



# IoT Platform for Real-Time Monitoring & AI Assistance

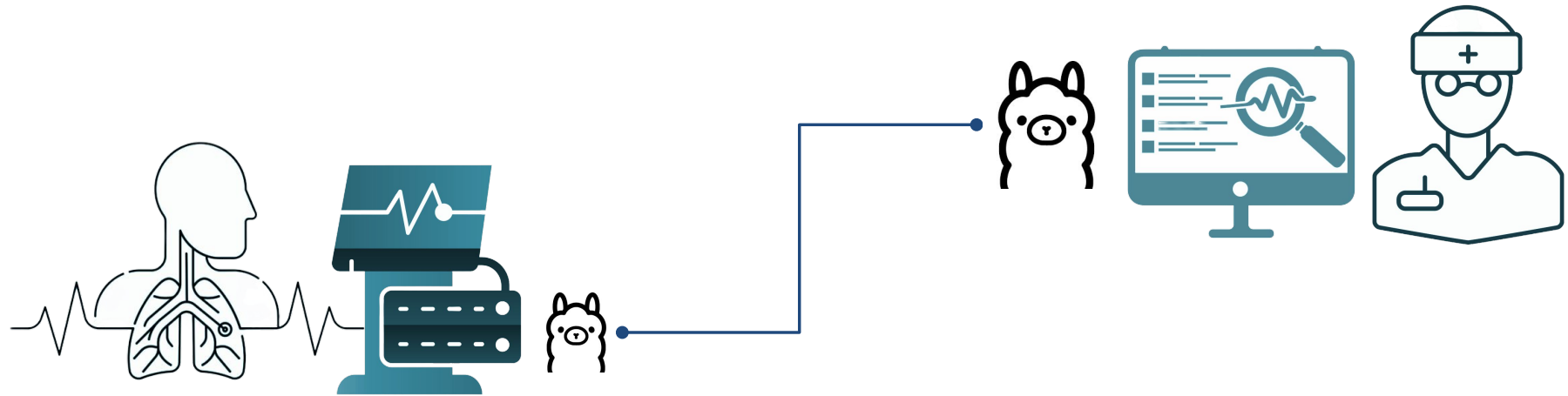
**From Sensors to Assistant - An Unified Health Monitoring Solution**

**Acossi Giorgio - Castagna Marco**

# A Smarter Way to Monitor and Assist

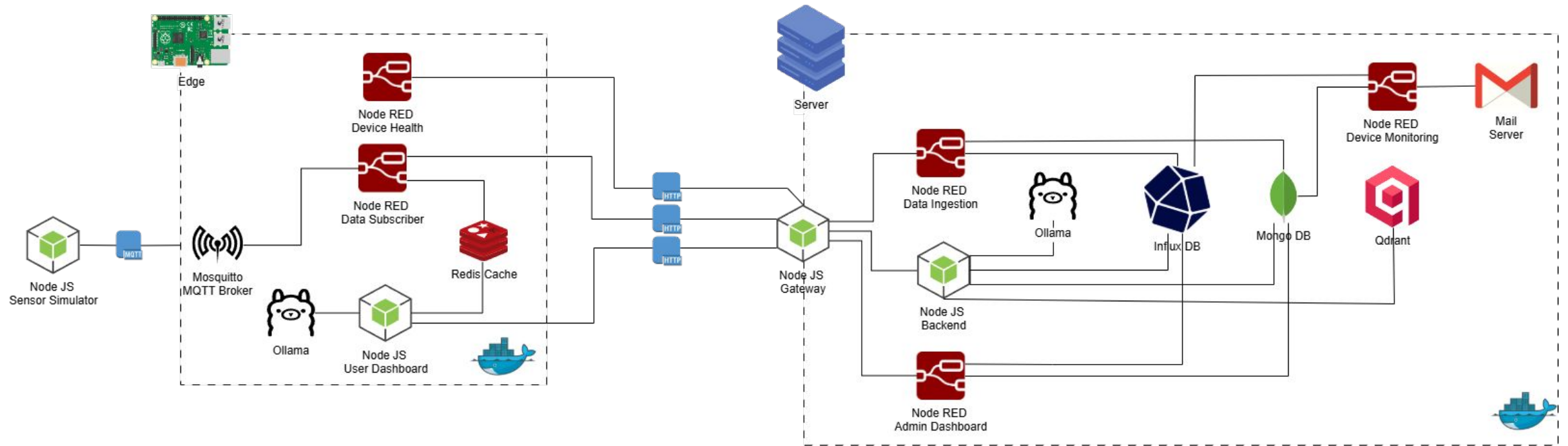
This **platform** acts as a bridge between patients, sensors, and clinicians. It continuously monitors **vital signs** and makes **remote supervision** easier and more reliable for medical experts.

It also provides intuitive **dashboards** and an **AI assistant** capable of interpreting the data, explaining what is happening, and suggesting the most appropriate actions to the patient.

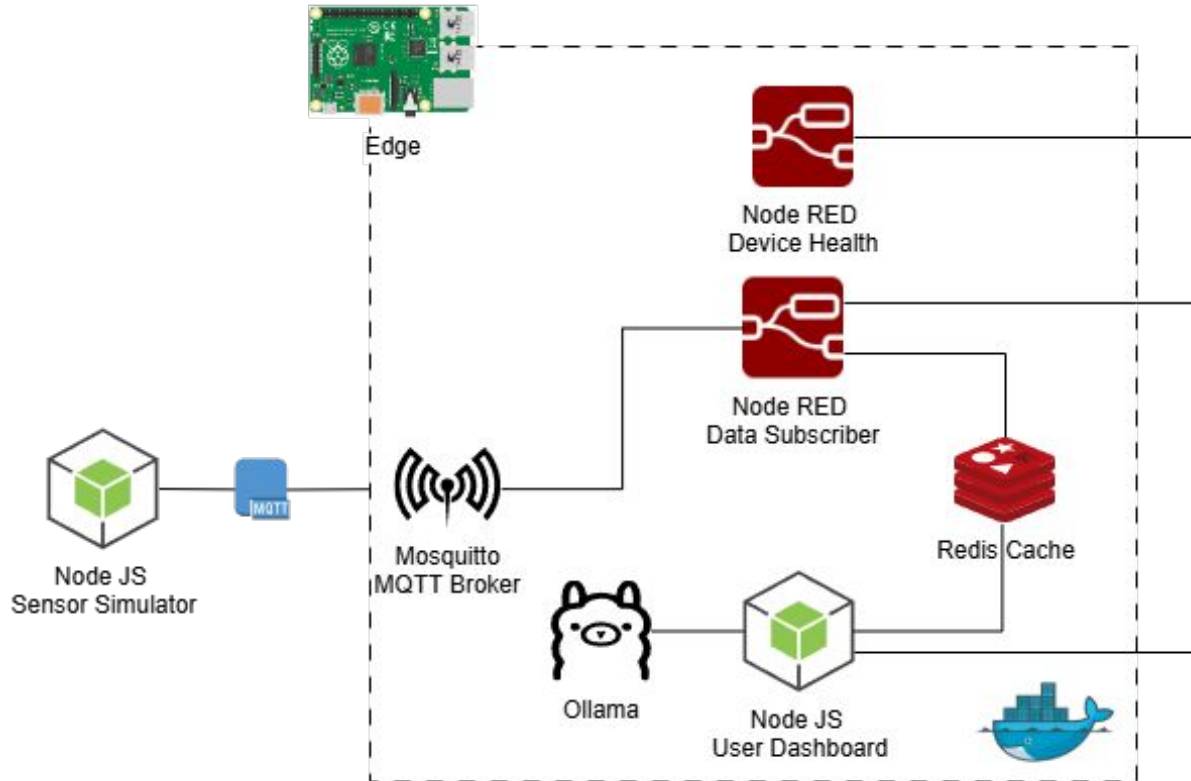


# Architecture

## Hybrid Approach



# Edge Architecture Overview



## Data Acquisition

- Sensor simulator
- MQTT broker for edge-level data ingestion

## Data Processing & Monitoring

- Device health flow
- Data subscriber flow
- Redis cache for local data storage
- Patient vitals dashboard

## AI Assistance

- AI Assistant Chat
- Edge LLM for local filtering and safety

# Cloud Architecture Overview

## Data Storage

- Time-series storage - InfluxDB
- Application data database - MongoDB
- Vector search index - Qdrant

## Data Processing Flows

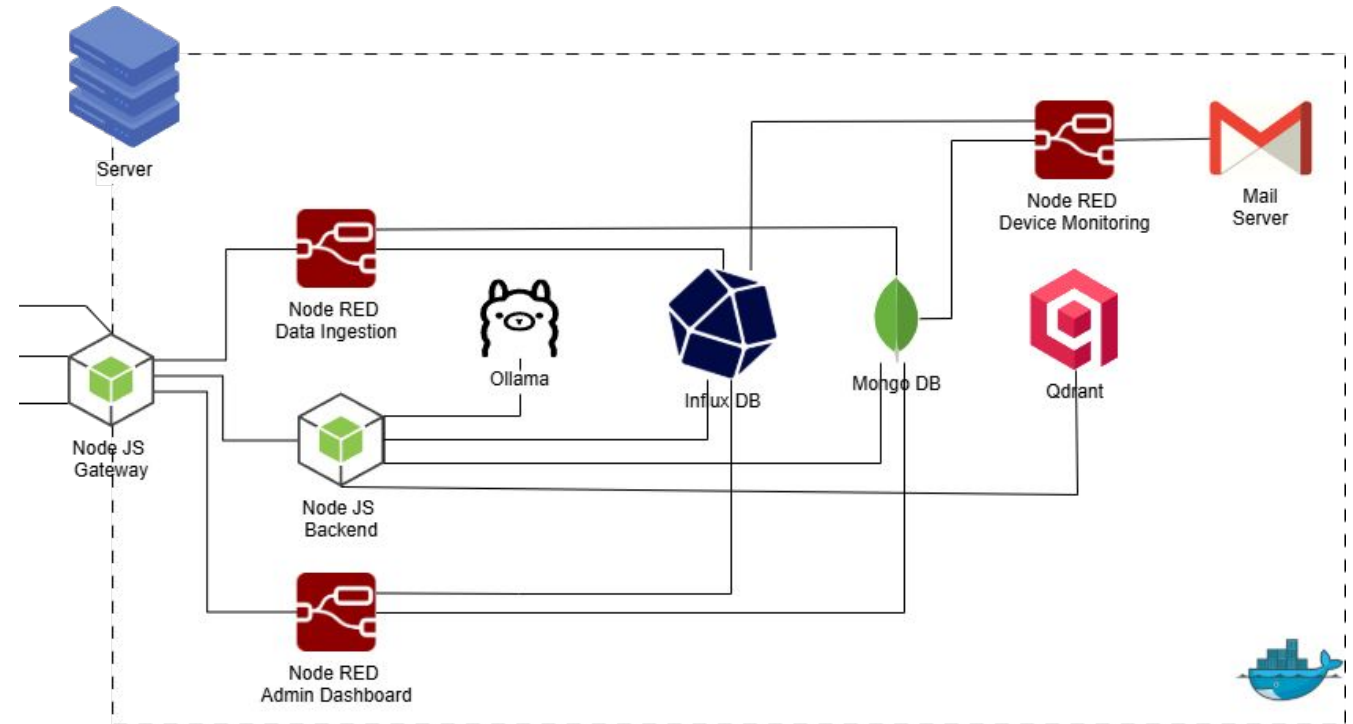
- Data ingestion flow
- Device monitoring flow
- Mail Server for notifications

## Dashboards & APIs

- API Gateway and auth
- API Backend
- Admin dashboard

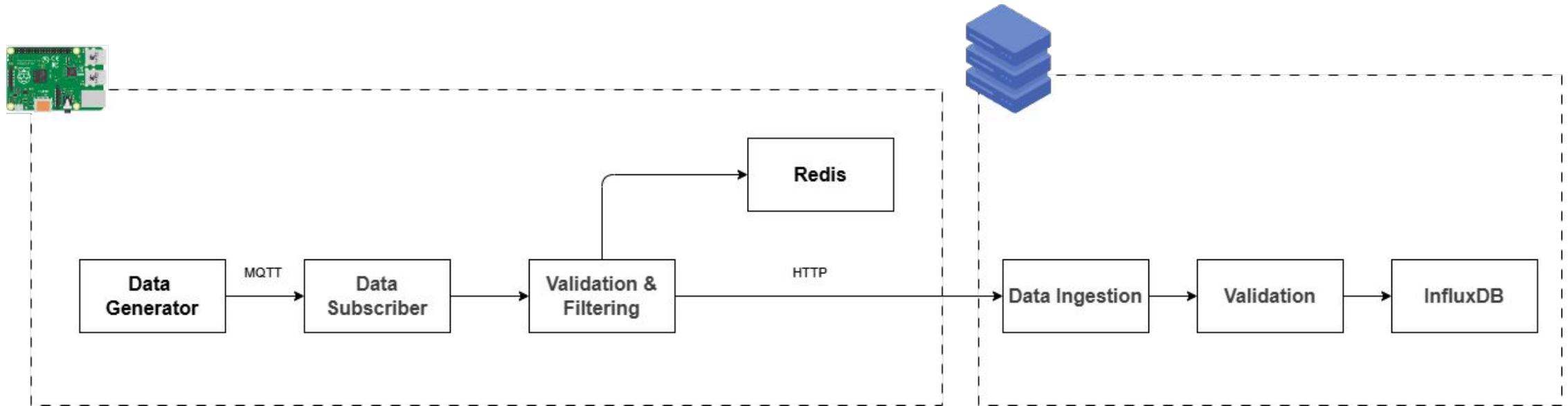
## AI Assistant

- Chat (RAG) Pipeline
- Data Analytics Pipeline



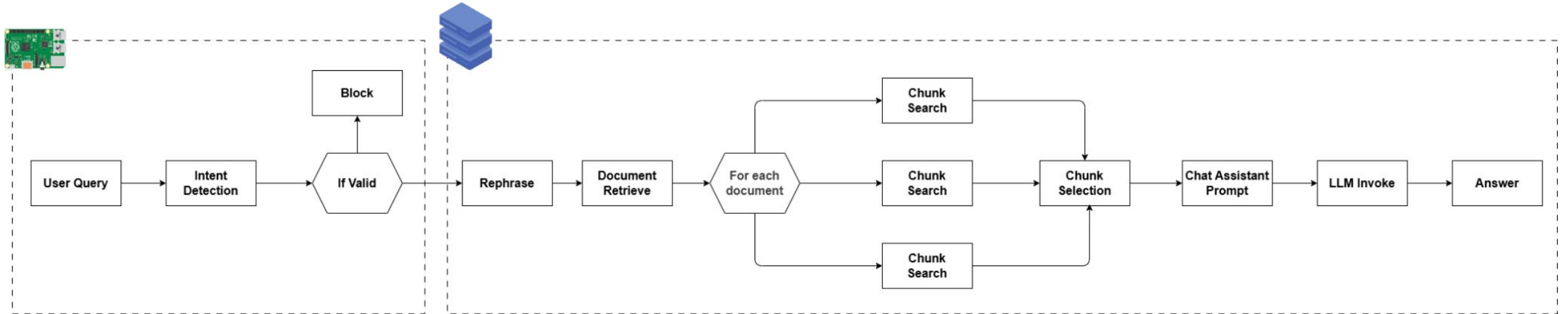
# Core Workflow

## IoT Data Processing & Ingestion



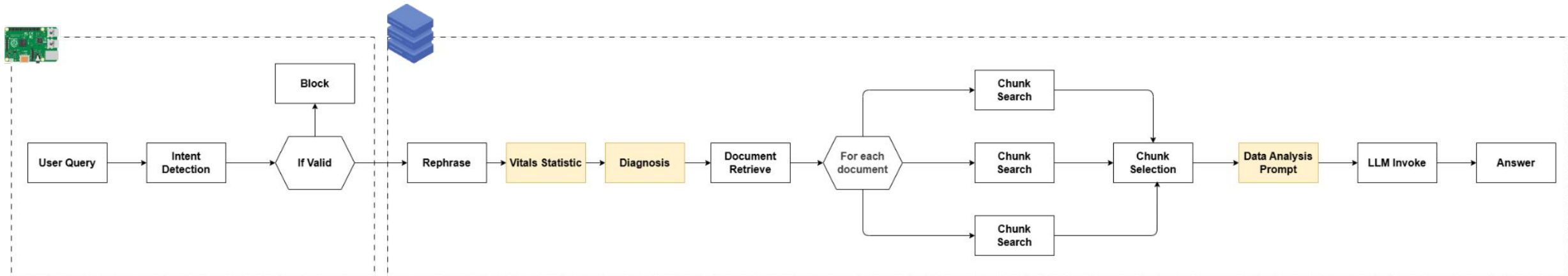
# Core Workflow

## Chat Assistant



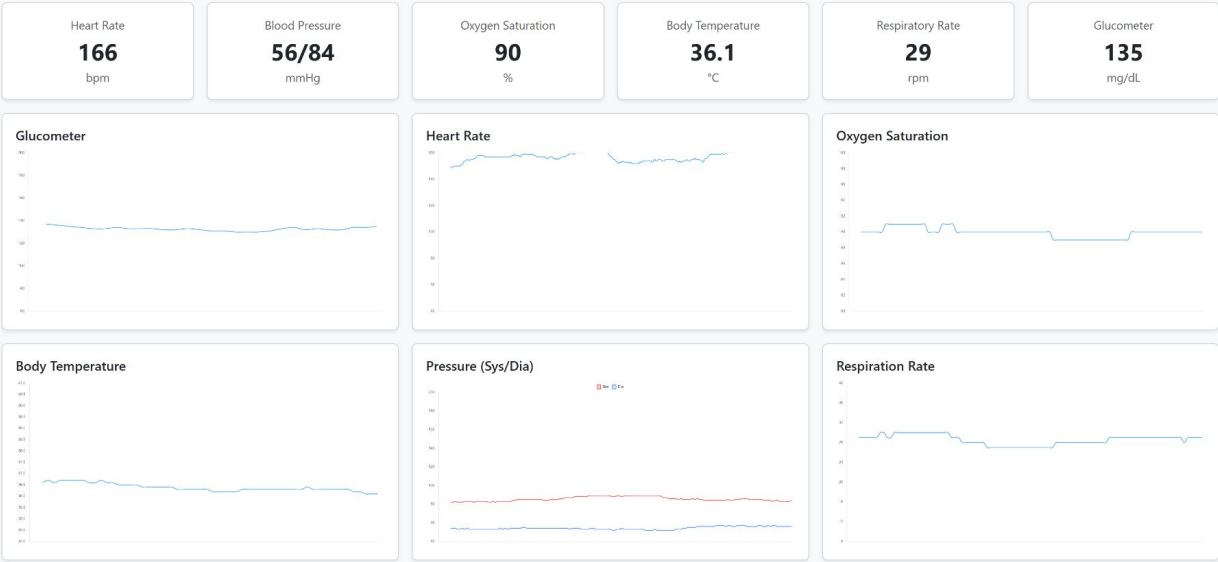
# Core Workflow

## Data Analysis





# Patient Dashboard



Hi! I'm your clinical assistant. I can help you to:

- Formulate and clarify clinical problems
- Analyze your vital data
- Contextualize symptoms and measurements

**Note:** You can use the **green button** with the chart icon to enable or disable the analysis of your biological data for each query.

Could you analyze my vitals data and tell me if there is any problem ?

Your vital signs indicate serious abnormalities requiring immediate medical attention:

- **Respiratory Rate:** 29 breaths/minute (normal: 12-20) – significantly elevated, suggesting respiratory distress.
- **Oxygen Saturation:** 89% (normal: 95-100%) – critically low, indicating hypoxemia.
- **Heart Rate:** 153 bpm (normal: 60-100) – severely elevated tachycardia.
- **Systolic Blood Pressure:** 56 mmHg (normal: 90-120) – dangerously low, indicating hypotension.

The combination of low oxygen saturation, very high heart rate, and critically low blood pressure is life-threatening. This pattern is consistent with severe respiratory failure, possible heart attack (myocardial infarction), or dangerous heart rhythm abnormalities. These signs require emergency evaluation and intervention. Do not delay seeking urgent medical care.



# Expert Dashboard

Devices			
<div><div></div><div>Search</div></div>			
Device Id	Name	Status	Last Update
device-1	Device-1	<div></div>	2025-12-02T22:29:30.981Z
device-2	Device-2	<div></div>	-
device-3	Device-3	<div></div>	-
device-4	Device-4	<div></div>	-

Sessions				
<div><div></div><div>Search</div></div>				
Id	Device Id	Created At	Updated At	Status
692f541f7b76d3f4cd8db7b87	device-1	2025-12-02T21:03:27.201Z	2025-12-02T21:03:27.201Z	<div></div>
692f53e17b76d3f4cd8db7b85	device-1	2025-12-02T21:02:25.433Z	2025-12-02T21:03:25.870Z	<div></div>
692f126c3ab92063c48e2507	device-1	2025-12-02T16:23:08.460Z	2025-12-02T16:27:37.269Z	<div></div>
692f10233ab92063c48e2506	device-1	2025-12-02T16:13:23.677Z	2025-12-02T16:23:06.825Z	<div></div>
692f0b423ab92063c48e2505	device-1	2025-12-02T15:52:34.336Z	2025-12-02T16:13:23.674Z	<div></div>
692f0b273ab92063c48e2504	device-1	2025-12-02T15:52:07.228Z	2025-12-02T15:52:33.436Z	<div></div>
692ec61f505b94edfe6651c9	device-1	2025-12-02T10:57:35.199Z	2025-12-02T15:52:07.223Z	<div></div>
692ec5aa505b94edfe6651c7	device-1	2025-12-02T10:55:38.849Z	2025-12-02T10:57:34.354Z	<div></div>
692ec4cd505b94edfe6651c6	device-1	2025-12-02T10:51:57.716Z	2025-12-02T10:55:38.008Z	<div></div>
692ec3bf505b94edfe6651c4	device-1	2025-12-02T10:48:27.131Z	2025-12-02T10:51:56.577Z	<div></div>
692e1535a262cd39bc591bea	device-1	2025-12-01T22:22:45.094Z	2025-12-02T10:48:27.128Z	<div></div>
692e11ff386e1f7db71b6970	device-1	2025-12-01T22:09:03.277Z	2025-12-01T22:22:43.804Z	<div></div>

Person ID

692f67047d6c77643bb779d3

Glucose

vitals, glucose (mg/dL)

200

180

160

140

120

100

80

60

2025

2026

2027

2028

2029

time

Heart Rate

vitals, heart\_rate (bpm)

160

140

120

100

80

60

40

2025

2026

2027

2028

2029

time

Blood Pressure

vitals, blood pressure\_systolic (mmHg)

vitals, blood pressure\_diastolic (mmHg)

200

180

160

140

120

2025

2026

2027

2028

2029

time

SPO2

vitals, spo2 (%)

100

95

90

85

80

2025

2026

2027

2028

2029

time

Body Temperature

vitals, body temperature (°C)

41

40

39

38

37

36

35

34

2025

2026

2027

2028

2029

time

Respiratory Rate

vitals, respiratory\_rate (breaths/min)

40

35

30

25

2025

2026

2027

2028

2029

time

Interactions

Question	Rephrased Question	Answer	Chunks	Vitals	Diagnosis	Type	Created At
Could you analyze my vitals data and tell me if there is any problem?	Could you analyze my vital data and tell me if there is anything wrong?	<p>Your vital signs indicate serious abnormalities requiring immediate medical attention:</p> <ul style="list-style-type: none"><li><b>Respiratory Rate:</b> 29 breaths/minute (normal: 12-20) - significantly elevated, suggesting respiratory distress.</li><li><b>Oxygen Saturation:</b> 89% (normal: 96-100%) - critically low, indicating hypoxemia.</li><li><b>Heart Rate:</b> 153 bpm (normal: 60-100) - severely elevated tachycardia.</li><li><b>Systolic Blood Pressure:</b> 56 mmHg (normal: 90-120) - dangerously low, indicating hypotension.</li></ul> <p>The combination of low oxygen saturation, very high heart rate, and critically low blood pressure is life-threatening. This pattern is consistent with severe respiratory failure, possible heart attack (myocardial infarction), or dangerous heart rhythm abnormalities. These signs require emergency evaluation and intervention. Do not delay seeking urgent medical care.</p>	<ul style="list-style-type: none"><li>Oxford Handbook of General Practice.pdf (Pg.1083)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2162)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2164)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2160)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2133)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2129)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2142)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2126)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2127)</li><li>Mayo Clinic Family Health Book.pdf (Pg.2139)</li></ul>	<ul style="list-style-type: none"><li><b>Respiration Rate:</b> Min: 25, Max: 36, Mean: 28.1, Latest: 29</li><li><b>Diastolic Blood Pressure:</b> Min: 81, Max: 85, Mean: 84.6, Latest: 85</li><li><b>SPO2:</b> Min: 89, Max: 91, Mean: 89.9, Latest: 89</li><li><b>Systolic Blood Pressure:</b> Min: 52, Max: 56, Mean: 51.4, Latest: 56</li><li><b>Heart Rate:</b> Min: 149, Max: 159, Mean: 155.8, Latest: 153</li><li><b>Glucose:</b> Min: 139, Max: 151, Mean: 136.7, Latest: 133</li><li><b>Body Temperature:</b> Min: 36.3, Max: 36.7, Mean: 36.4, Latest: 36.3</li></ul>	<ul style="list-style-type: none"><li>Respiratory failure</li><li>Possible myocardial infarction</li><li>Tachycardia</li></ul>	dataAnalysis	2025-12-02T22:27:59.786Z

# Simulation Scenario

## Base AI Assistant

 Dashboard

 Chat

**Hi!** I'm your clinical assistant. I can help you to:

- Formulate and clarify clinical problems
- Analyze your vital data
- Contextualize symptoms and measurements

Type me a question, for example:

- "I don't feel very well, which parameters are out of range?"

I think that i could have some fever, what i could do ?

Take your temperature to confirm a fever (typically defined as 100.4°F/38°C or higher). Rest and drink plenty of fluids to stay hydrated. Monitor your symptoms closely. Seek medical attention immediately if:

- You are under 3 months old with any fever
- Your temperature exceeds 103°F (39.4°C)
- You experience severe symptoms like confusion, stiff neck, shortness of breath, chest pain, or a rash
- Fever lasts more than 3 days without improvement
- You have underlying health conditions like heart disease, diabetes, or weakened immunity

For most adults and older children with mild fever, home care (rest, fluids, over-the-counter pain relievers like acetaminophen or ibuprofen) is sufficient unless symptoms worsen or persist.

✕ Close



|



# Simulation Scenario

## Data Analysis Assistant - Healthy

Dashboard

Chat

Heart Rate

75

bpm

Blood Pressure

76/127

mmHg

Oxygen Saturation

99

%

Body Temperature

36.7

°C

Respiratory Rate

16

rpm

Glucometer

99

mg/dL

Glucometer



Heart Rate



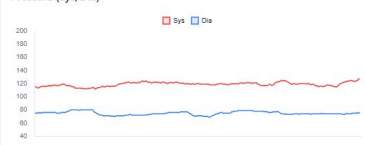
Oxygen Saturation



Body Temperature



Pressure (Sys/Dia)



Respiration Rate



Dashboard

Chat

Hi! I'm your clinical assistant. I can help you to:

- Formulate and clarify clinical problems
- Analyze your vital data
- Contextualize symptoms and measurements

**Note:** You can use the **green button** with the chart icon to enable or disable the analysis of your biological data for each query.

Could you analyze my vitals data and tell me if there is any problem ?

Your vital signs are all within normal ranges and show consistent stability. Here's a clear breakdown:

- **Respiration Rate:** 17 breaths per minute (normal range: 12-20), with consistent breathing patterns.
- **Blood Glucose:** 93 mg/dL (normal fasting range: 70-99), showing stable levels.
- **Oxygen Saturation:** 97% (normal range: 95-100%), indicating excellent oxygen levels.
- **Blood Pressure:** 122/72 mmHg (normal: systolic <120, diastolic <80), with stable readings.
- **Heart Rate:** 74 bpm (normal resting range: 60-100), consistent with good cardiovascular function.
- **Body Temperature:** 36.6°C (normal range: 36.1-37.2°C), showing no signs of fever or hypothermia.

All measurements demonstrate low variability, confirming a stable physiological state. There are no indications of medical concerns based on these vitals.

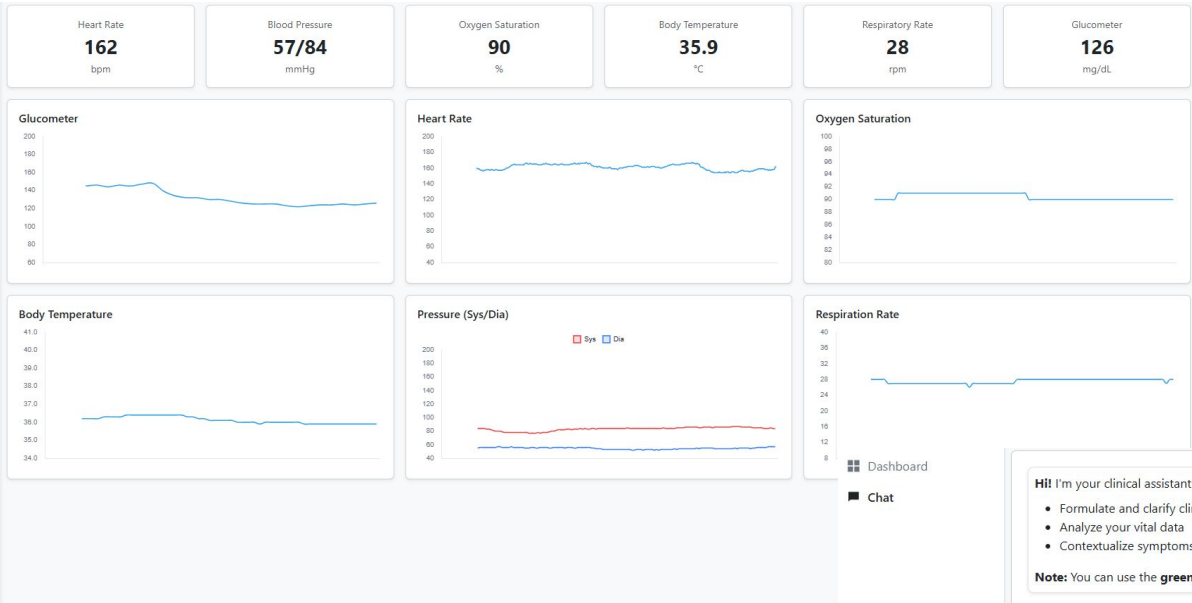
Close



# Simulation Scenario

## Data Analysis Assistant - Hearth Attack

Dashboard  
Chat



Close

Dashboard  
Chat

Hi! I'm your clinical assistant. I can help you to:

- Formulate and clarify clinical problems
- Analyze your vital data
- Contextualize symptoms and measurements

**Note:** You can use the **green button** with the chart icon to enable or disable the analysis of your biological data for each query.

Could you analyze my vitals data and tell me if there is any problem ?

Your vital signs show several significant abnormalities that require immediate medical evaluation:

- **Heart rate (160 bpm)** is severely elevated (normal resting range: 60-100 bpm), indicating possible tachycardia.
- **Systolic blood pressure (84 mmHg)** is critically low (normal: 90-120 mmHg), suggesting hypotension.
- **Oxygen saturation (91%)** is below normal (normal: 95-100%), indicating potential oxygen deficiency.
- **Respiratory rate (27 breaths/min)** is elevated (normal resting: 12-20 breaths/min), reflecting increased breathing effort.

These combined findings—high heart rate, low blood pressure, low oxygen, and rapid breathing—are clinical indicators of a serious cardiovascular or respiratory emergency. They align with conditions such as heart attack (myocardial infarction) or life-threatening arrhythmias, as suggested by your algorithm diagnosis. Do not delay seeking emergency medical care.

Close



# Future Developments

LLM Fine  
Tuning

Advance RAG

Autonomous  
Agent

ML Driven  
Diagnosis

Security  
Improvement

Real  
Device & Data

# Questions & Answers

Thank you for your attention.