Combating Vaccine Hesitancy: A predictive approach to disease severity with AI

## Sakshi Khanduri & Shraddha Mamarde
Malmo Univeristy

What is Vaccine Hesitancy ?

Vaccine hesitancy refers to delay in acceptance or refusal of vaccines despite availability of vaccination services.

Using a machine learning model (LightGBM), this study analysed over 43,000 vaccination records to predict vaccination status and identify key factors influencing vaccine acceptance. The model achieved 79% accuracy, with Reported Symptoms, Disease Severity, and Immunity Levels identified as the top predictors of vaccine hesitancy. These findings offer actionable strategies to address hesitancy and enhance vaccination campaigns.

Global Challenge-Why does it matter?

• **Low vaccine uptake can lead to outbreaks of preventable diseases.**
• **SHAP analysis highlighted how symptoms and disease severity reduce hesitancy, emphasizing the role of perceived health risks.**
• **Vaccine hesitancy is influenced by health factors, with younger, low-immunity individuals at higher risk of hesitancy.**

Chronic Conditions vs Not Vaccinated People
Not Vaccinated — 0 = Vaccinated, 1 = Not Vaccinated
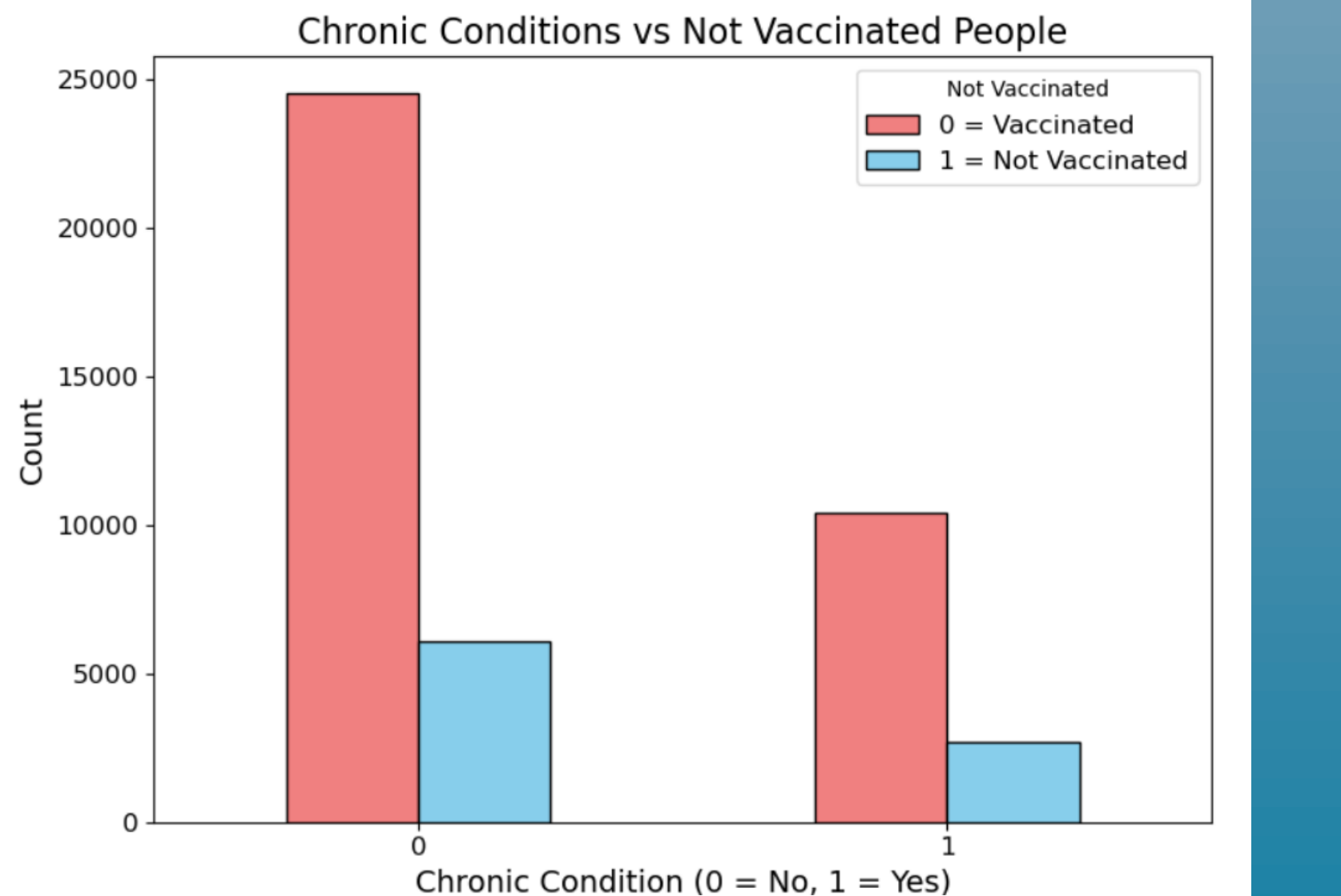
Methodology

• **Dataset: Over 43,000 records of vaccination status and associated features.**
• **Model: LightGBM classifier used for prediction.**
• **Data Pre-processing: Label encoding, SMOTE for class imbalance, scaling.**
• **Evaluation: Accuracy and feature importance, and SHAP analysis.**

Accuracy: 79% accuracy achieved with the LightGBM model.
Key Predictors: Reported Symptoms, Immunity Level, SES, Hospital Capacity and Age.

➢ **Low SES individuals reported higher levels of chronic conditions.**
➢ **Disease severity and reported symptoms were linked to vaccination status.**
➢ **People with higher immunity levels were less likely to be vaccinated.**

Feature Importances

Disease Severity by Vaccination Status

Immunity Levels by Vaccination Status

Reported Symptoms by Vaccination Status
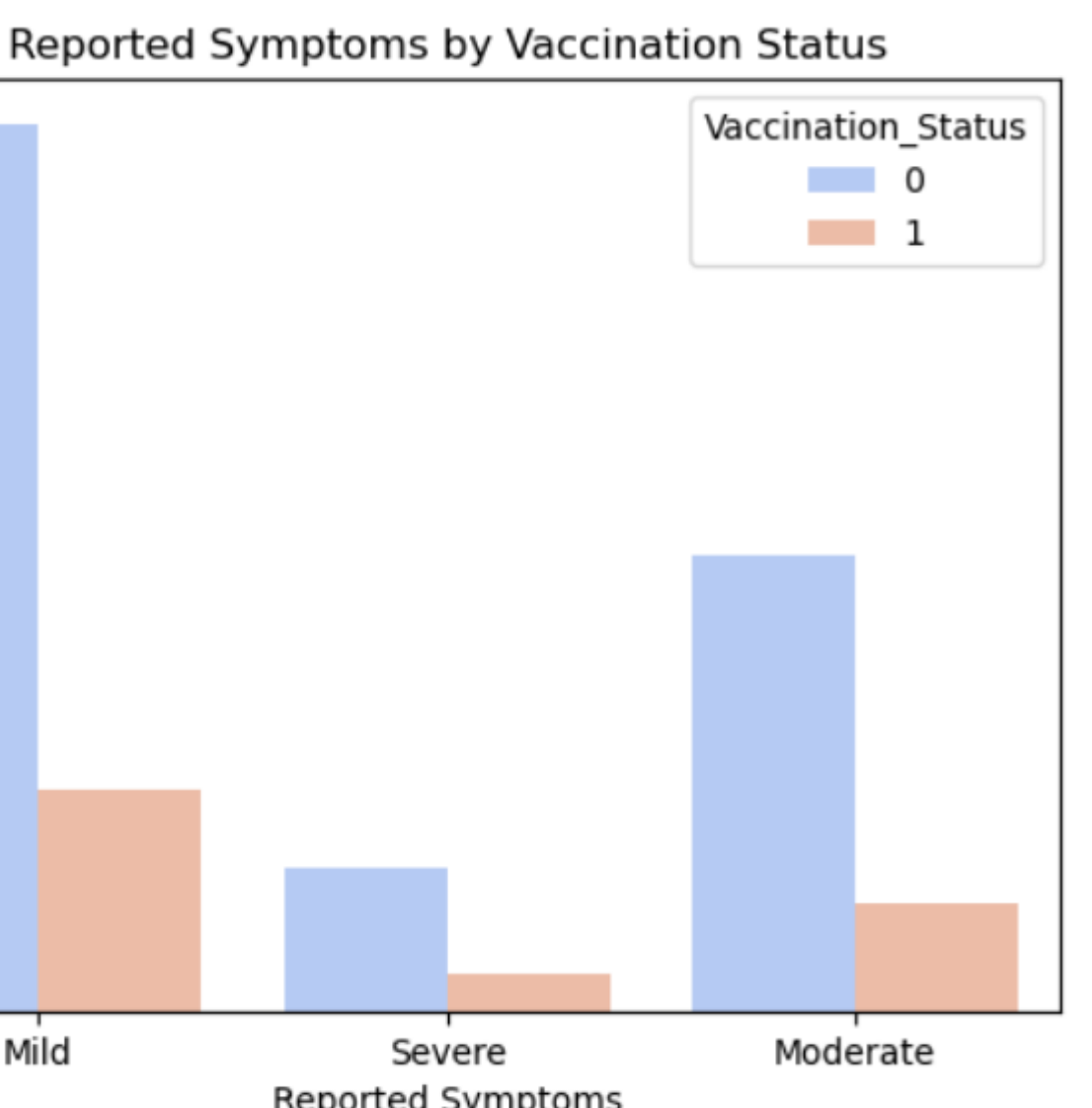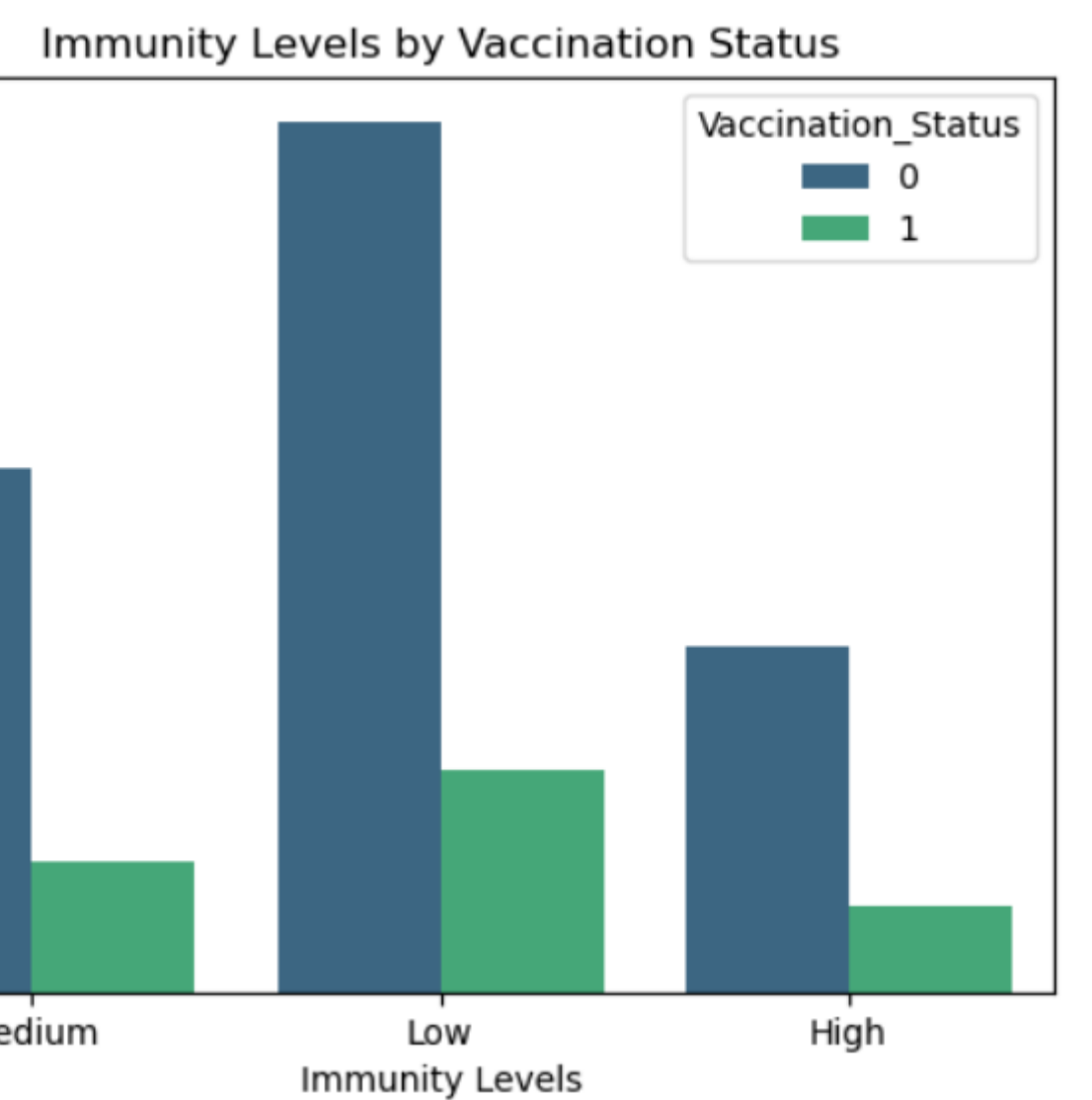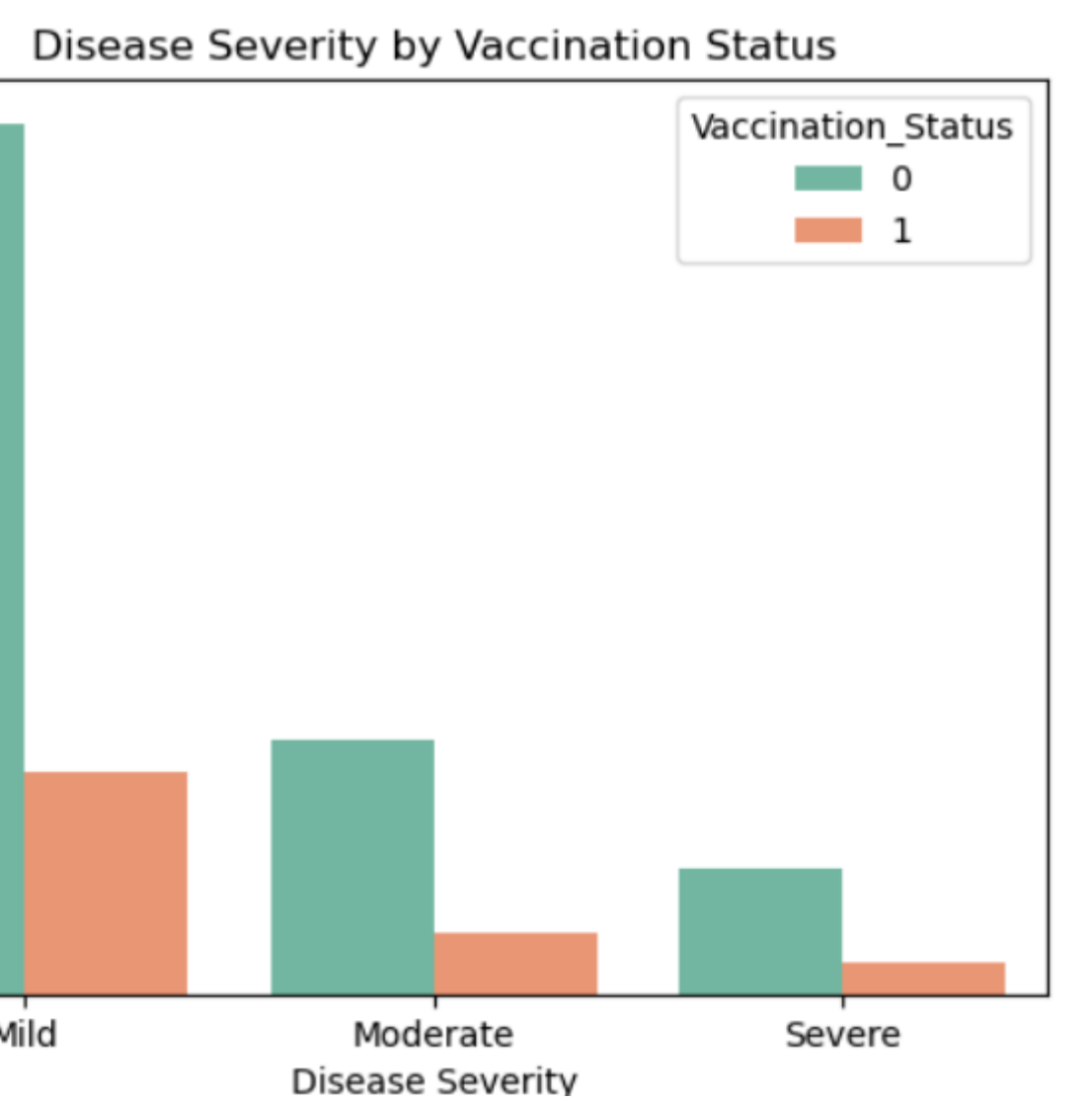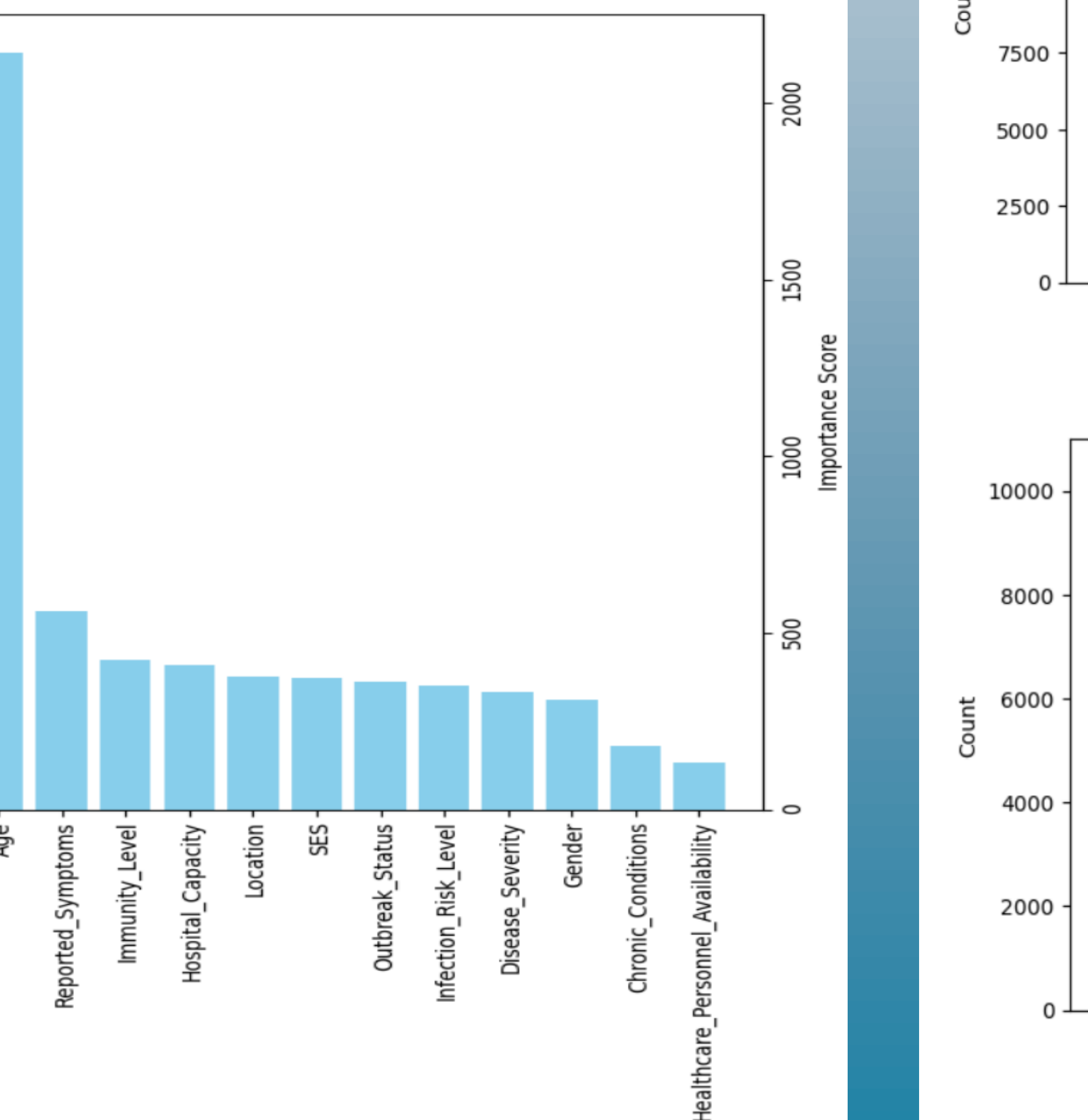
How to overcome Vaccine Hesitancy?

1. **Low SES Groups:**
   • Target interventions toward socio-economically disadvantaged groups and individuals with chronic conditions.
2. **Awareness Campaigns:**
   • Provide targeted health communication to dispel myths and misinformation.
   • Raise awareness about vaccine safety and benefits.
3. **Building Trust:**
   • Transparent communication on vaccine development and safety processes.
4. **Community Engagement:**
   • Partner with community leaders and vaccinated individuals to share positive experiences.
5. **Incentivizing Vaccination:**
   • Financial and logistical incentives to encourage uptake among hesitant populations.
6. **Healthcare Worker Training:**
   • Equip professionals to address specific vaccine concerns empathetically and knowledgeably.
7. **Mobile Health Clinics:**
   • Offer vaccination services in underserved areas, especially for those with chronic health conditions.

Challenges and Limitation

❑ **Data Bias:** Class imbalance in the dataset reduced recall for vaccinated individuals, despite SMOTE adjustments.
❑ **Model Constraints:** Limited by the scope of available features and the generalizability of the LightGBM model.
❑ **Investigating region-specific** interventions tailored to local vaccine hesitancy drivers.