Installation & User Guide

Project: AI-Driven Chest Radiograph Analysis System

Group 8

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Installation

Our application is a comprehensive medical imaging analysis platform that combines deep learning models with large language models to provide automated chest X-ray analysis and report generation. The system consists of a FastAPI-based backend server and a React-based frontend interface, enabling medical professionals to upload X-ray images, receive AI-powered diagnostic assistance, and generate detailed medical reports.

(1) System Requirements

Hardware: The system requires a modern computer with at least 8GB of RAM and 60GB of free storage space. A multi-core CPU is recommended for optimal performance. While a CUDA-compatible GPU is optional, it significantly accelerates model inference. Internet connectivity is essential for accessing external report generation APIs.

Software: The backend requires Python 3.9 or higher with pip package manager installed. For GPU acceleration, CUDA 12.1 toolkit is needed. The frontend requires Node.js version 14 or higher with npm package manager. A modern web browser such as Chrome, Firefox, Safari, or Edge is necessary for accessing the user interface.

(2) Backend Installation

Step1: Environment Setup

Navigate to the backend directory located at Chexpert_back. Create a Python virtual environment to isolate dependencies from the system Python installation. On Windows, activate the environment using the Scripts\activate command. On macOS or Linux, use source venv/bin/activate.

Bash
```bash
cd Chexpert_back
python -m venv venv
venv\Scripts\activate
```

Step 2: Install Dependencies

Install all required Python packages using the requirements file. The core dependencies include FastAPI for the web framework, Uvicorn as the ASGI server, PyTorch and Torchvision for deep learning, and Pillow for image processing.

Bash
```bash
pip install -r requirements.txt
```

Step 3: Start Backend Server

Launch the backend server using the provided startup script or by running the Python entry point directly. The server will start on port 8000 by default and automatically load both model files into memory.

```
Bash
```

```
    uvicorn app.main:app --reload --host 0.0.0.0 --port 8000
```

(3) Frontend Installation

Step1: Install Dependencies

Install all required Node.js packages using npm. This process downloads React, Ant Design component library, React Router for navigation, and various testing utilities.

```
Bash
```

```
cd Chexpert_front
npm install
```

Step 2: Start Development Server

Launch the React development server which will automatically open the default web browser to the application home page. The server runs on port 3000 by default.

```
Bash
```

```
npm start
```

(4) Troubleshooting

Backend Issues: If the backend fails to start, first verify that both model files exist in the weights directory and are the correct size. Check that port 8000 is not already in use by another application. Examine the console output for Python errors related to missing dependencies or incompatible package versions.

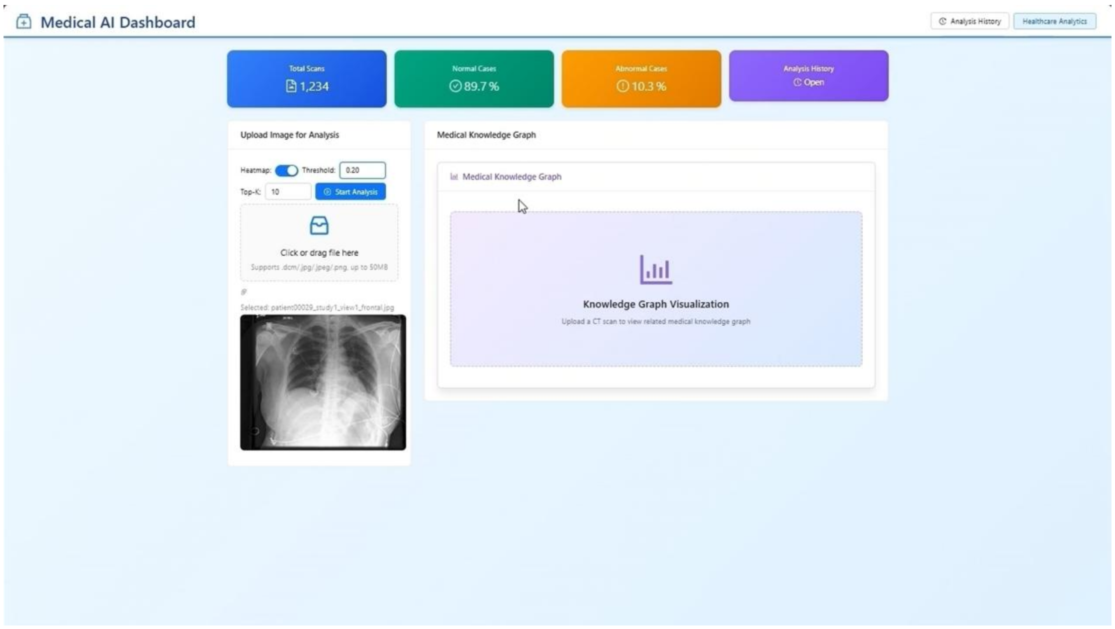
Frontend Issues: CORS errors typically indicate that the backend is not configured to accept requests from the frontend origin. Add the frontend URL to the CORS_ORIGINS list in the backend config.py file. If the frontend cannot connect to the backend, verify that REACT_APP_API_BASE_URL in the frontend .env file matches the actual backend address and port.

Model and API Issues: Report generation timeouts occur when external API services are slow or unavailable. Increase the API_TIMEOUT value in the backend configuration or check that ngrok tunnels are active and accessible. Image upload failures usually result from incorrect file formats or files exceeding the 10 MB size limit. Ensure images are in DICOM, JPEG, or PNG format.

User Guide

(1) Image Upload and Analysis

The primary workflow begins with uploading a medical image through the drag-and-drop interface or file selection dialog. The system accepts DICOM, JPEG, and PNG formats with a maximum file size of 10 MB. Before uploading, user can configure analysis parameters including whether to generate a heatmap visualization, set the confidence threshold for classification results, and specify how many top predictions to return.


Medical AI Dashboard

Total Scans 1,234
Normal Cases 89.7 %
Abnormal Cases 10.3 %
Analysis History Open

Upload Image for Analysis

Heatmap: on Threshold: 0.20
Top-K: 10

Click or drag file here
Supports .dcm/.jpg/.jpeg/.png, up to 50MB

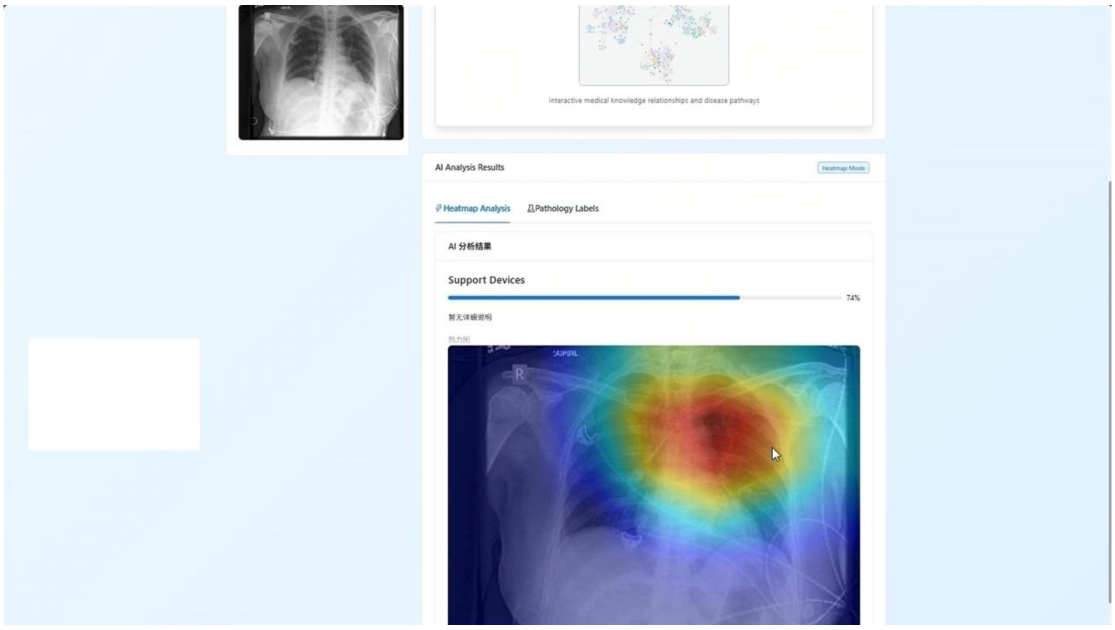
Selected: patient00029_study1_view1_frontal.jpg

Medical Knowledge Graph

Knowledge Graph Visualization
Upload a CT scan to view related medical knowledge graph

Figure 1 Picture upload and parameter settings

After uploading, the system automatically processes the image through two Pathology models in parallel. The model generates a Grad-CAM heatmap highlighting regions of interest and produces classification probabilities for 14 disease categories. The Pathology model provides a second opinion with its own probability distribution. Results appear in two tabs showing the heatmap overlay on the original image and a comparative table of disease classifications.


Interactive medical knowledge relationships and disease pathways

AI Analysis Results

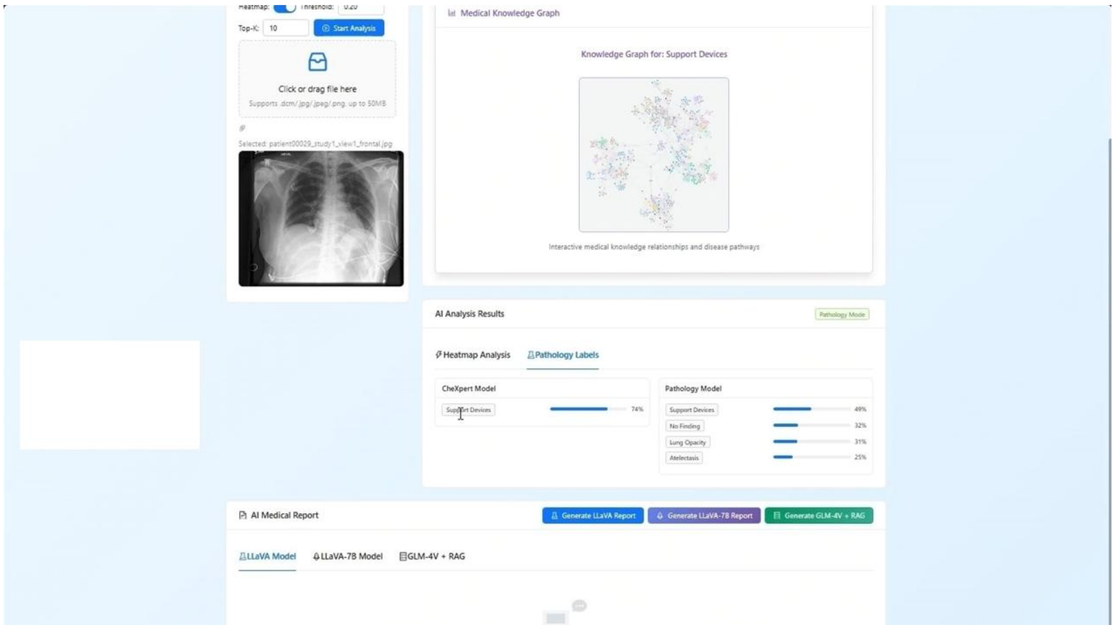
AI 分析结果

Support Devices 74%

暂无详细说明

热力图

Figure 2 Heatmap Analysis



Heatmap: Threshold: 0.20
Top-K: 10

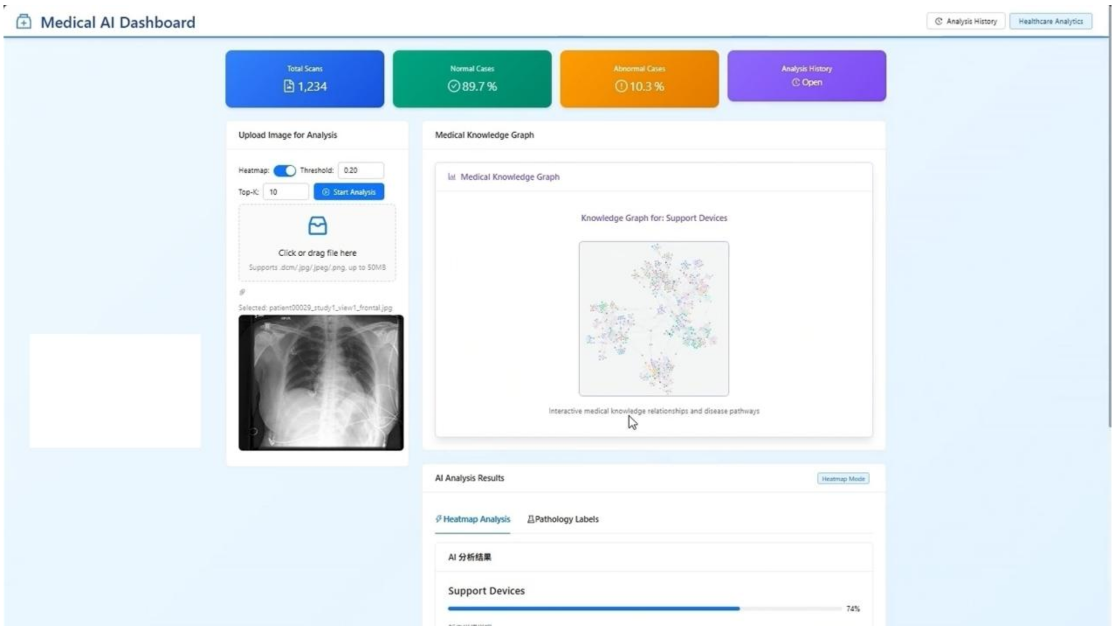
CheXpert Model	
Support Devices	74%

Pathology Model	
Support Devices	49%
No Finding	32%
Lung Opacity	31%
Atelectasis	25%

Figure 3 Pathology labels

(2) Knowledge Graph

The system includes an integrated medical knowledge graph that provides detailed information about detected diseases. The system retrieves comprehensive disease information including symptoms, causes, risk factors, diagnostic criteria, and treatment options from authoritative medical databases. The results of the knowledge graph query will be included in the RAG report.



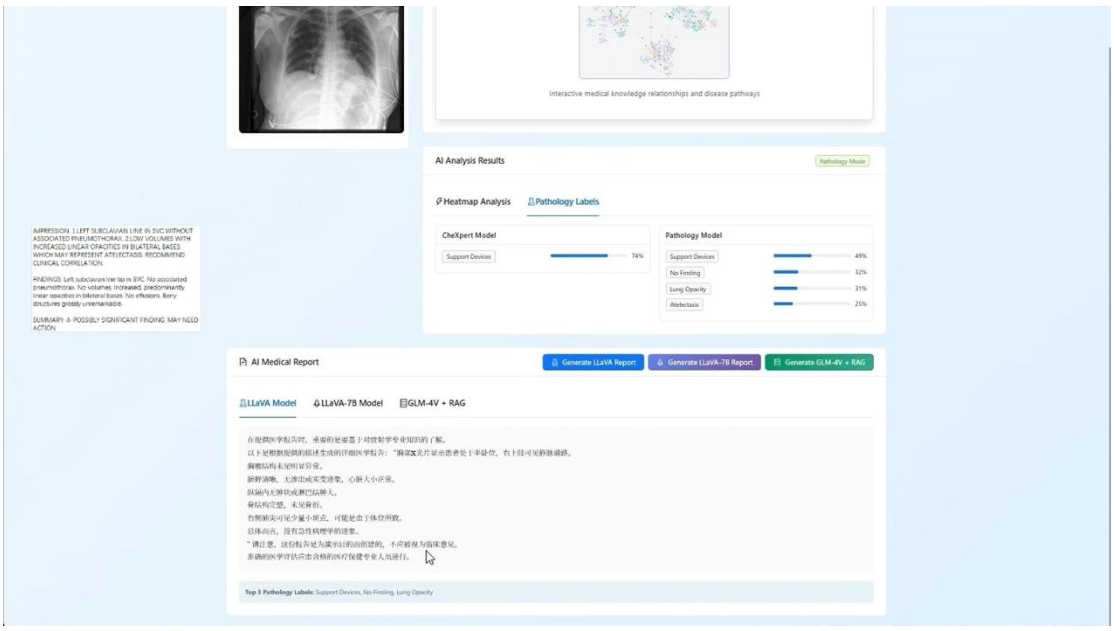
Heatmap: Threshold: 0.20
Top-K: 10

Support Devices 74%

Figure 4 Medical Knowledge Graph

(3) Report Generation

Once analysis is complete, users can generate comprehensive medical reports using one of several AI models. The LLaVA options provides detailed reports through a remote Colab API via ngrok endpoint. The GLM-4V with RAG option integrates retrieval-augmented generation for context-aware reporting, and a simple Markdown template is available for basic reports.



IMPRESSION: 1.LEFT SUBCLAVIAN LINE IN SVC WITHOUT ASSOCIATED PNEUMOTHORAX. 2.LOW VOLUMES WITH INCREASED LINEAR OPACITIES IN BILATERAL BASES WHICH MAY REPRESENT ATELECTASIS. RECOMMEND CLINICAL CORRELATION.

FINDINGS: Left subclavian line tip in SVC. No associated pneumothorax. No volumes. Increased, predominantly linear opacities in bilateral bases. No effusions. Bony structures grossly unremarkable.

SUMMARY: 4- POSSIBLY SIGNIFICANT FINDING. MAY NEED ACTION.

Interactive medical knowledge relationships and disease pathways

AI Analysis Results

CheXpert Model	
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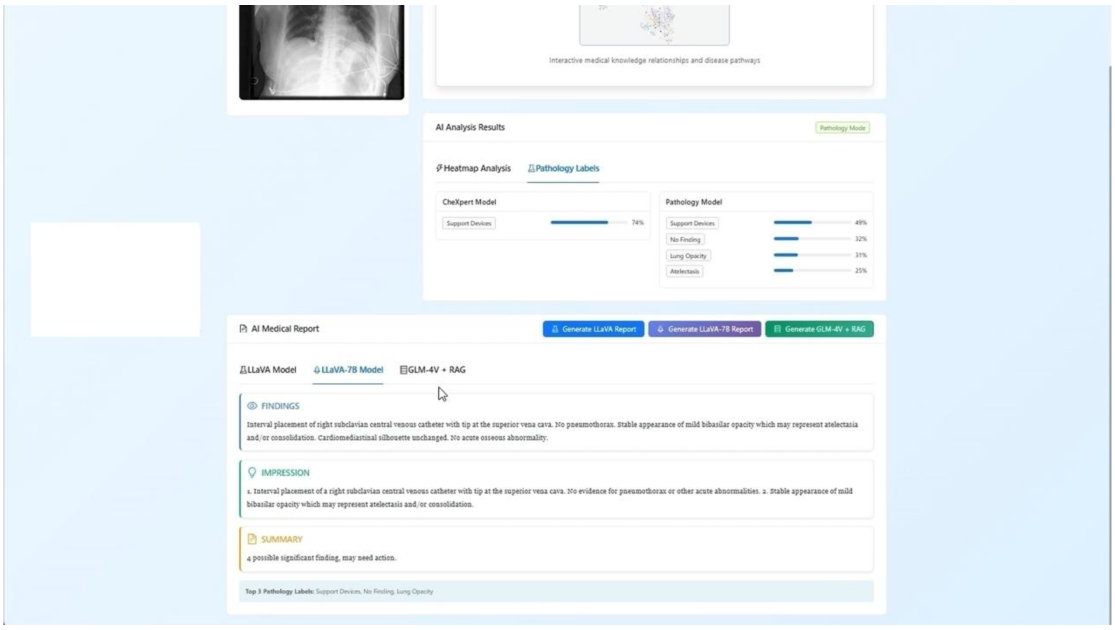
AI Medical Report

在提供医学报告时，重要的是要基于对放射学专业知识的了解。
以下是根据提供的描述生成的详细医学报告："胸部X光片显示患者处于半卧位，右上肢可见静脉通路。
胸廓结构未见明显异常。
肺野清晰，无渗出或实变迹象，心脏大小正常。
纵隔内无肿块或淋巴结肿大。
骨结构完整，未见骨折。
右侧肺尖可见少量小斑点，可能是由于体位所致。
总体而言，没有急性病理学的迹象。
"请注意，这份报告是为演示目的而创建的，不应被视为临床意见。
准确的医学评估应由合格的医疗保健专业人员进行。

Top 3 Pathology Labels: Support Devices, No Finding, Lung Opacity

Figure 5 LLaVA report generated



Interactive medical knowledge relationships and disease pathways

AI Analysis Results

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Pathology Model	
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AI Medical Report

FINDINGS

Interval placement of right subclavian central venous catheter with tip at the superior vena cava. No pneumothorax. Stable appearance of mild bibasilar opacity which may represent atelectasia and/or consolidation. Cardiomediastinal silhouette unchanged. No acute osseous abnormality.

IMPRESSION

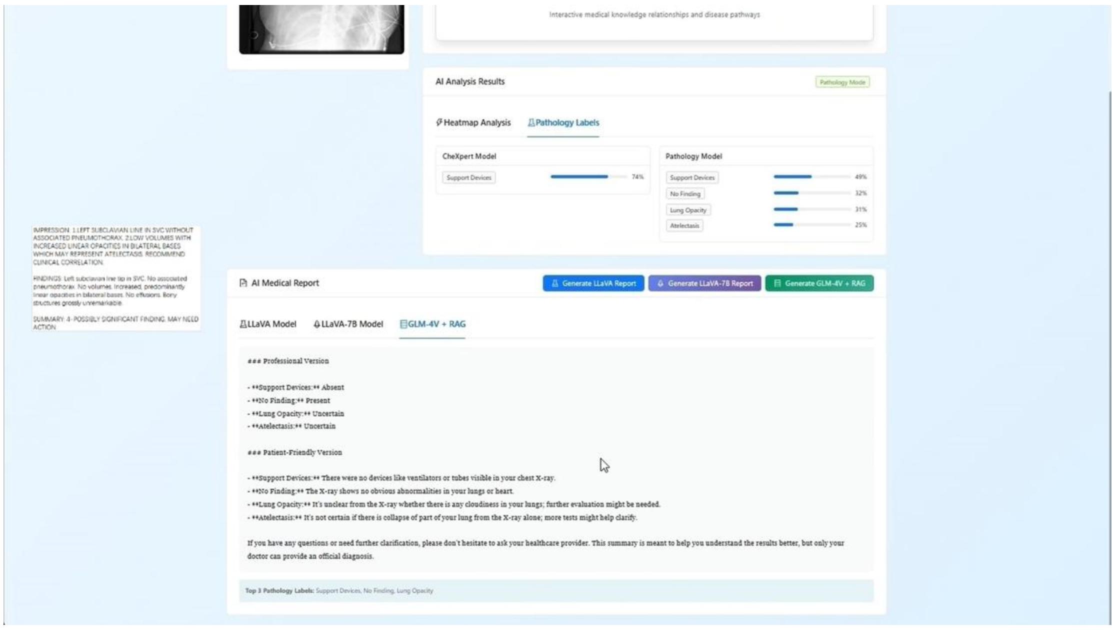
1. Interval placement of a right subclavian central venous catheter with tip at the superior vena cava. No evidence for pneumothorax or other acute abnormalities. 2. Stable appearance of mild bibasilar opacity which may represent atelectasis and/or consolidation.

SUMMARY

4 possible significant finding, may need action.

Top 3 Pathology Labels: Support Devices, No Finding, Lung Opacity

Figure 6 LLaVA-7B report generated



IMPRESSION: 1.LEFT SUBCLAVIAN LINE IN SVC WITHOUT ASSOCIATED PNEUMOTHORAX. 2.LOW VOLUMES WITH INCREASED LINEAR OPACITIES IN BILATERAL BASES WHICH MAY REPRESENT ATELECTASIS. RECOMMEND CLINICAL CORRELATION.

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SUMMARY: 4- POSSIBLY SIGNIFICANT FINDING, MAY NEED ACTION

CheXpert Model	
Support Devices	74%

Pathology Model	
Support Devices	49%
No Finding	32%
Lung Opacity	31%
Atelectasis	25%

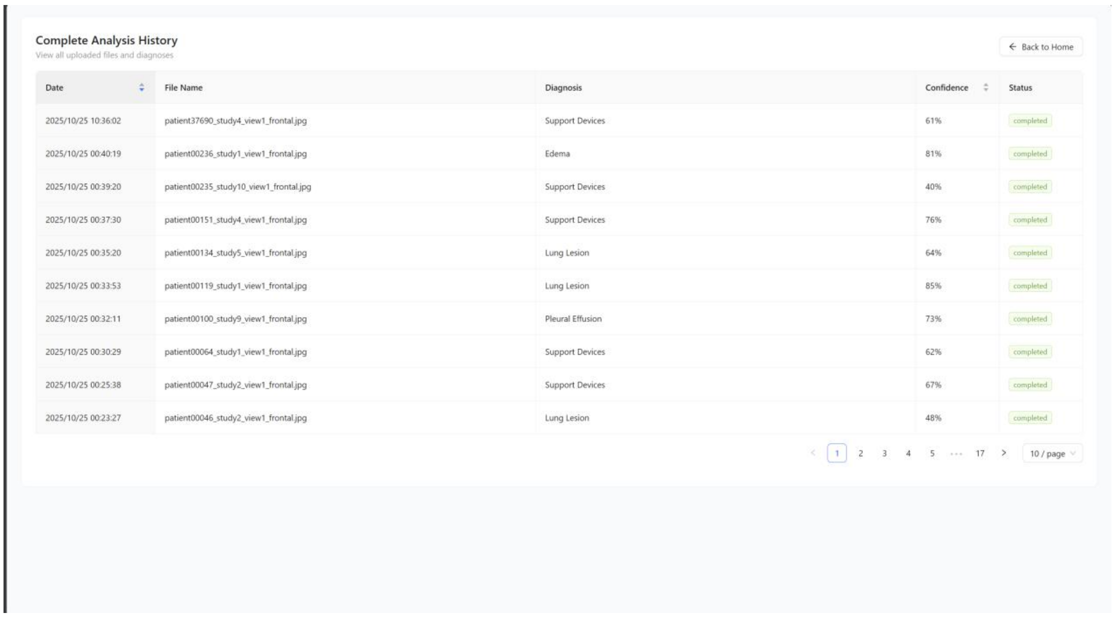
```
### Professional Version

- **Support Devices:** Absent
- **No Finding:** Present
- **Lung Opacity:** Uncertain
- **Atelectasis:** Uncertain

### Patient-Friendly Version

- **Support Devices:** There were no devices like ventilators or tubes visible in your chest X-ray.
- **No Finding:** The X-ray shows no obvious abnormalities in your lungs or heart.
- **Lung Opacity:** It's unclear from the X-ray whether there is any cloudiness in your lungs; further evaluation might be needed.
- **Atelectasis:** It's not certain if there is collapse of part of your lung from the X-ray alone; more tests might help clarify.

If you have any questions or need further clarification, please don't hesitate to ask your healthcare provider. This summary is meant to help you understand the results better, but only your doctor can provide an official diagnosis.
```

Top 3 Pathology Labels: Support Devices, No Finding, Lung Opacity

Figure 7 GLM-4V+RAG report generated

(4) History Management

Every analysis is automatically saved to the history database accessible through the History navigation menu. The history page displays a chronological table of all past analyses with sortable columns for timestamp, filename, top diagnosis, and confidence score.



Complete Analysis History
View all uploaded files and diagnoses
Back to Home
1 2 3 4 5 ··· 17
10 / page

Date	File Name	Diagnosis	Confidence	Status
2025/10/25 10:36:02	patient37690_study4_view1_frontal.jpg	Support Devices	61%	completed
2025/10/25 00:40:19	patient00236_study1_view1_frontal.jpg	Edema	81%	completed
2025/10/25 00:39:20	patient00235_study10_view1_frontal.jpg	Support Devices	40%	completed
2025/10/25 00:37:30	patient00151_study4_view1_frontal.jpg	Support Devices	76%	completed
2025/10/25 00:35:20	patient00134_study5_view1_frontal.jpg	Lung Lesion	64%	completed
2025/10/25 00:33:53	patient00119_study1_view1_frontal.jpg	Lung Lesion	85%	completed
2025/10/25 00:32:11	patient00100_study9_view1_frontal.jpg	Pleural Effusion	73%	completed
2025/10/25 00:30:29	patient00064_study1_view1_frontal.jpg	Support Devices	62%	completed
2025/10/25 00:25:38	patient00047_study2_view1_frontal.jpg	Support Devices	67%	completed
2025/10/25 00:23:27	patient00046_study2_view1_frontal.jpg	Lung Lesion	48%	completed

Figure 8 Analysis History