

Clinical Agent - Static Medical Risk Assessment

Overview

The Clinical Agent calculates cardiac risk based on patient's static medical profile using a trained logistic regression model. Unlike the other agents, this risk score only changes when the patient manually updates their clinical information.

Purpose

Provides a **baseline vulnerability score** based on:

- Demographics (age, sex)
- Physical measurements (BMI, blood pressure)
- Lab values (cholesterol levels)
- Medical conditions (diabetes, smoking, hypertension)
- Current medications

Model Details

Algorithm: Logistic Regression

Input Features: 14 clinical variables

Output: Risk probability (0-1)

Confidence: Always 1.0 (static data)

Input Features

1. **age** - Patient age in years
2. **sex** - 0=Female, 1=Male
3. **BMI** - Body Mass Index (kg/m²)
4. **SBP** - Systolic Blood Pressure (mmHg)
5. **DBP** - Diastolic Blood Pressure (mmHg)
6. **total_cholesterol** - Total cholesterol (mg/dL)
7. **HDL** - High-density lipoprotein (mg/dL)
8. **diabetes** - 0=No, 1=Yes
9. **smoker** - 0=No, 1=Yes (current smoker)
10. **hypertension** - 0=No, 1=Yes
11. **on_beta_blocker** - 0=No, 1=Yes
12. **on_antihypertensive** - 0=No, 1=Yes
13. **on_statin** - 0=No, 1=Yes
14. **on_anticoagulant** - 0=No, 1=Yes

How It Works

1. User Input

Patient navigates to </clinical> page and enters their medical information through a web form.

2. Profile Validation

System checks if all required fields are provided:

- Age, sex, BMI (required)
- Blood pressure (SBP, DBP) (required)
- Cholesterol levels (total, HDL) (required)
- Medical conditions (optional, defaults to No)
- Medications (optional, defaults to No)

3. Risk Calculation

Once profile is complete:

```
python
```

```
feature_vector = [age, sex, BMI, SBP, DBP, total_chol, HDL,  
                  diabetes, smoker, hypertension,  
                  beta_blocker, antihypertensive, statin, anticoagulant]
```

```
risk_probability = logistic_regression_model.predict_proba(feature_vector)[0][1]
```

4. Risk Categorization

- **LOW:** < 30% (0.0 - 0.29)
- **MODERATE:** 30-59% (0.30 - 0.59)
- **HIGH:** 60-79% (0.60 - 0.79)
- **VERY HIGH:** \geq 80% (0.80 - 1.00)

5. Risk Factor Identification

System automatically identifies contributing factors:

Risk Factors:

- Advanced age (>65)
- Obesity ($\text{BMI} \geq 30$) or Overweight ($\text{BMI} \geq 25$)
- Elevated systolic BP (≥ 140 mmHg)
- Elevated diastolic BP (≥ 90 mmHg)
- High cholesterol (≥ 240 mg/dL)
- Low HDL (<40 mg/dL)
- Diabetes
- Current smoker
- Hypertension

Protective Factors:

- On statin therapy
- On antihypertensive medication
- On beta blocker
- On anticoagulant

API Endpoints

GET /clinical

Web page for entering/updating clinical profile

GET /api/clinical/profile

Returns complete clinical profile and risk:

```
json
{
  "patient_id": "patient_001",
  "last_update": "2025-12-27T10:30:00",
  "profile_complete": true,
  "clinical_risk": 0.45,
  "profile": {
    "age": 62,
    "sex": "Male",
    "BMI": 28.5,
    "SBP": 145,
    "DBP": 90,
    "total_cholesterol": 220,
    "HDL": 45,
    "diabetes": false,
    "smoker": true,
    "hypertension": true,
    "medications": {
      "beta_blocker": false,
      "antihypertensive": true,
      "statin": true,
      "anticoagulant": false
    }
  }
}
```

POST /api/clinical/update

Update clinical profile with new data:

Request Body:

json

```
{
  "age": 62,
  "sex": 1,
  "BMI": 28.5,
  "SBP": 145,
  "DBP": 90,
  "total_cholesterol": 220,
  "HDL": 45,
  "diabetes": 0,
  "smoker": 1,
  "hypertension": 1,
  "on_beta_blocker": 0,
  "on_antihypertensive": 1,
  "on_statin": 1,
  "on_anticoagulant": 0
}
```

Response:

json

```
{
  "success": true,
  "clinical_output": {
    "day": "2025-12-27",
    "clinical_risk": 0.45,
    "confidence": 1.0
  },
  "profile": { ... }
}
```

GET /api/clinical/risk_factors

Returns identified risk and protective factors:

json

```
{
  "risk_factors": [
    "Advanced age (>65)",
    "Overweight (BMI 28.5)",
    "Elevated systolic BP (145 mmHg)",
    "Active smoker",
    "Hypertension"
  ],
  "protective_factors": [
    "On antihypertensive medication",
    "On statin therapy"
  ],
  "risk_level": "MODERATE"
}
```

Persistent Storage

Clinical profile stored in `data/clinical_profile.json`:

json

```
{
  "patient_id": "patient_001",
  "created_date": "2025-12-01T00:00:00",
  "last_update": "2025-12-27T10:30:00",
  "clinical_risk": 0.45,
  "profile_complete": true,
  "age": 62,
  "sex": 1,
  "BMI": 28.5,
  ...
}
```

Integration with Multi-Agent System

Clinical Agent (Static)



Outputs: clinical_risk = 0.45, confidence = 1.0



Decision Agent (Future)



Combines with:

- Sensor Agent (physio_risk)
- Patient Agent (sensitivity_factor)



Final Risk Score + Alert Decision

Usage Flow

1. **Initial Setup:** Patient clicks "Clinical Profile" button in dashboard
2. **Form Completion:** Enters all medical information
3. **Risk Calculation:** System computes risk using logistic regression
4. **Risk Display:** Shows percentage and risk level with identified factors
5. **Static Until Updated:** Risk stays the same until patient manually updates profile

Important Notes

When to Update Profile

- Initial setup (first use)
- Annual checkup with new lab values
- New diagnosis (diabetes, hypertension)
- Medication changes
- Significant weight changes
- Blood pressure changes

Not for Real-Time Monitoring

Clinical Agent provides **baseline vulnerability**, not real-time risk. It answers: "Given this patient's medical history, what's their underlying cardiac risk?"

Real-time changes are captured by:

- **Sensor Agent:** Immediate physiological changes
- **Patient Agent:** Personal pattern deviations

Medical Disclaimer

⚠ **Not a Medical Device:** This tool is for research/educational purposes only. Clinical decisions should be made by healthcare professionals with complete medical evaluation.

Model Files Required

```
models/  
├── clinical_agent_model.joblib  # Trained logistic regression  
└── clinical_agent_features.joblib # Feature names/order
```

Both files must be present for risk calculation. If missing, agent returns default risk of 0.5 (50%).

Design Philosophy

- **Simple & Interpretable:** Logistic regression over complex models
- **Clinically Meaningful:** Uses standard medical risk factors
- **Explainable:** Every risk factor is identifiable
- **Static by Design:** Updates only when patient chooses
- **Conservative:** Defaults to medium risk if incomplete

This provides the **clinical context** that personalizes the entire risk assessment system.