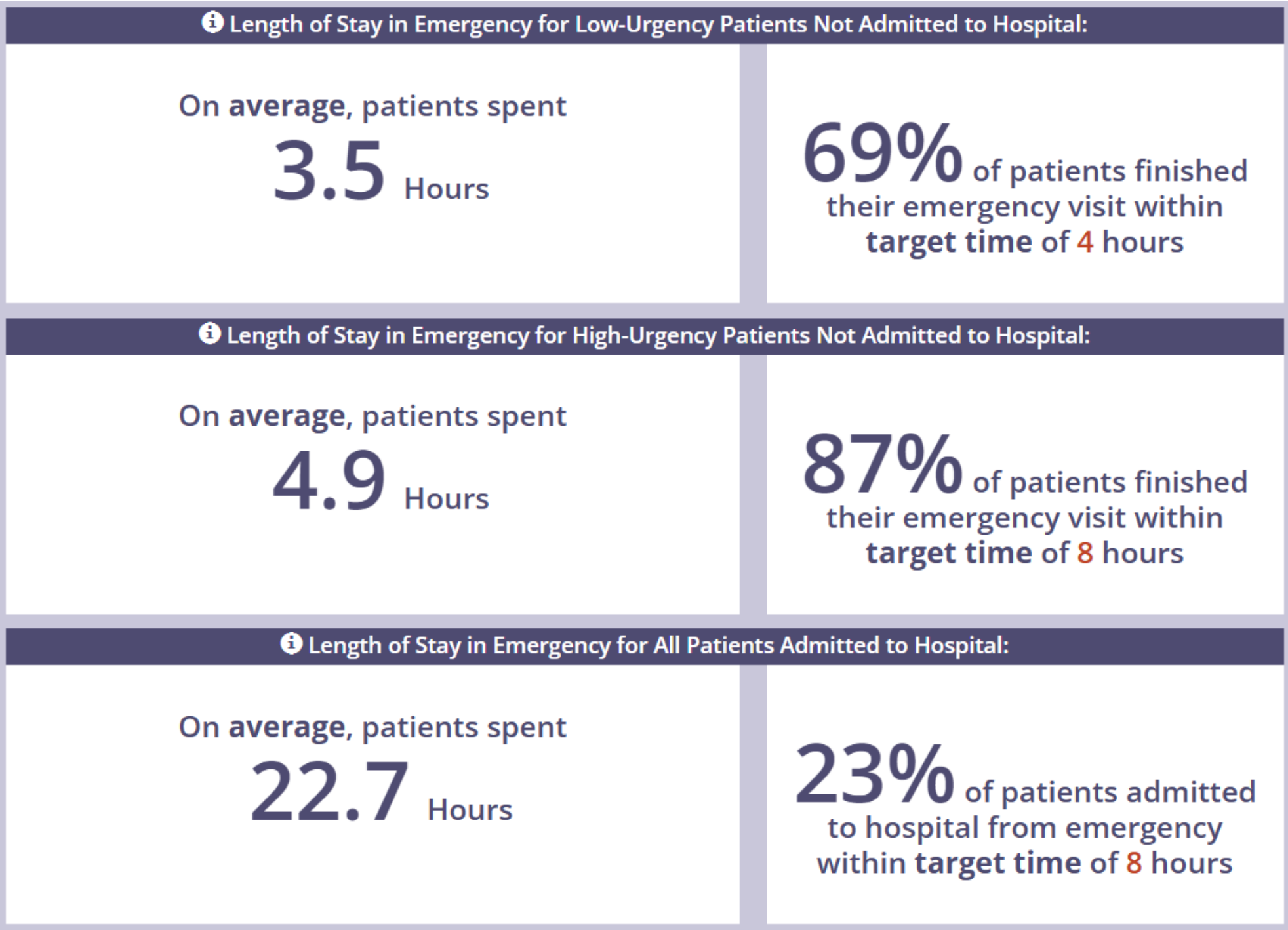 - **Hard to traverse** through patient **data**

ℹ Length of Stay in Emergency for Low-Urgency Patients Not Admitted to Hospital:

On **average**, patients spent **3.5** Hours

69% of patients finished their emergency visit within target time of 4 hours

ℹ Length of Stay in Emergency for High-Urgency Patients Not Admitted to Hospital:

On **average**, patients spent **4.9** Hours

87% of patients finished their emergency visit within target time of 8 hours

ℹ Length of Stay in Emergency for All Patients Admitted to Hospital:

On **average**, patients spent **22.7** Hours

23% of patients admitted to hospital from emergency within **target time** of 8 hours

Figure 1: Stats for Wait times in ER [3]

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What Could We Do?

- The NLP techniques and speech recognition software have made significant advancements in recent years

- These technologies can be adapted to improve accuracy and efficiency of healthcare workflows

- Retrieval and Generation can be used to provide diagnostic and medication suggestions based on accepted documentation

- Improve User Interface to improve user experience
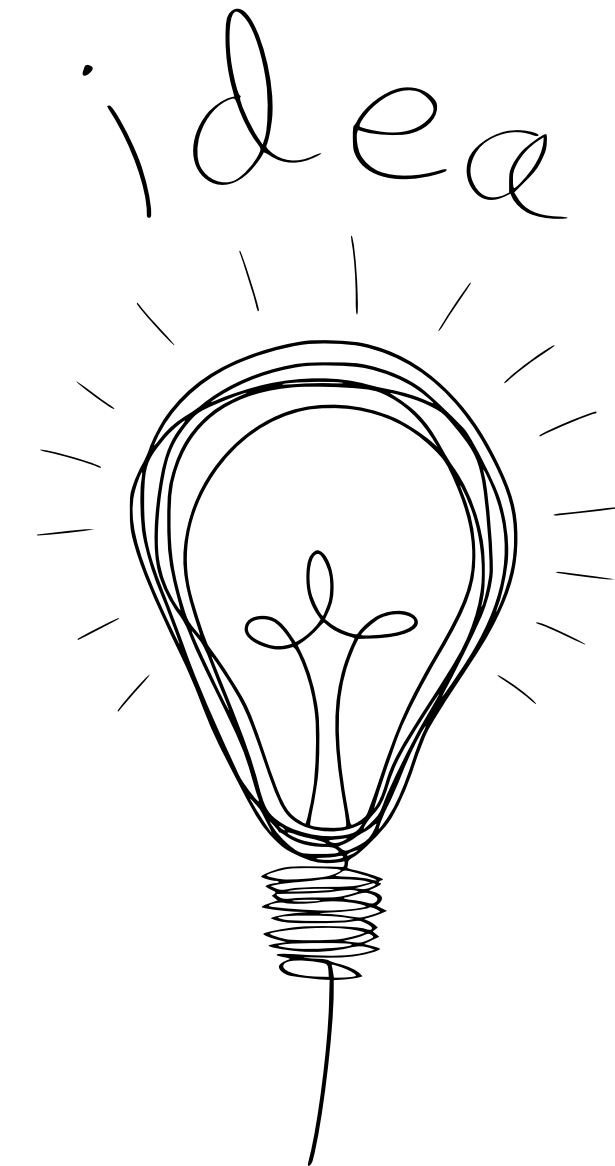
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Solution Overview

- Effectively record and store patient data, clinical notes, treatment plans with **real-time data access**

- Record, transcribe, and classify patient-doctor interactions to **automatically fill patient records**

- Provide **comprehensive diagnosis predication**
- **Comprehensive action plan** to address diagnosis prediction

- **AI Assistant**, to **query** patient previous visits and **health conditions**

- **High discoverability** and **clear affordances** for admin and healthcare professionals
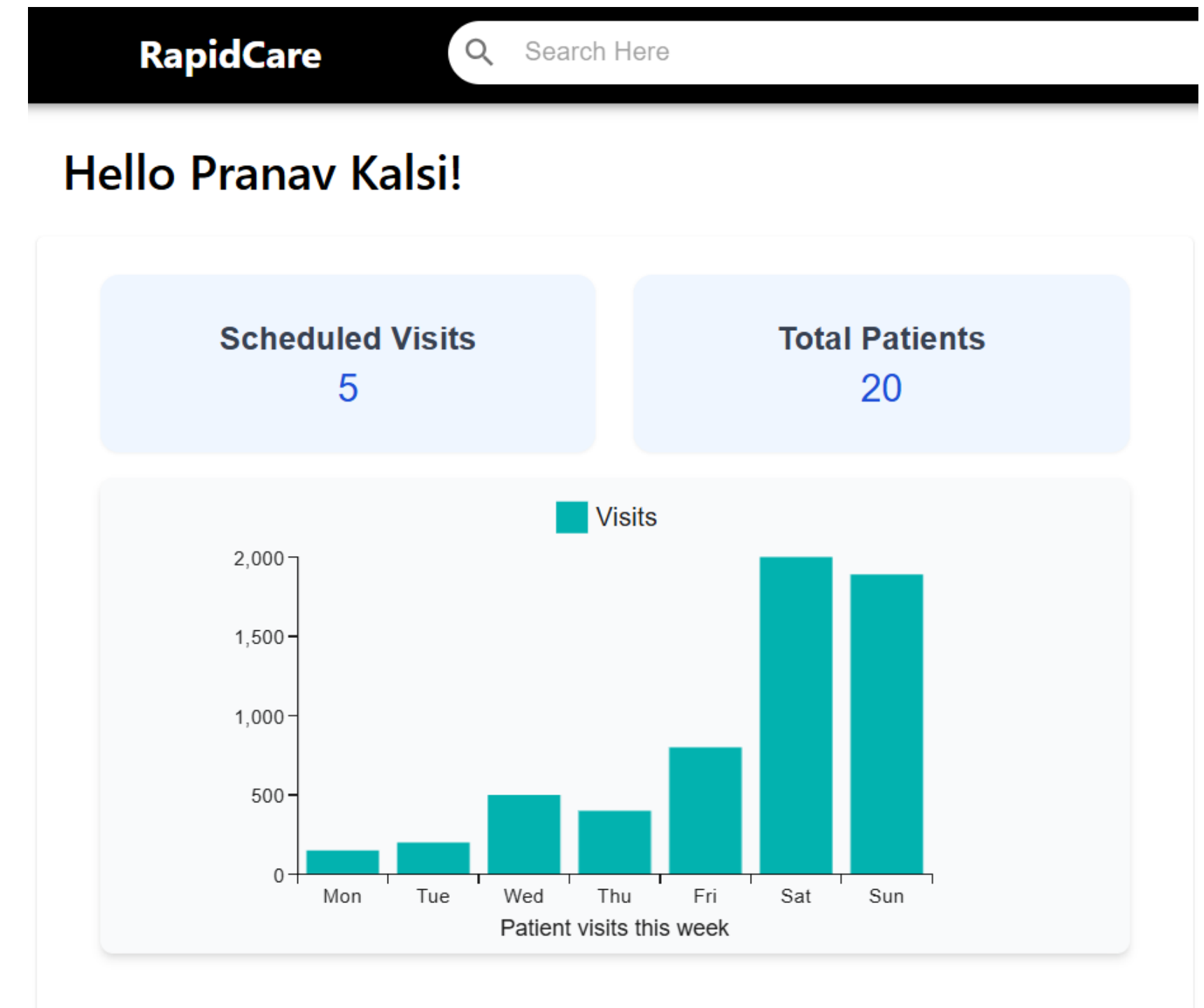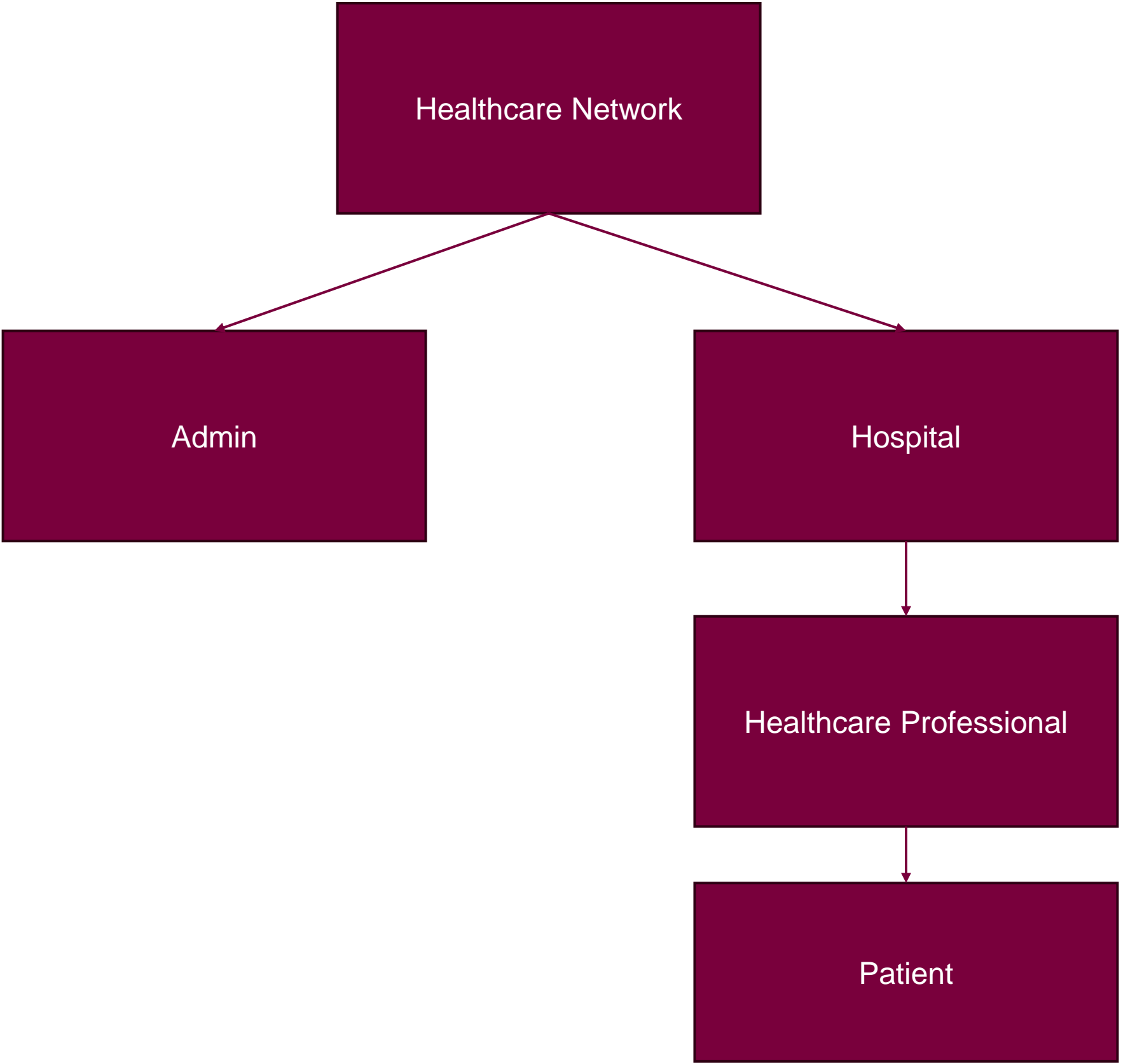

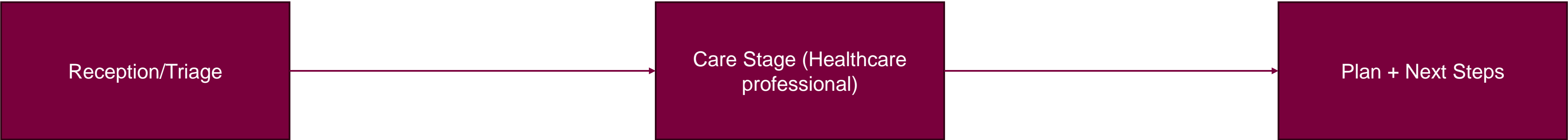*Figure 2: Snapshot of RapidCare dashboard*

Background on Healthcare Networks

Health Care Network
Brief Overview

Health Care Network

Patient – Treatment Interaction

Reception/Triage → Care Stage (Healthcare professional) → Plan + Next Steps

Application Demo

Let's checkout the app!

Interactions within the key components.

Inside operation.

# Voice-to-Text Transcription

The Insides

- Using **socket communication**, the frontend records and sends audio bytes to the backend.

- Backend service receive the bytes converts into an audio format (webm)

- Sends the webm over to **Whisper for Classification**

Client Socket

TS

1   6

Server Socket

2   3   4   5

(REST)   (REST)

FFmpeg

OpenAI Whisper

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Classification Service

The Insides

- Using **socket communication**, the frontend records and sends audio bytes to the backend.

- Backend service receive the bytes and responds with **transcribed text**.

- Using **LangGraph** the transcription is classified.
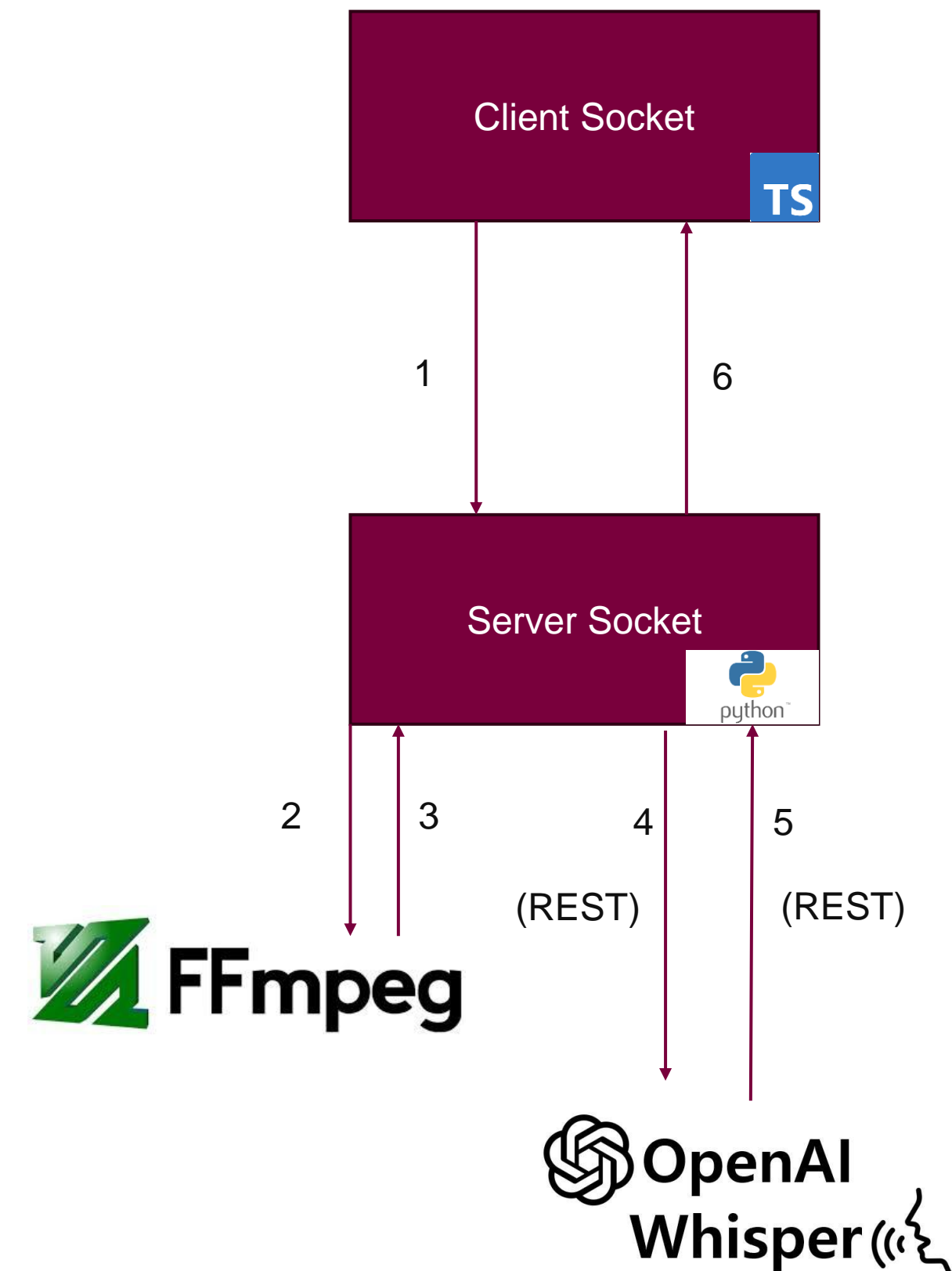
Diagnosis + Plan Prediction

The Insides

- Based on patient doctor **conversation** provide an **analysis** of what possible **diagnosis** could **apply**.

- Based on the **analysis** provides a **plan** of actions and **medicines** based on **supported context**.

- The **context** for the **model** is **reputed** and **accepted** **standard protocols** such that the outputs are **focused to certain norms**.
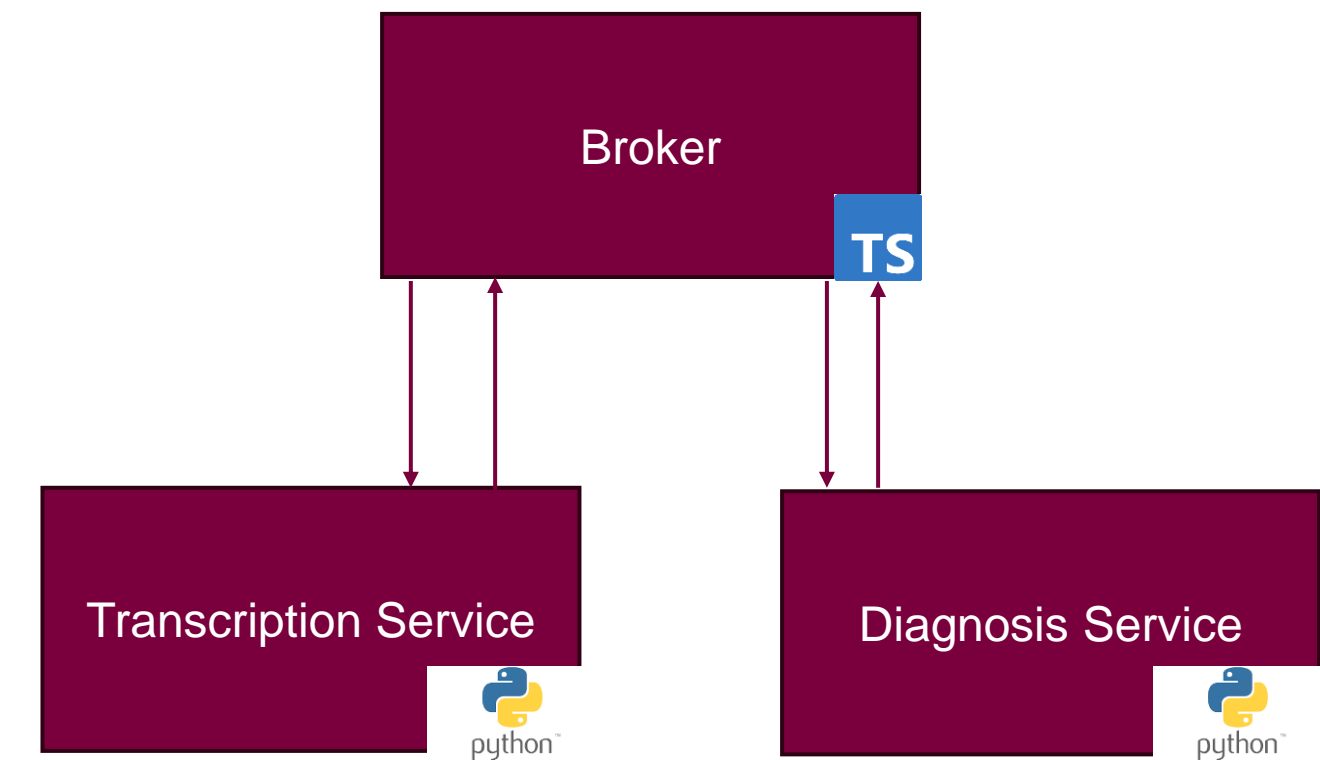
# Diagnosis + Plan Prediction- Context Based Reponses
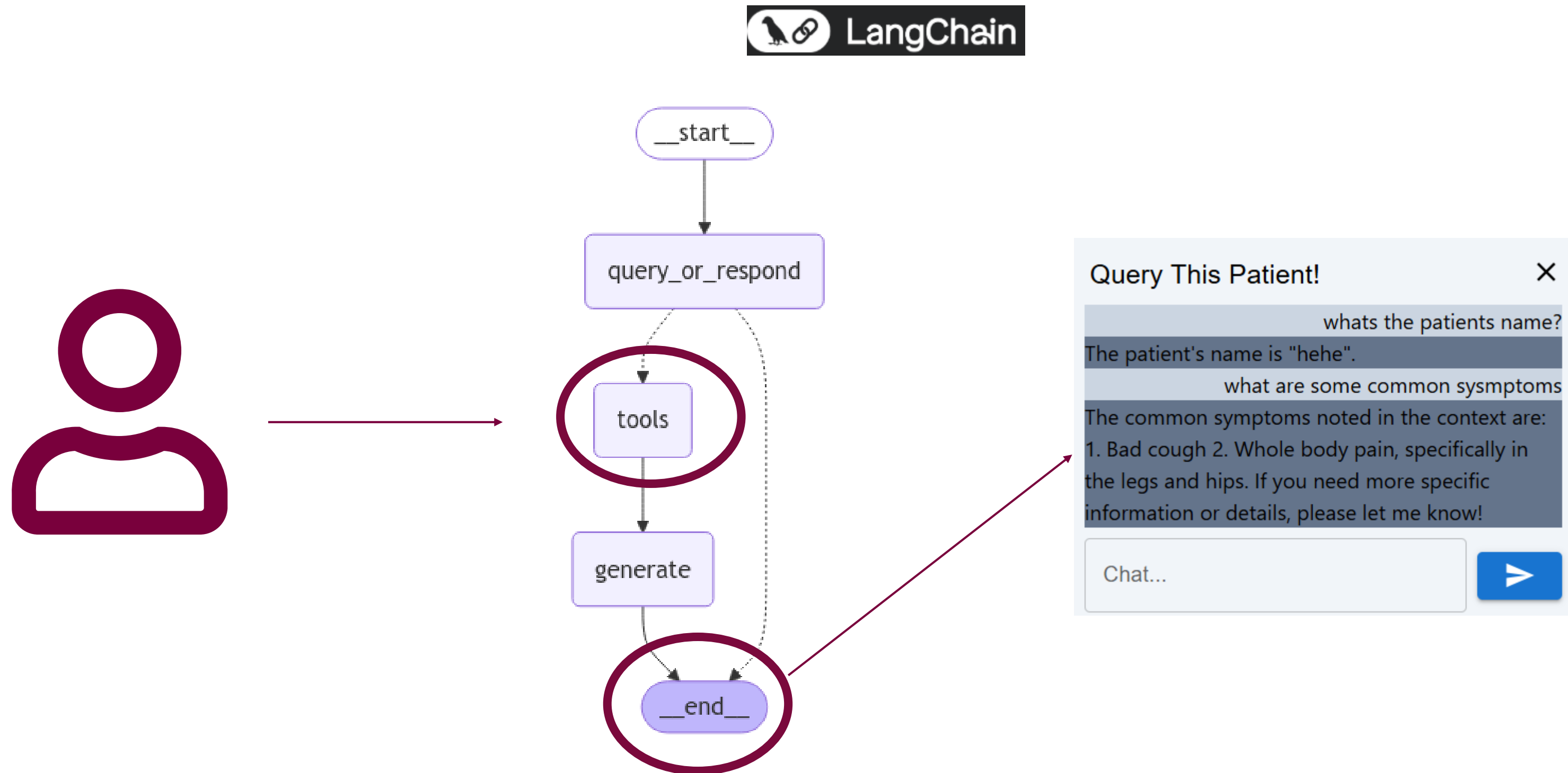
RAG Architecture
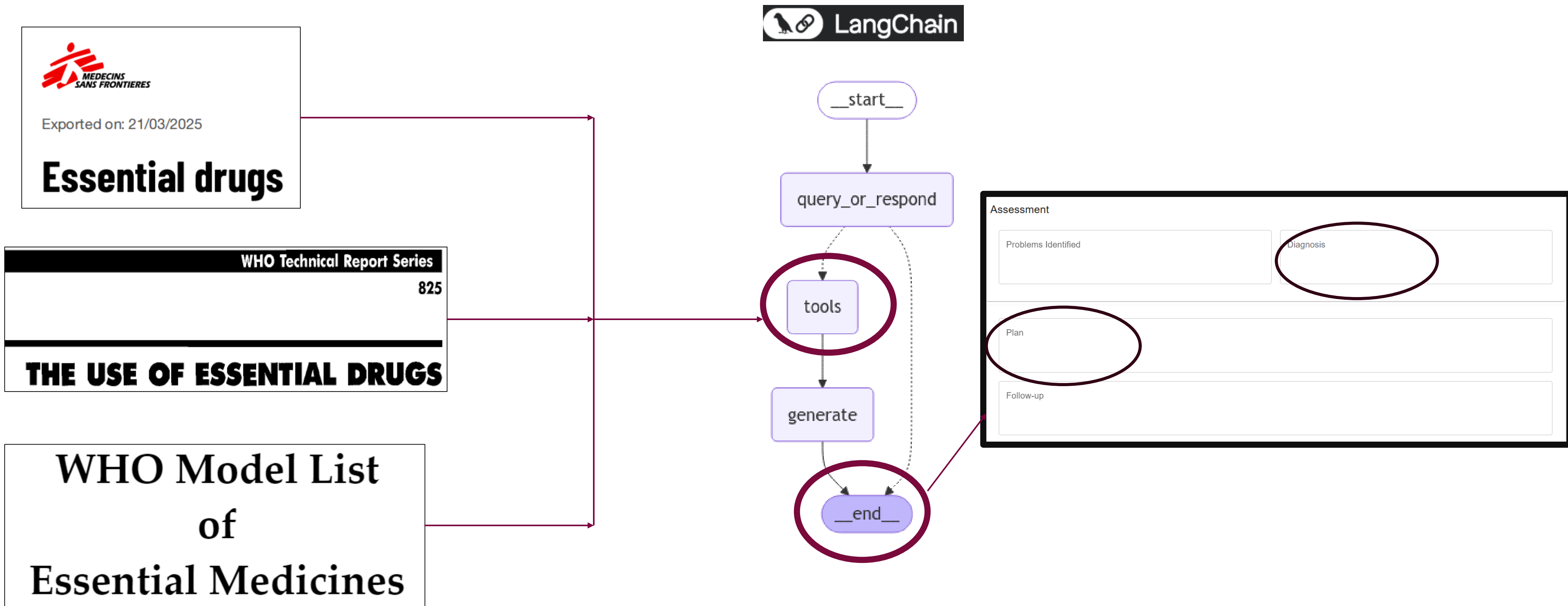
AI Assist

The Insides

- Based on the patient context, provides information on the patient.

- Can **improve data-lookup efficiency**, current solutions provide poor functionality.

- Functionality **can be extended** to adding more context for other conversation base interactions.

Broker

TS

Diagnosis Service

python
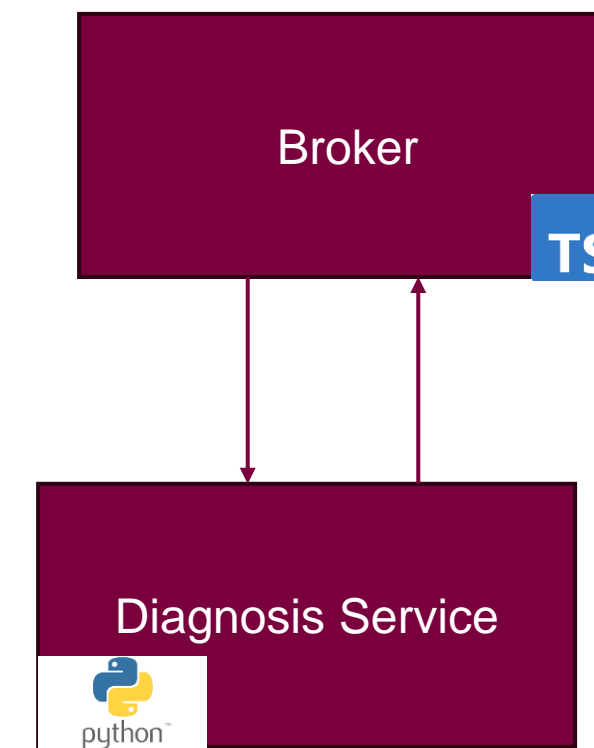
AI Assistant - Context Based Reponses

RAG Architecture

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Design and Architecture

- Adapted Model-View-Controller (MVC) architecture
  - Easily **extendable design** as new features and services are added

- Single responsibility principle
  - Each microservice (transcription, classification, AI assist etc.) has **single responsibility**
  - Ensures **cleaner, maintainable, and scalable code** while minimizing technical debt

- Human-Computer Interaction (HCI) Principles for UI
  - Key features and actions are **discoverable**, reducing cognitive load
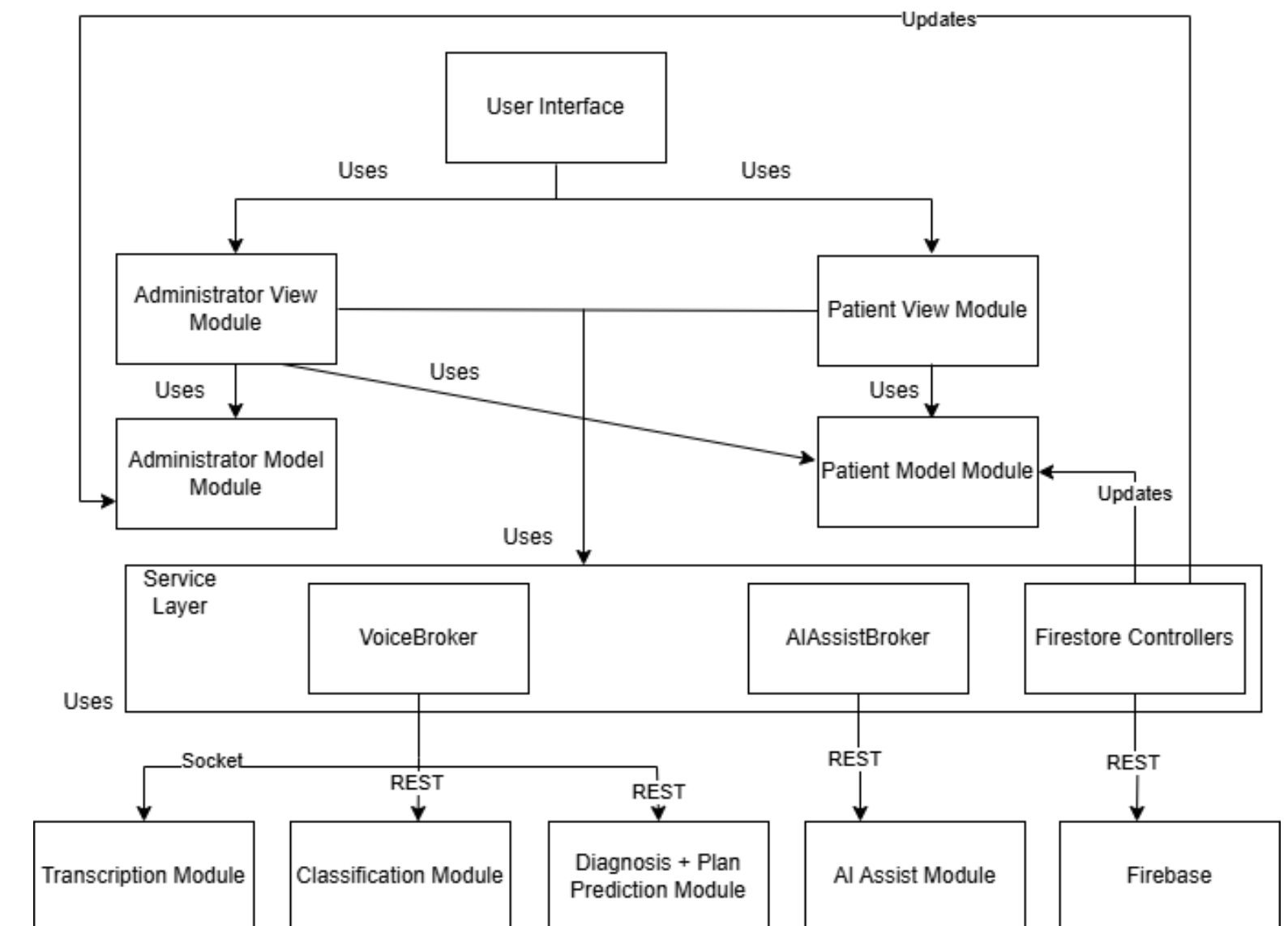 - Appropriate **feedback** such that users are never lost.

Figure 3: System design diagram

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Impacts of the Solution

✓ **Improved access to healthcare for patients**

- Reduction in documentation and administrative overhead
- Reduction in ER wait times and patient flow

✓ **Improved User experience**

- UI follows HCI principles ensuring ease of use and user-friendly interaction
- Intuitive and easy to navigate UI, minimizing learning curve

✓ **Improved patient data management**

- Comprehensive data modelling ensuring accuracy and reliability
- Real-time data access facilitating quick decision making

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What Next?
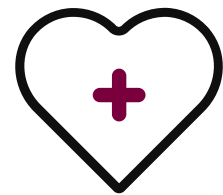
- **Expand functionality to auto-generate prescriptions, referrals**
  - Faster decision making and enhances efficiency
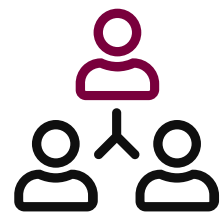 - Reduce errors

- **Seamless integration with blood work labs and diagnostic centres**
  - Improved data exchange
  - Streamlined workflows

- **Advanced workflow analytics for hospitals and clinics**
  - Optimize operations
  - AI prompting the patient for more detail to further improve diagnosis suggestions
  - Help hospitals to better allocate resources

- **Multi-language support for healthcare professionals**
  - Improves accessibility for diverse populations

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References

[1] N. Ireland, "2.5 million Ontarians don't have a family doctor, college says | CBC News," CBCnews, https://www.cbc.ca/news/canada/toronto/ontario-family-doctor-shortage-record-high-1.7261558 (accessed Mar. 29, 2025).

[2] Ryan Patrick Jones, "Family doctor shortage affects every region and is getting worse, Ontario Medical Association says," CBC, https://www.cbc.ca/news/canada/toronto/family-doctor-shortage-oma-1.7097935 accessed Mar. 29, 2025).

[3] Let's make our health system healthier, "System performance," Emergency Department Time Spent by Patients in Ontario – Health Quality Ontario (HQO), https://www.hqontario.ca/system-performance/time-spent-in-emergency-departments (accessed Mar. 29, 2025).

[4] I. Yuan, Human Computer Interfaces, Lecture: "Norman Principles", Faculty of Engineering, McMaster University, Hamilton, October 2024.

[5] "TypeScript," Wikipedia, https://en.wikipedia.org/wiki/TypeScript (accessed Mar. 29, 2025).

[6] "Python (programming language)," Wikipedia, https://en.wikipedia.org/wiki/Python_%28programming_language%29 (accessed Mar. 29, 2025).

[7] "Build a retrieval augmented generation (RAG) app: Part 2," LangChain, https://python.langchain.com/docs/tutorials/qa_chat_history/ (accessed Mar. 29, 2025).

[8] Aiaaic, "Getting to grips with ... Whisper Ai," Getting to grips with ... Whisper AI, https://aiaaicalert.substack.com/p/getting-to-grips-with-whisper-ai (accessed Mar. 29, 2025).

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Thank you!

Questions?

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