

A person in a white lab coat and blue gloves is administering a vaccine into a person's arm. The background shows a modern building with a wooden roof structure and a colorful rug on the floor.

# Predicting Seasonal Flu Vaccine Uptake

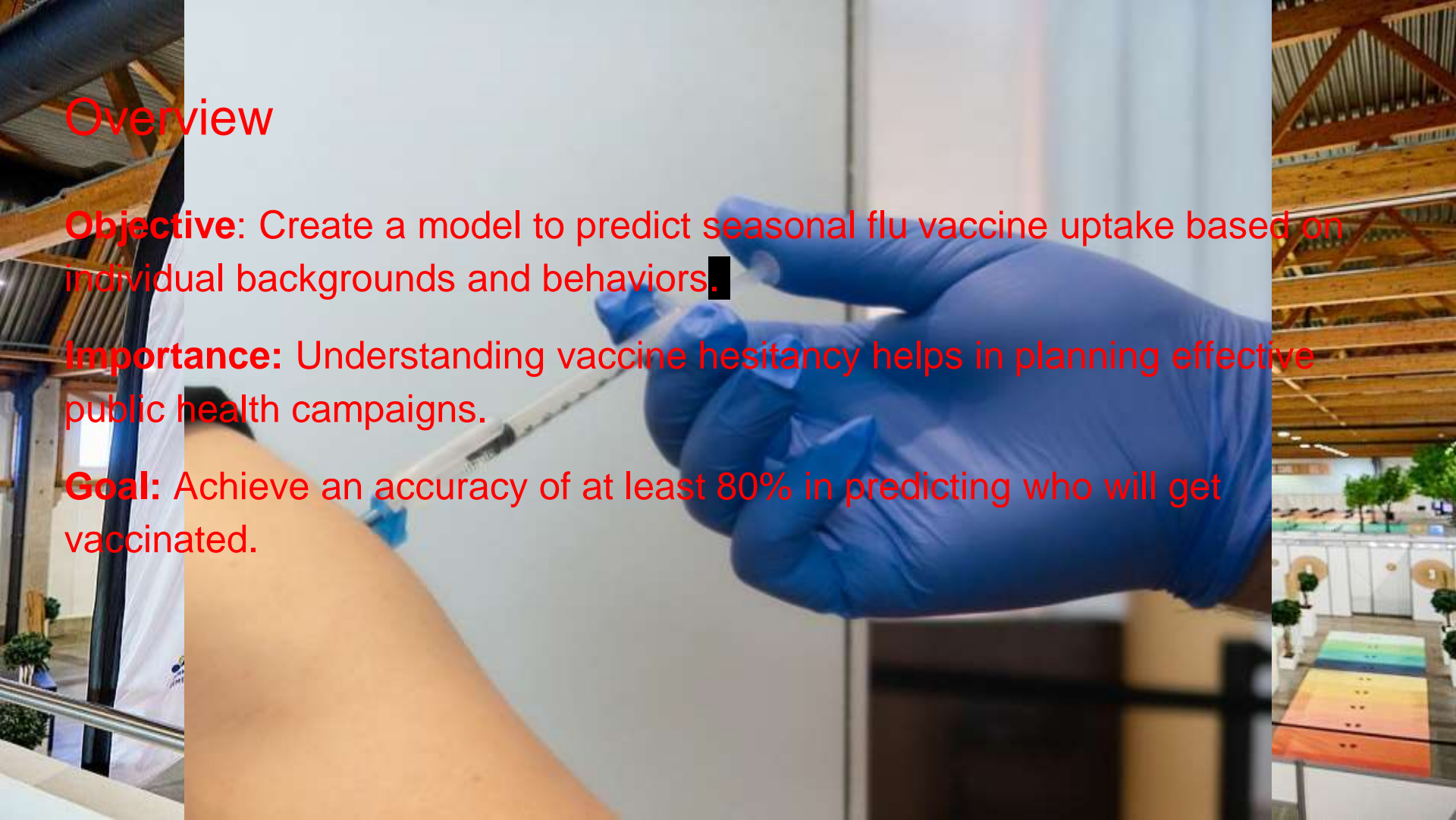
Addressing Vaccine Hesitancy Using Machine Learning

# Overview

**Objective:** Create a model to predict seasonal flu vaccine uptake based on individual backgrounds and behaviors.

**Importance:** Understanding vaccine hesitancy helps in planning effective public health campaigns.

**Goal:** Achieve an accuracy of at least 80% in predicting who will get vaccinated.



# Business and Data Understanding

## Problem Statement:

- ❖ Vaccine hesitancy poses a significant threat to global health, especially during pandemics.
- ❖ Understanding the factors behind vaccine reluctance can help mitigate risks and improve public health responses.

## Data Sources:

- ❖ Demographic information (age, education, income)
- ❖ Behavioral patterns (use of face masks, handwashing)
- ❖ Medical history (chronic conditions, health worker status)
- ❖ Opinions on vaccines (effectiveness, risks)



# Modeling

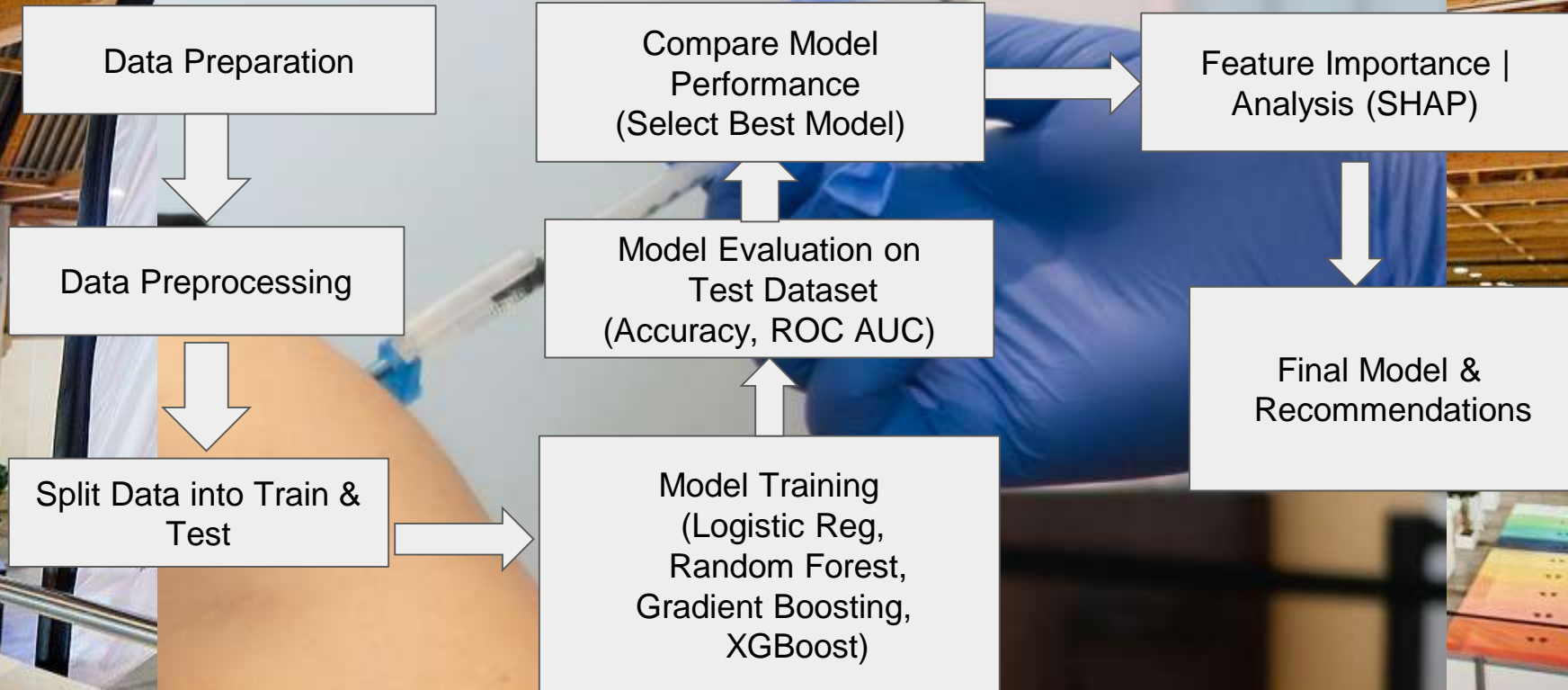
## Approach:

- ❖ We used various machine learning models to predict vaccine uptake.
- ❖ Models included Logistic Regression, Random Forest, Gradient Boosting, and XGBoost.
- ❖ Each model was trained and evaluated for accuracy, precision, recall, and ROC AUC score.

## Why Classification?

- ❖ Classification helps us categorize individuals into two groups: those who will get vaccinated and those who won't.
- ❖ This allows targeted interventions and better resource allocation.

# Modelling Process Flowchart



# Modelling Continued

## Models Compared:

Baseline Model (Logistic Regression):

Accuracy: 80.81%

ROC AUC Score: 0.878

Random Forest:

Accuracy: 80.78%

ROC AUC Score: 0.8782





Modelling Continued.

**Gradient Boosting:**

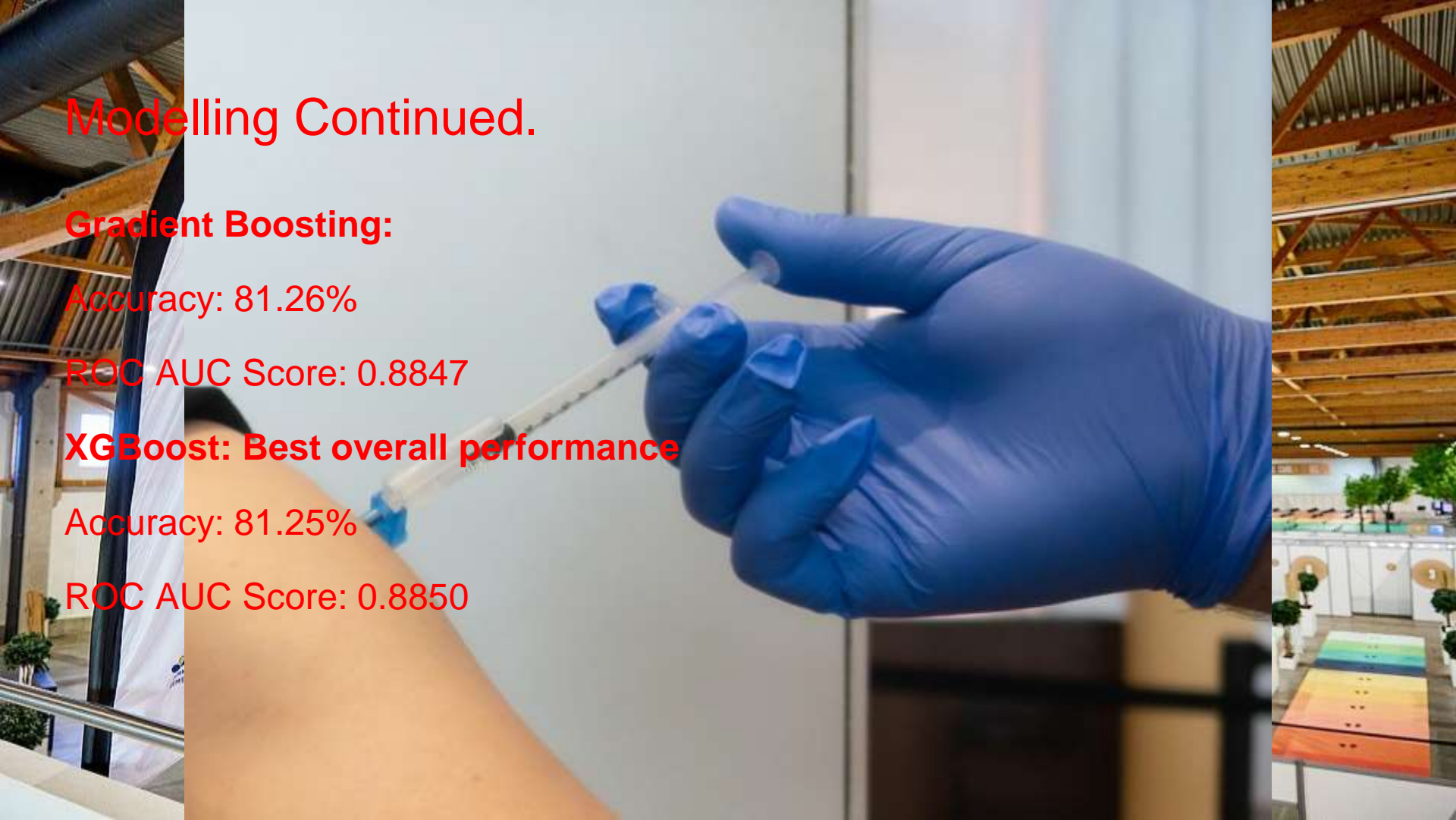
Accuracy: 81.26%

ROC AUC Score: 0.8847

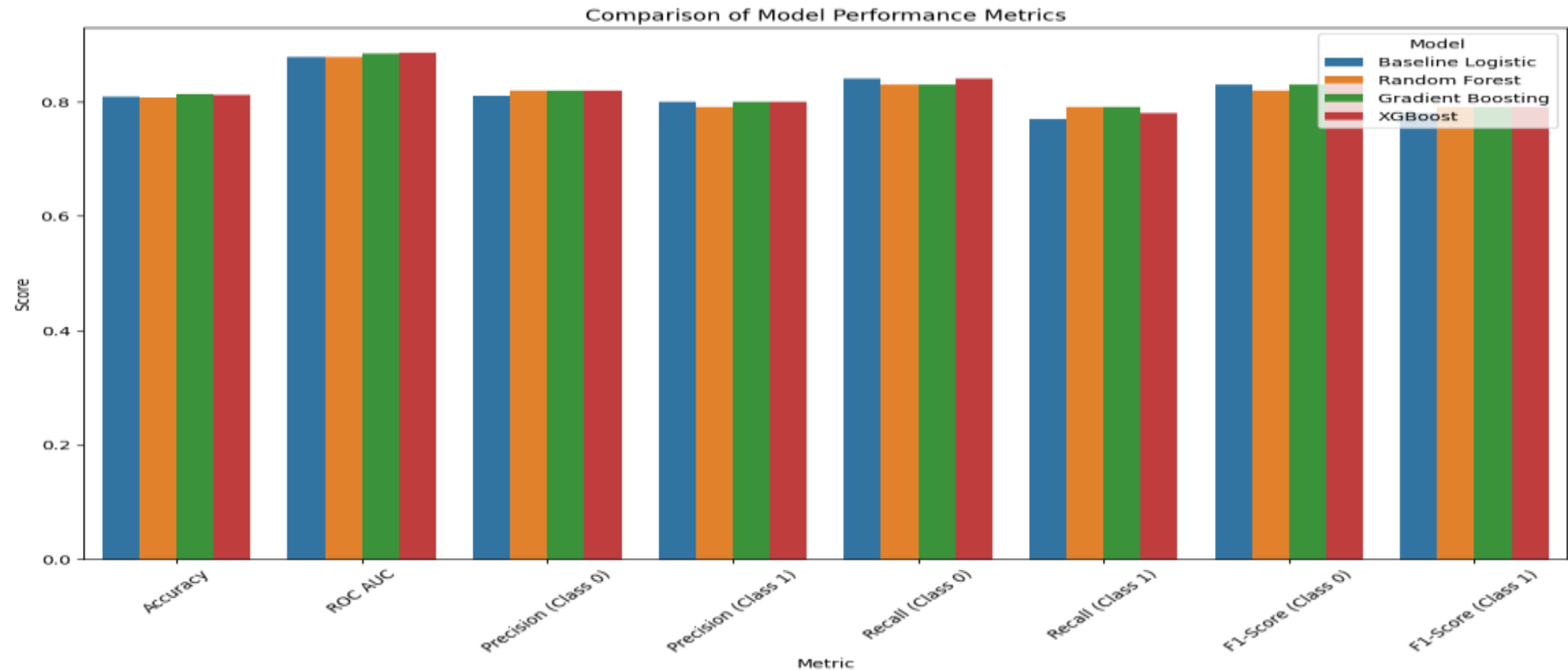
**XGBoost: Best overall performance**

Accuracy: 81.25%

ROC AUC Score: 0.8850



# Comparison of Model Performance Metrics

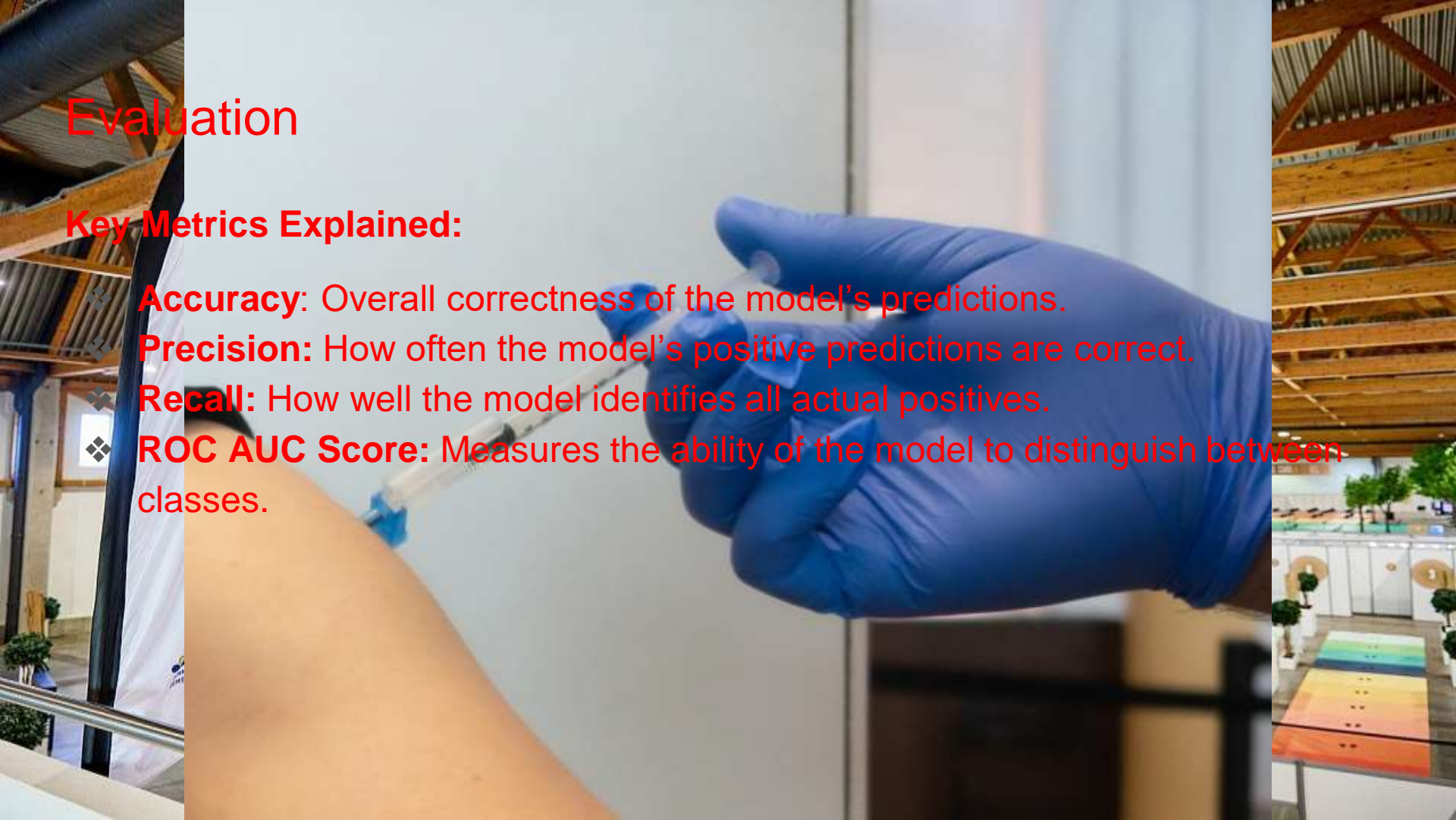




# Evaluation

## Key Metrics Explained:

- ❖ **Accuracy:** Overall correctness of the model's predictions.
- ❖ **Precision:** How often the model's positive predictions are correct.
- ❖ **Recall:** How well the model identifies all actual positives.
- ❖ **ROC AUC Score:** Measures the ability of the model to distinguish between classes.



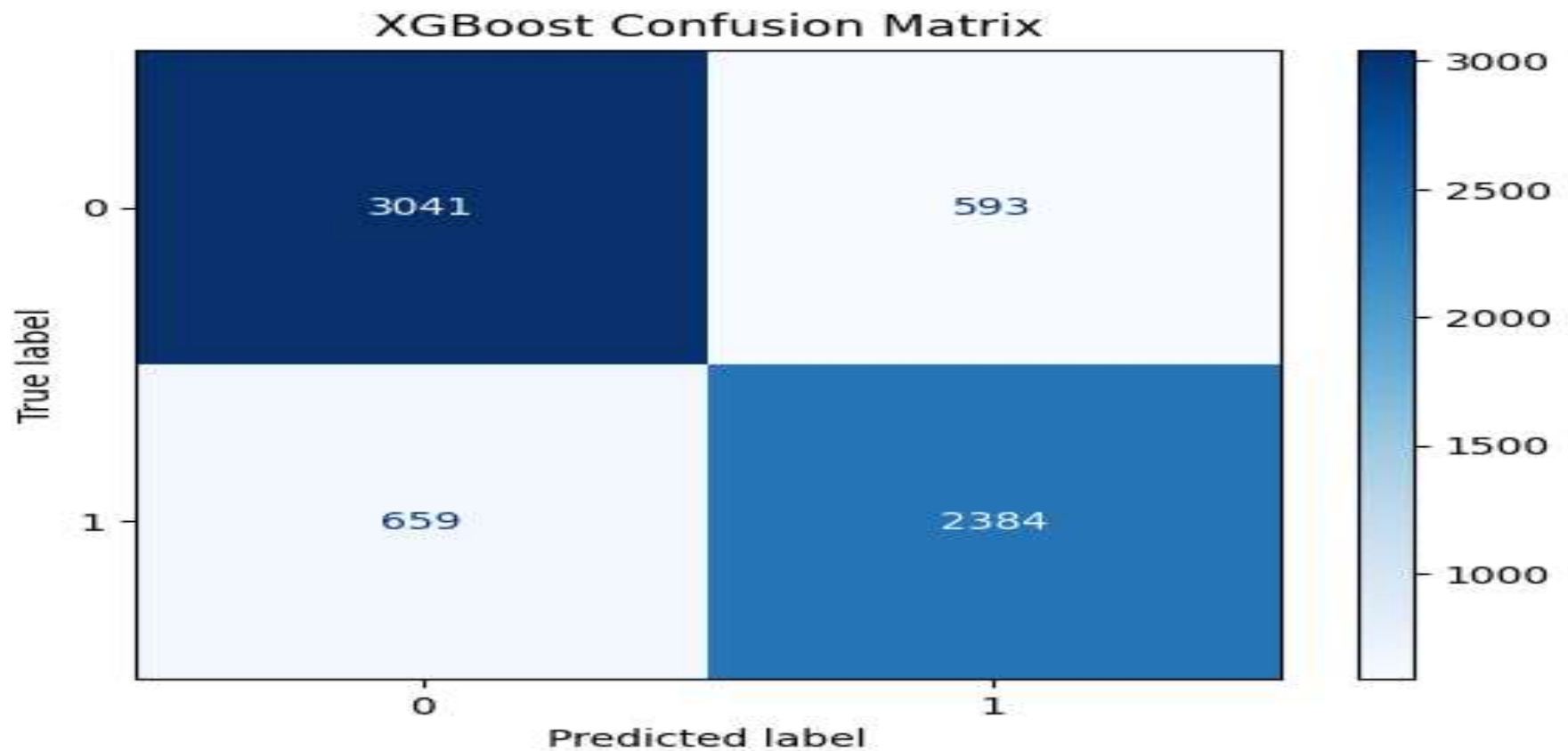
# Evaluation Continued

## XGBoost Results:

- ❖ Accuracy: 81.25%
- ❖ ROC AUC Score: 88.50%
- ❖ High precision and recall for both vaccinated and non-vaccinated groups.



# Confusion Matrix for XGBoost

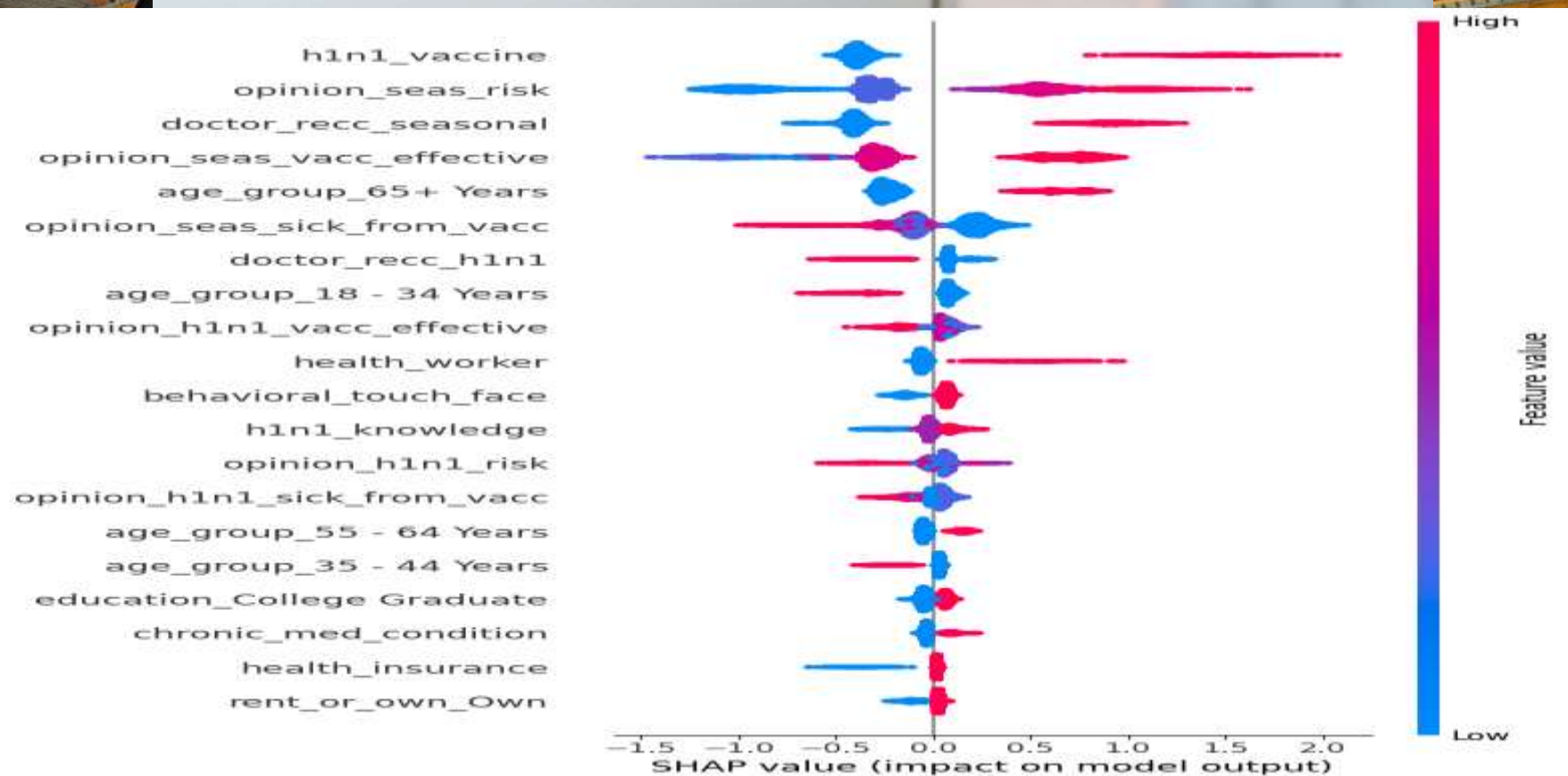




# Feature Importance (SHAP Analysis)

- ❖ **Top Influential Factors:**
- ❖ **Doctor Recommendation:** Strongly encourages vaccination.
- ❖ **Opinion on Vaccine Effectiveness:** Positive beliefs increase uptake.
- ❖ **Past Vaccine Behavior:** Those who took the H1N1 vaccine are likely to take the flu vaccine.
- ❖ **Interpretation:**
- ❖ Recommendations from healthcare professionals and positive opinions about vaccines play crucial roles in vaccine uptake.
- ❖ Understanding these factors helps tailor public health messages.

# SHAP Summary Plot



# Recommendations

## ❖ **Targeted Campaigns:**

- ❖ Focus on younger and older age groups, lower education levels, and lower-income individuals.

## ❖ **Doctor Engagement:**

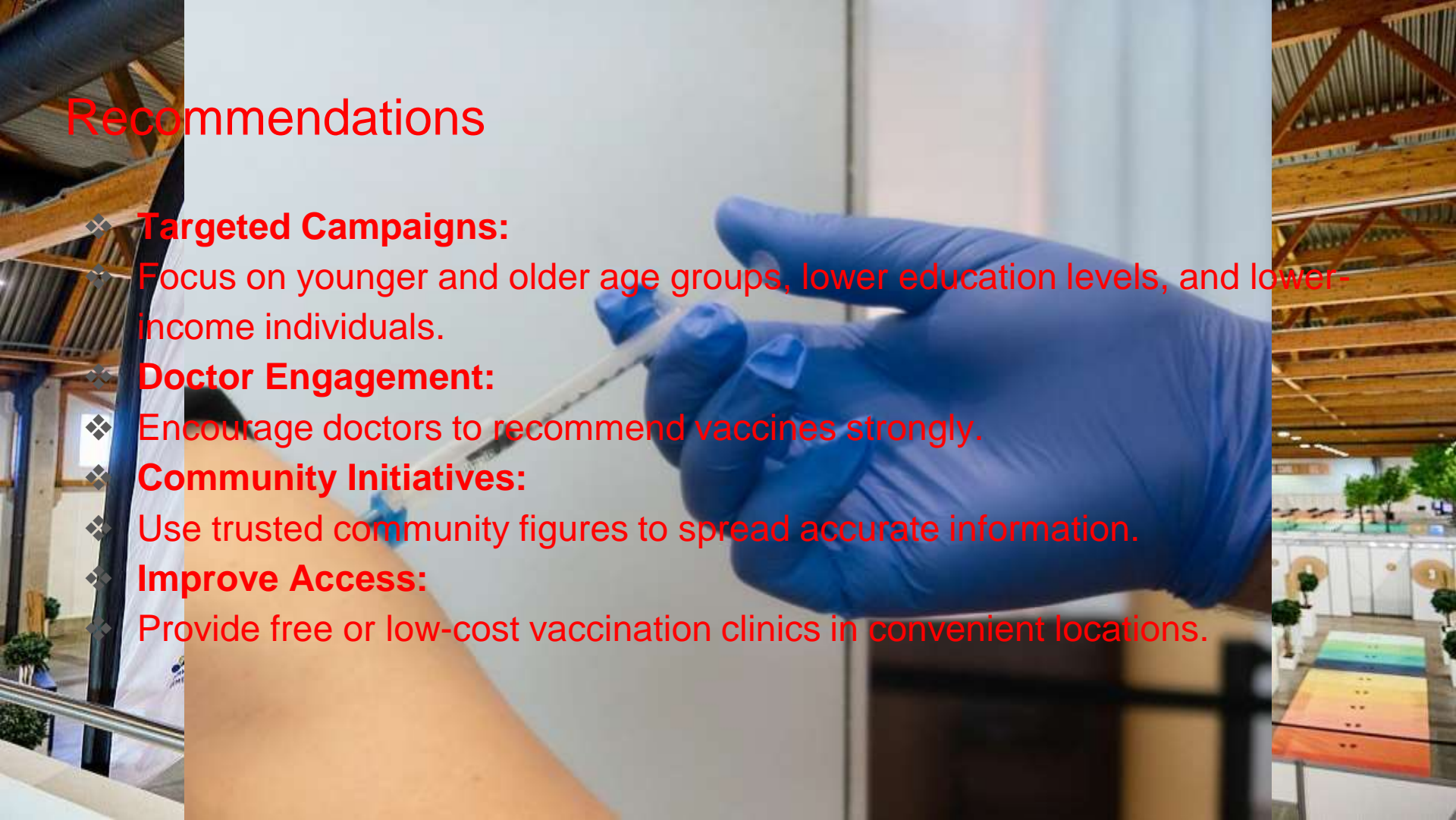
- ❖ Encourage doctors to recommend vaccines strongly.

## ❖ **Community Initiatives:**

- ❖ Use trusted community figures to spread accurate information.

## ❖ **Improve Access:**

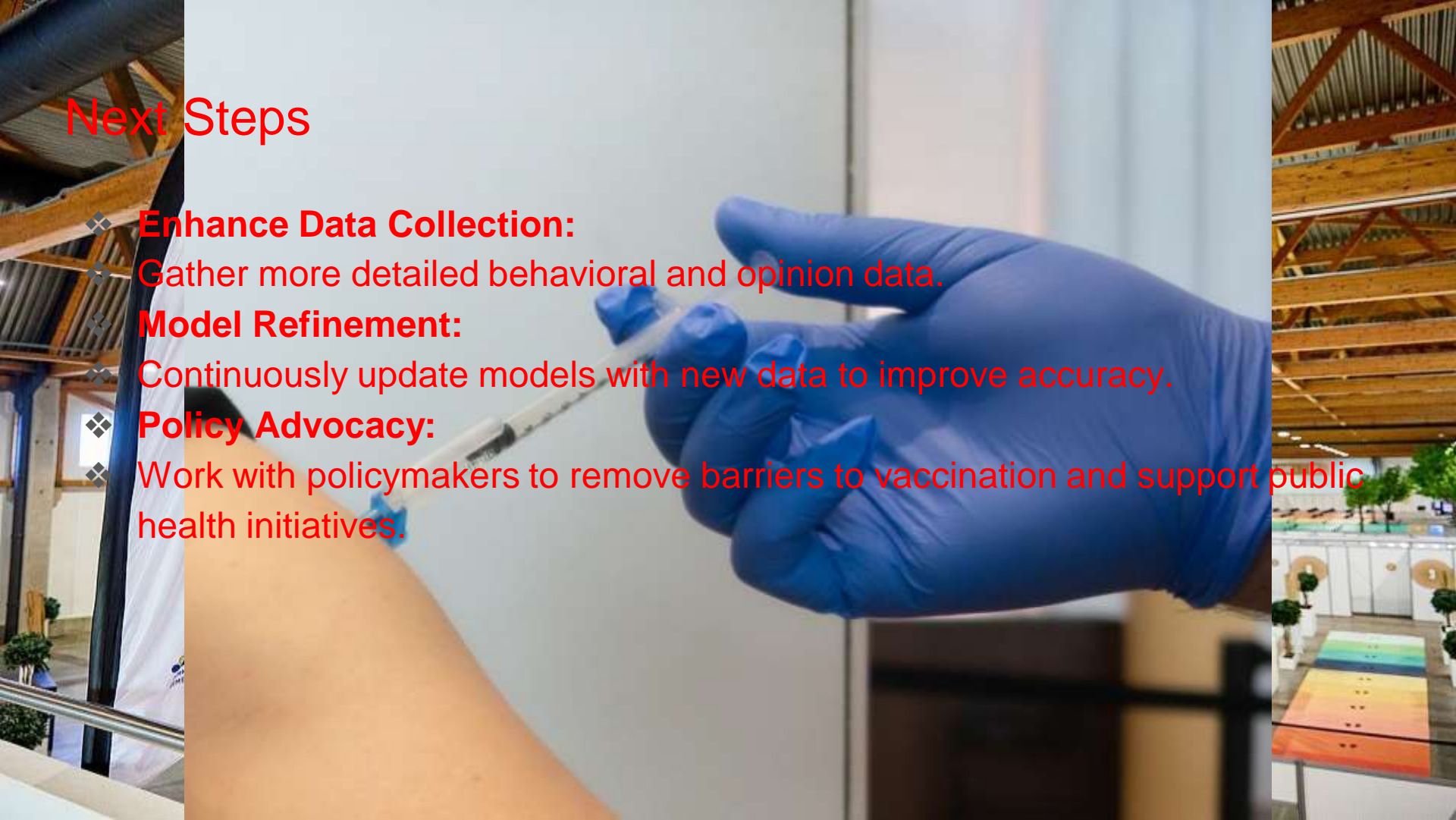
- ❖ Provide free or low-cost vaccination clinics in convenient locations.





# Next Steps

- ❖ **Enhance Data Collection:**
  - ❖ Gather more detailed behavioral and opinion data.
- ❖ **Model Refinement:**
  - ❖ Continuously update models with new data to improve accuracy.
- ❖ **Policy Advocacy:**
  - ❖ Work with policymakers to remove barriers to vaccination and support public health initiatives.



## Contact information

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