# Heart Disease Prediction – Project Analysis

## Problem statement:

In this project, we're diving deep into heart disease data to uncover valuable insights. The goal is to understand patterns, risk factors, and trends that could help in early detection. Using machine learning, we'll build a model that predicts the likelihood of heart disease in individuals, making diagnosis faster and more efficient.  we'll suggest practical steps for hospitals to improve early detection and take preventive measures. Aim is to help save lives by making heart disease predictions more accurate and actionable.

## Goal of the Project:

Our objective is to predict the binary class heart_disease_present, which indicates whether or not a patient is diagnosed with heart disease based on various medical features.

- 0 → No heart disease present
- 1 → heart disease present

## Data analysis:

1. **slope_of_peak_exercise_st_segment** (type: int): The slope of the peak exercise ST segment, an electrocardiography readout indicating quality of blood flow to the heart.
2. **thal** (type: categorical): Results of thallium stress test measuring blood flow to the heart, with possible values: normal, fixed defect, reversible_defect.
3. **resting_blood_pressure** (type: int): Resting blood pressure.
4. **chest_pain_type** (type: int): Chest pain type (4 values).
5. **num_major_vessels** (type: int): Number of major vessels (0–3) colored by fluoroscopy.
6. **fasting_blood_sugar_gt_120_mg_per_dl** (type: binary): Fasting blood sugar > 120 mg/dl.
7. **resting_ekg_results** (type: int): Resting electrocardiographic results (values 0, 1, 2).
8. **serum_cholesterol_mg_per_dl** (type: int): Serum cholesterol in mg/dl.
9. **oldpeak_eq_st_depression** (type: float): ST depression induced by exercise relative to rest, a measure of abnormality in electrocardiograms.
10. **sex** (type: binary): 0 = female, 1 = male.
11. **age** (type: int): Age in years.
12. **max_heart_rate_achieved** (type: int): Maximum heart rate achieved (beats per minute).
13. **exercise_induced_angina** (type: binary): Exercise-induced chest pain (0 = False, 1 = True).
14. **heart_disease_present** (type: binary): Represents whether or not a patient has heart disease (0 = no heart disease present, 1 = heart disease present).

## Challenges Faced:

1. Understanding roc_curve and auc_score
2. Predicting binary classes using neural network model was very difficult as it requires intense tuning and modifications to give us our expected results.
3. Hyperparameter tuning using Gridsearchcv took us a significant computation time which delayed our progress in the project, so therefore we have to switch to randomizedsearchcv to reduce our computation time.

## Suggestions for Hospitals to Enhance Heart Disease Predictions & Prevent Life Threats:

1. Implement AI-Powered Prediction Models

Leverage machine learning algorithms to analyse patient data and detect early warning signs of heart disease, enabling proactive diagnosis and timely treatment.

2. Regular Screening Programs

Introduce periodic heart check-ups, particularly for high-risk individuals such as those with diabetes, hypertension, obesity, or a family history of heart conditions.

3. Integrate Electronic Health Records (EHRs) with Predictive Analytics

Utilize historical patient data to uncover patterns, forecast potential risks, and deliver personalized early intervention strategies.

4. Leverage Wearable & IoT Devices Encourage the use of smartwatches, fitness trackers, and heart monitors to continuously track vital signs such as heart rate, ECG, and blood pressure.

5. Real-Time Alert Systems

Establish remote and hospital-based monitoring systems that send real-time alerts to healthcare providers upon detecting abnormal vital signs.

6. Enhance Patient Awareness & Education

Organize community workshops, webinars, and one-on-one counselling to raise awareness about heart disease, healthy living, and preventive care.

7. Promote Telemedicine & Remote Consultations

Enable virtual consultations with cardiologists to ensure timely access to care and ongoing monitoring for patients in remote or underserved areas.

8. Encourage Personalized Treatment Plans

Use AI-driven tools to recommend personalized treatment paths, lifestyle changes, and dietary plans based on the patient's medical profile and risk factors.

9. Adopt Smart Medication Management Systems

Introduce digital medication tracking apps and devices that remind patients to take their prescribed medications regularly and on time.

10. Collaboration with Fitness & Wellness Centres

Partner with gyms, wellness coaches, and nutritionists to offer integrated cardiac care that includes supervised exercise routines and tailored diet plans.