



# CLEAR-MIND

*Your Personalized Companion in Migraine Management*

Presented By :  
**Group 01**

# “HEAD-ACHE”

## *From Headache to Migraine: A Daily Battle*



Globally, headache disorders affect approximately 40% of the population, or 3.1 billion people in 2021, and are more common in females compared to males. They are among the top three most common neurological conditions for most age groups, starting with age 5 and remaining in the top three until the age of 80. Despite some regional variations, headache disorders are a worldwide problem, affecting people of all races, income levels and geographical areas (1).

**A WHO expert committee proposal discusses the global prevalence of migraine (estimated at about 14–15%) and its ranking as a leading cause of years lived with disability**

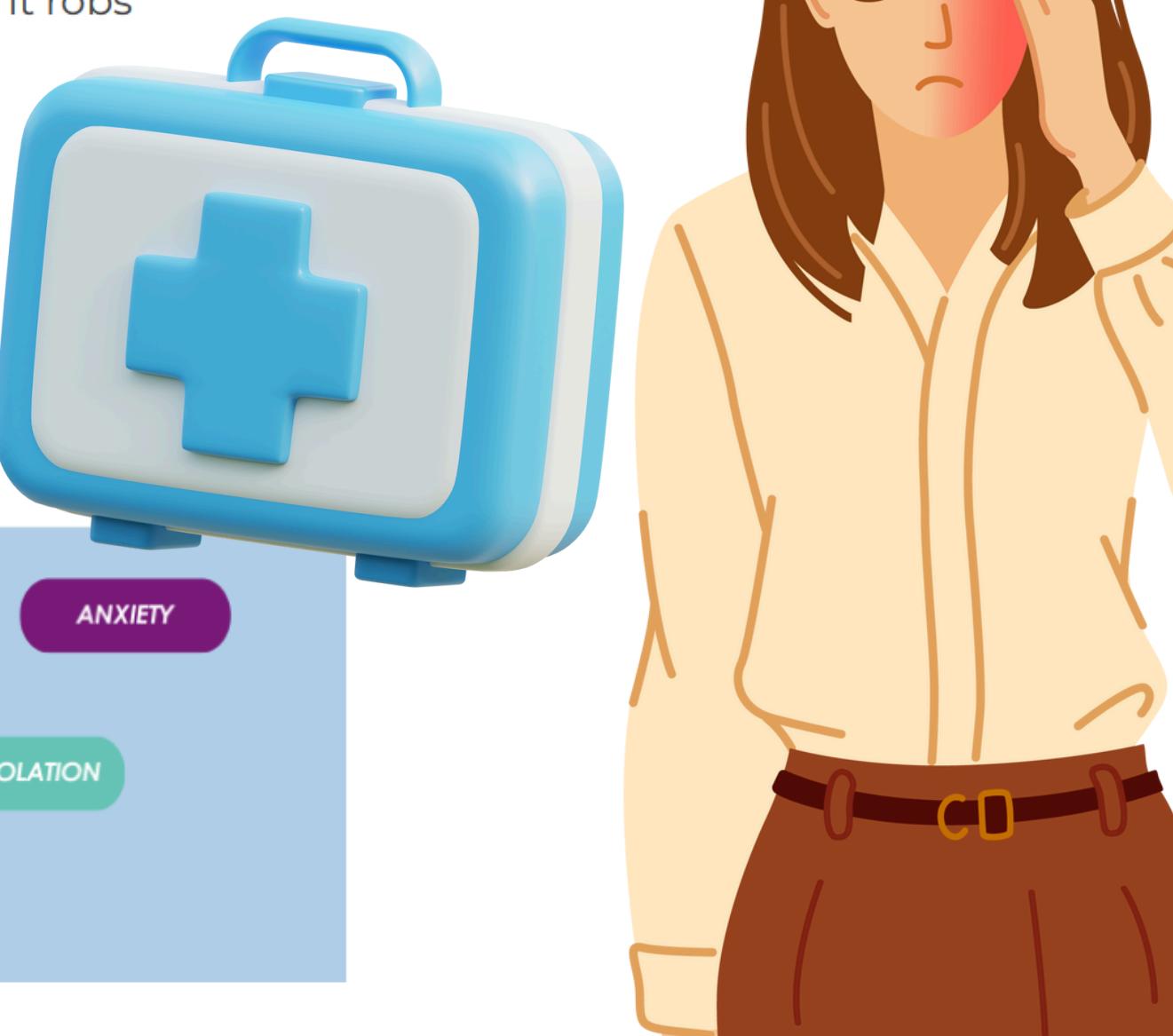
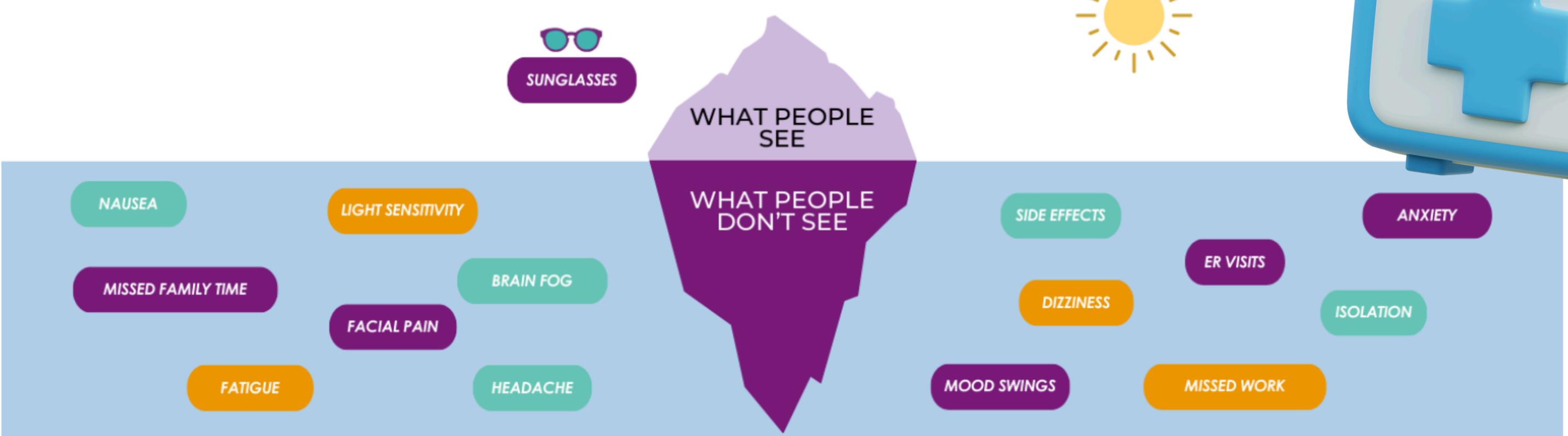
# WHAT IS MIGRAINE?

## OVER 1 BILLION PEOPLE ARE LIVING WITH MIGRAINE

Migraine disease is a complex neurological disease that impacts nearly every body system. As a spectrum disease, the frequency and severity of attacks and the range of symptoms vary from person to person. While it isn't deadly, it robs individuals of their quality of life.



### MIGRAINE ICEBERG



# TYPES OF MIGRAINE



Migraine has several clinically recognized subtypes:

- **Migraine Without Aura** – No sensory warning signs
- **Migraine With Aura** – Visual/sensory symptoms before pain
- **Aura Without Headache** – Neurological changes, no pain
- **Episodic vs. Chronic Migraine**
- **Other types: Menstrual, Hemiplegic, Vestibular**

Each subtype differs by symptoms, neurological features, and treatment approach.

# WHY DO WE WANT TO IDENTIFY THE TYPE OF MIGRAINE?

Ensures the right treatment plan

For example:

- Migraine with aura may require early intervention before the headache starts.
- Menstrual migraines might need hormone-specific treatments.
- Chronic migraines call for long-term prevention strategies.

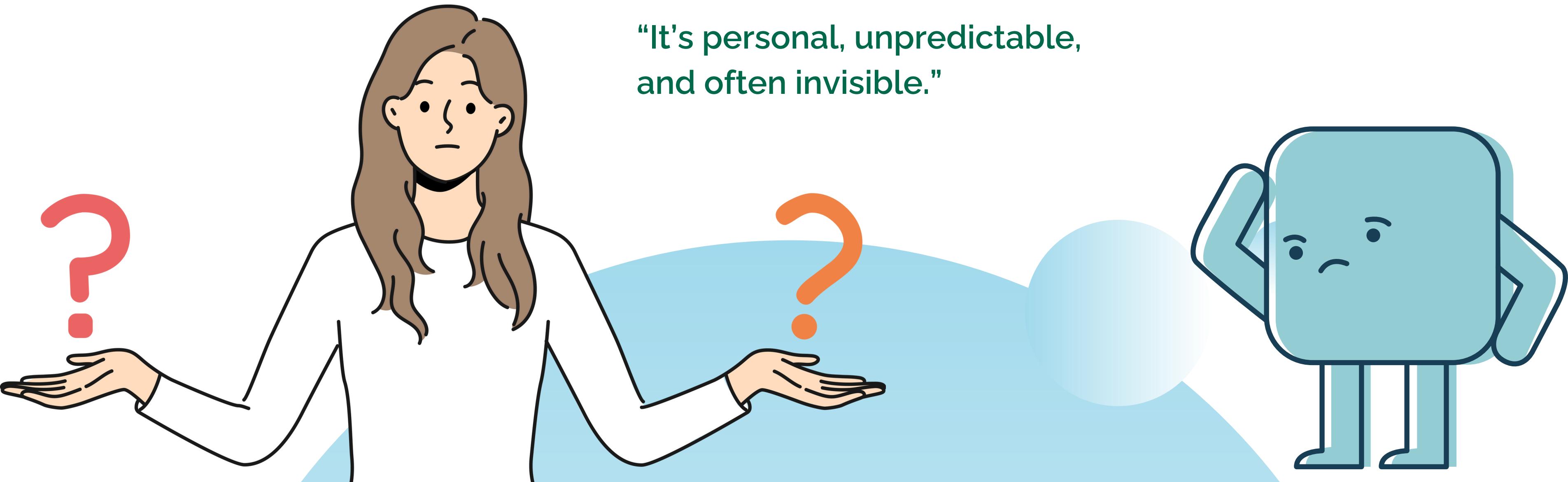
Avoids misdiagnosis or overmedication



# WHY IS IT SO HARD TO IDENTIFY THE TYPE OF MIGRAINE?

- Overlapping symptoms (aura, nausea, visual changes)
- People struggle to describe symptoms during pain
- Lack of tracking makes diagnosis guesswork

“It’s personal, unpredictable,  
and often invisible.”



# Meet Our App: **CLEARHEAD**

- Your smart assistant for identifying migraine types
- Tracks symptoms, classifies types, analyzes patterns
- Built for ease-of-use and scientific accuracy



# WHO WILL BENEFIT FROM THIS APP?

- Migraine sufferers (new or chronic)
- Caregivers
- Students, professionals, parents



# WHAT WE OFFER

- Real-time symptom tracking
- Machine learning-based migraine type prediction
- Identifies lifestyle triggers
- Generates medical reports
- Access to blogs and expert guidance

From tracking to treatment planning  
your migraine ally



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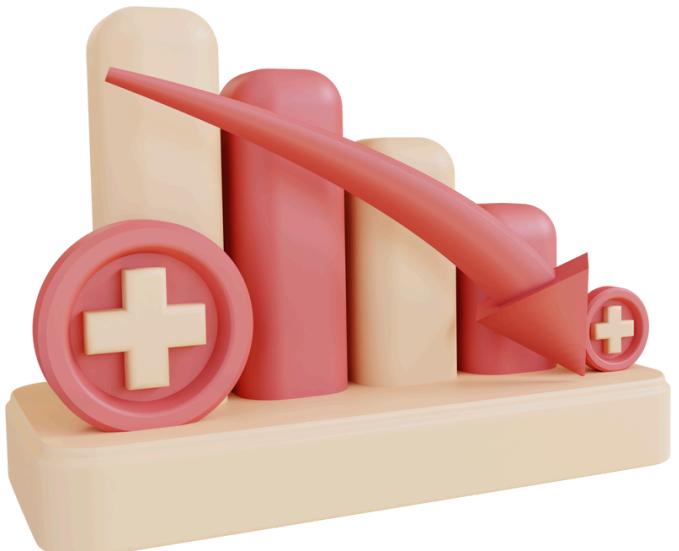
# STORY OF BUILDING CLEARHEAD



# THE DATA

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400  
Observations



23 Features

**Pain:**  
Location  
Character  
Intensity

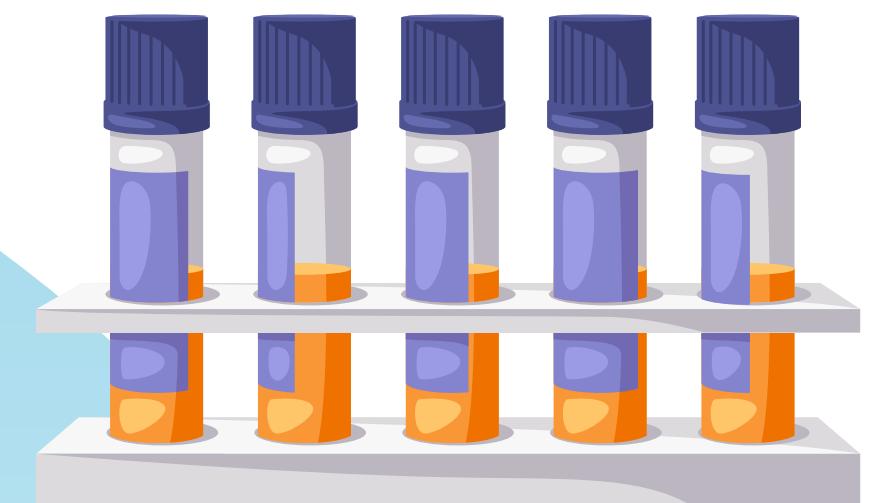
Age

Duration  
Frequency

**Symptoms:**

Nausea  
Vomit  
Phonophobia  
Photophobia  
Visual  
Sensory  
Motor  
Language  
Vertigo  
Tinnitus  
Hypoacusis  
Diplopia  
Defect  
Ataxia  
Conscience  
Paresthesia  
DPF

**Response:**  
Type



R  
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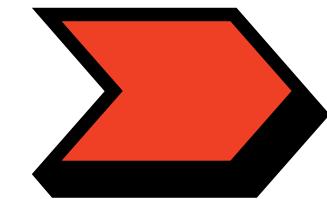
- Typical aura with migraine
- Typical aura without migraine
- Migraine without aura
- Familial hemiplegic migraine
- Sporadic hemiplegic migraine
- Basilar-type aura
- Other



- Migraine with typical aura
- Migraine without aura
- Hemiplegic migraine variants
- Other

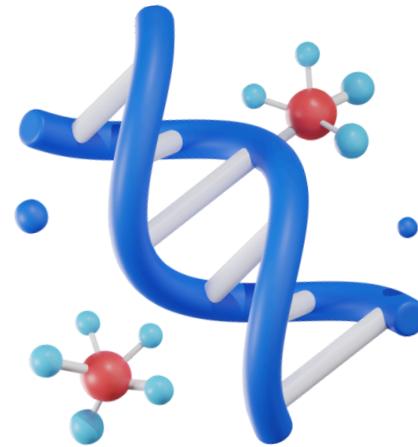
This mapping reduces complex migraine type labels into four practical clinical categories.

Goal



Enable more robust classification, and easier interpretation

Source: International Classification of Headache Disorders, 3rd Edition (ICHD-3)



# PRE PROCESSING

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## Checking Duplicates



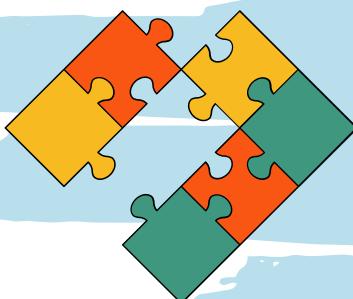
6 Duplicates

## One Hot Encoding

## Split the data set

80% and 20%

## Missing values



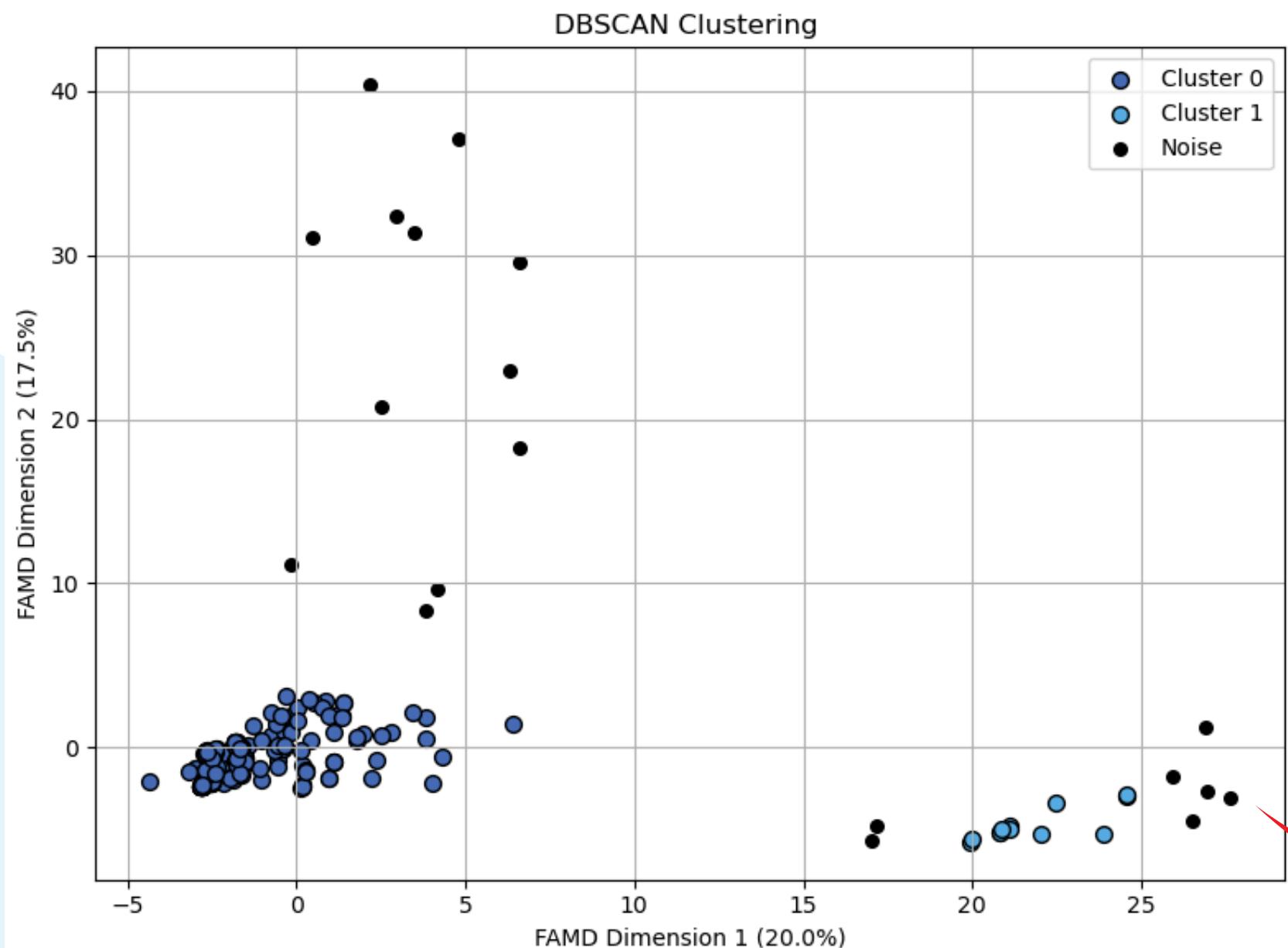
No missing values

## SMOTE



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# CLUSTERING

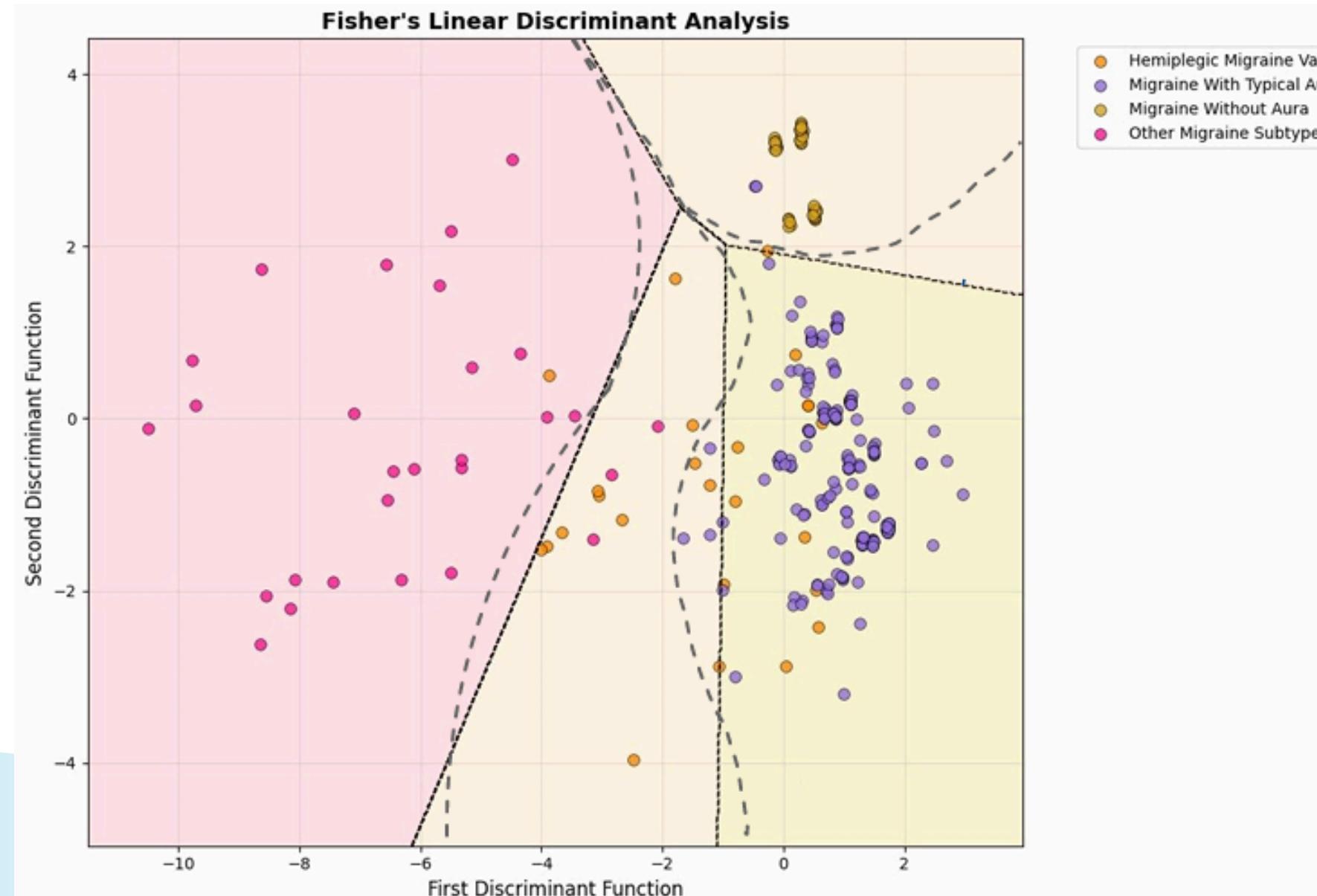


Two clusters

Only 12  
observations  
included



# DECISION BOUNDARIES



This plot shows that migraine subtypes cannot be separated by linear boundaries. The decision regions are curved and intersect, indicating the need for nonlinear models to achieve accurate classification.

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# OUR BEST MODEL



Model	Training Set				Test set			
	Precision	Recall	F1	Accuracy	Precision	Recall	F1	Accuracy
Desicion Tree	0.790	0.730	0.738	0.730	0.631	0.672	0.598	0.608
XG Boost	0.702	0.929	0.929	0.929	0.702	0.660	0.677	0.823
SVM	0.940	0.940	0.940	0.938	0.850	0.820	0.830	0.823
Gradient Boosting	0.98	0.98	0.98	0.98	0.83	0.82	0.82	0.82
Random Forest	0.97	0.97	0.97	0.975	0.91	0.91	0.90	0.905

Best Model

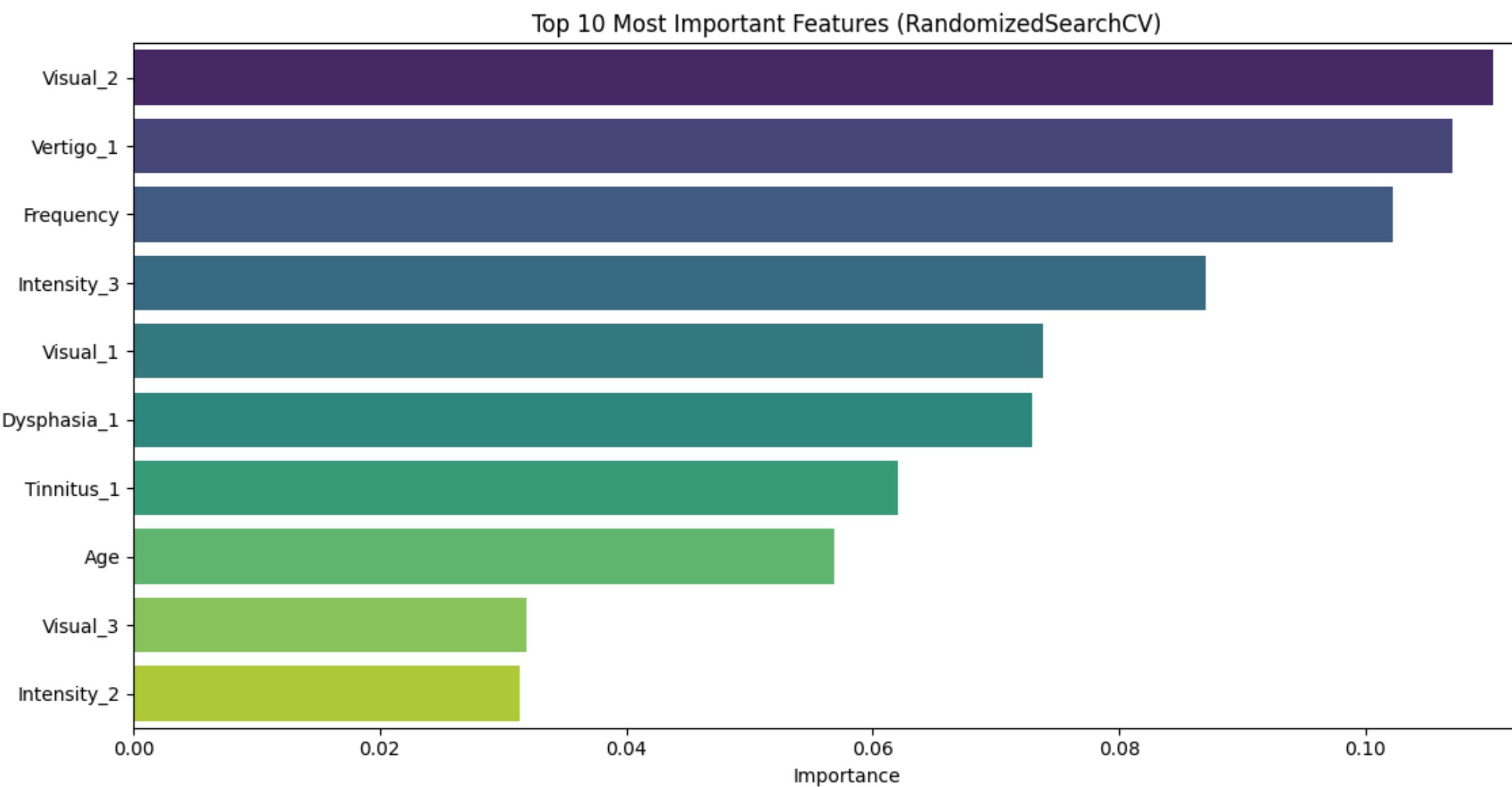


Random Forest

# FINDINGS OF OUR BEST MODEL



# VARIABLE IMPORTANCE OF BEST MODEL

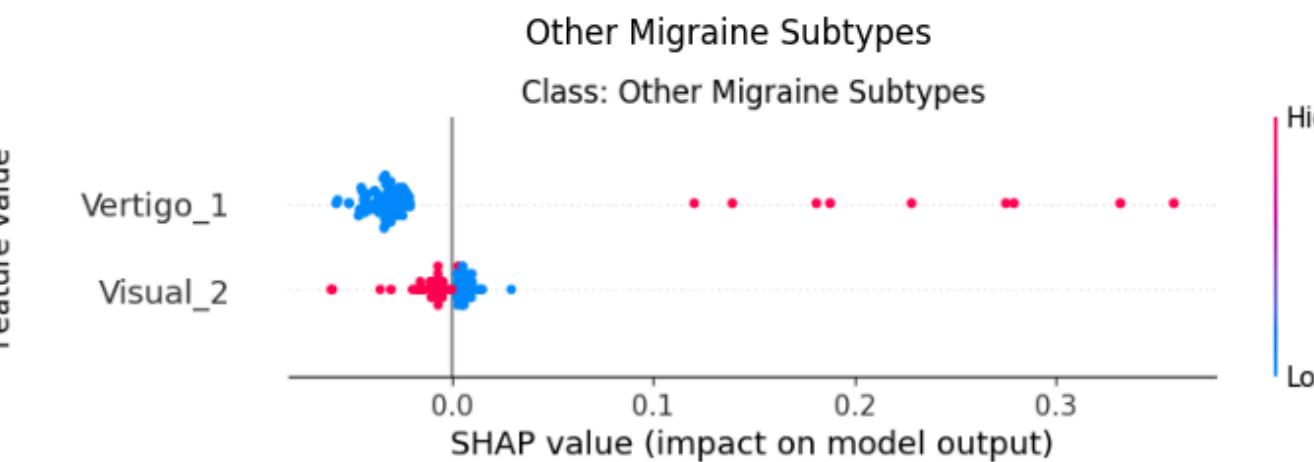
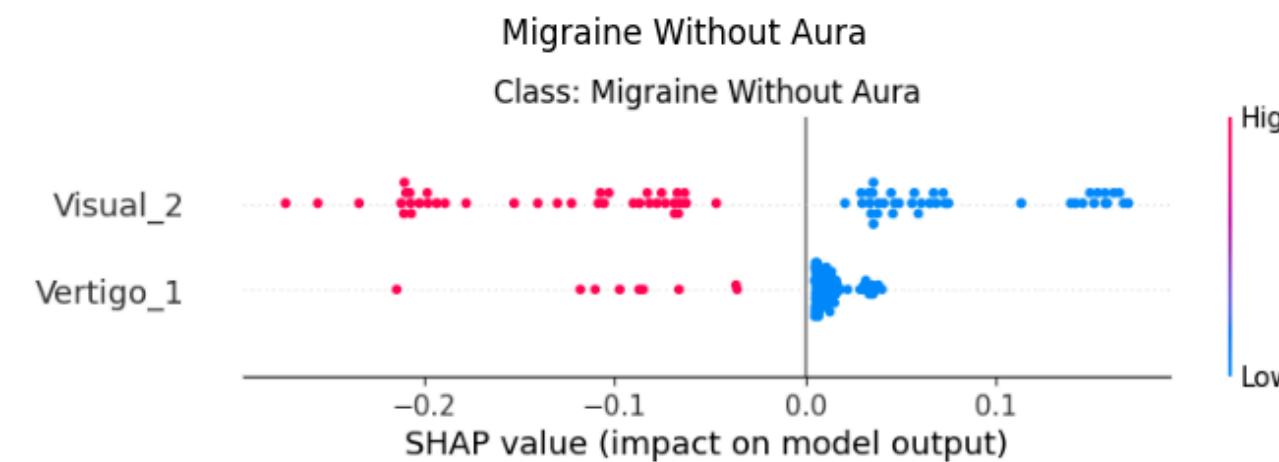
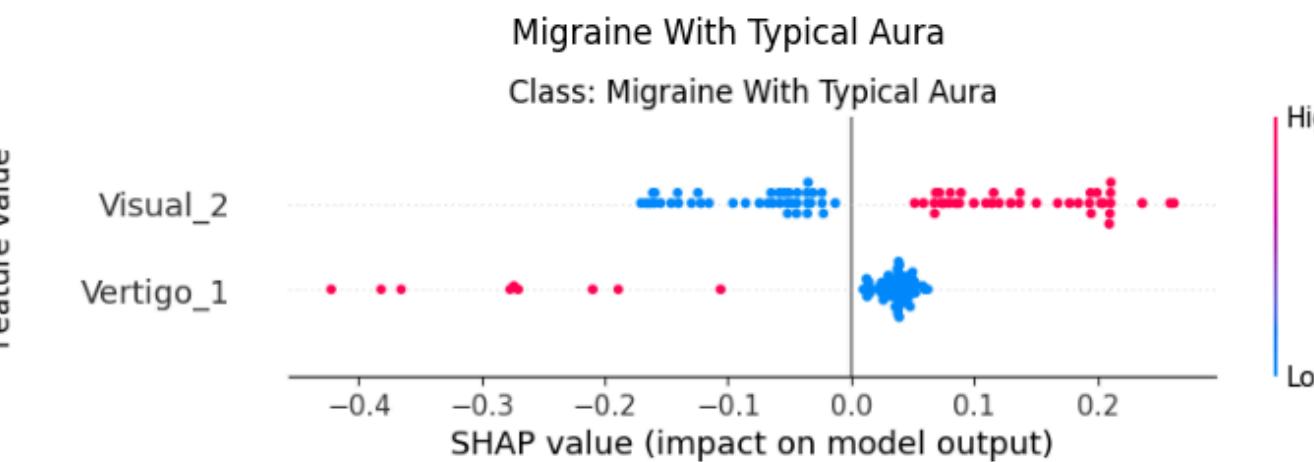
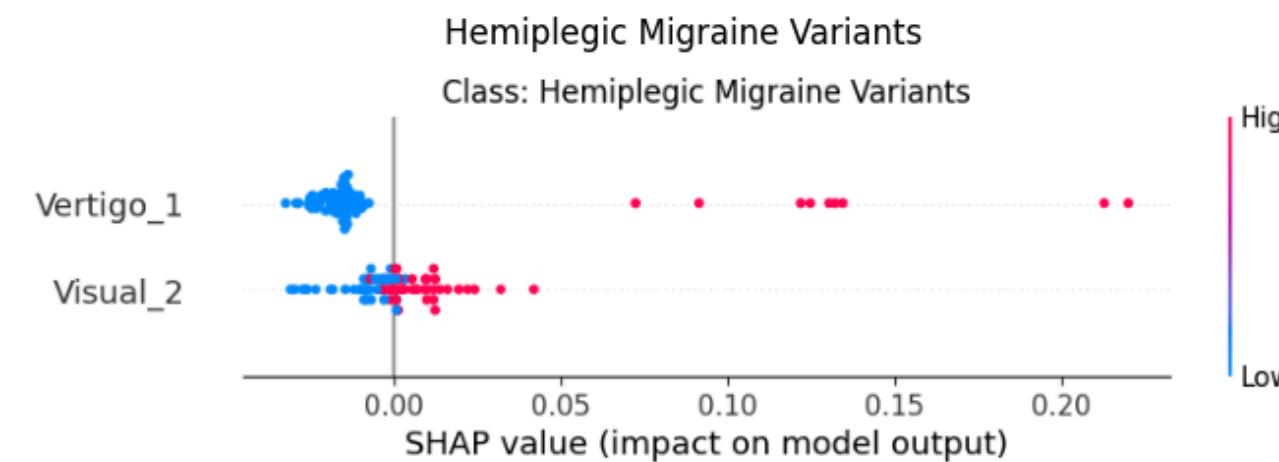


**IMPORTANT VARIABLES  
TO THE MODEL**

- **Visual\_2**
- **Vertigo\_1**
- **Frequency**

# FEATURE IMPACT BY CLASS:

## SHAP ANALYSIS OF CATEGORICAL VARIABLES

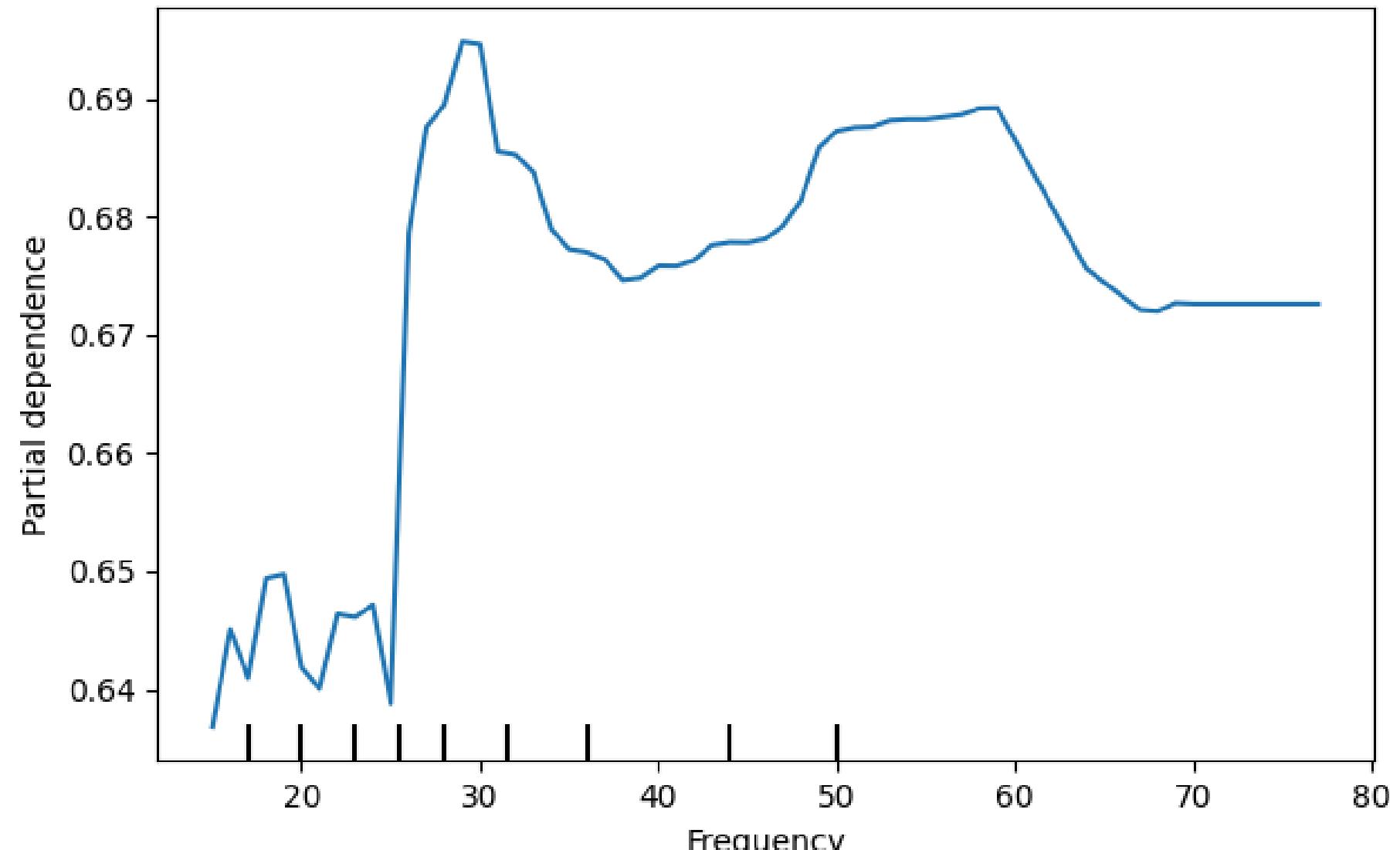


- SHAP reveals how individual features contribute to each migraine subtype prediction.
- Vertigo\_1 and Visual\_2 are key features with subtype-specific influence.
- Feature effects vary across classes — in both direction and magnitude.
- Supports model transparency and enhances clinical interpretability.

# PARTIAL DEPENDENCIES OF FREQUENCY

# MIGRAINE WITH TYPICAL AURA

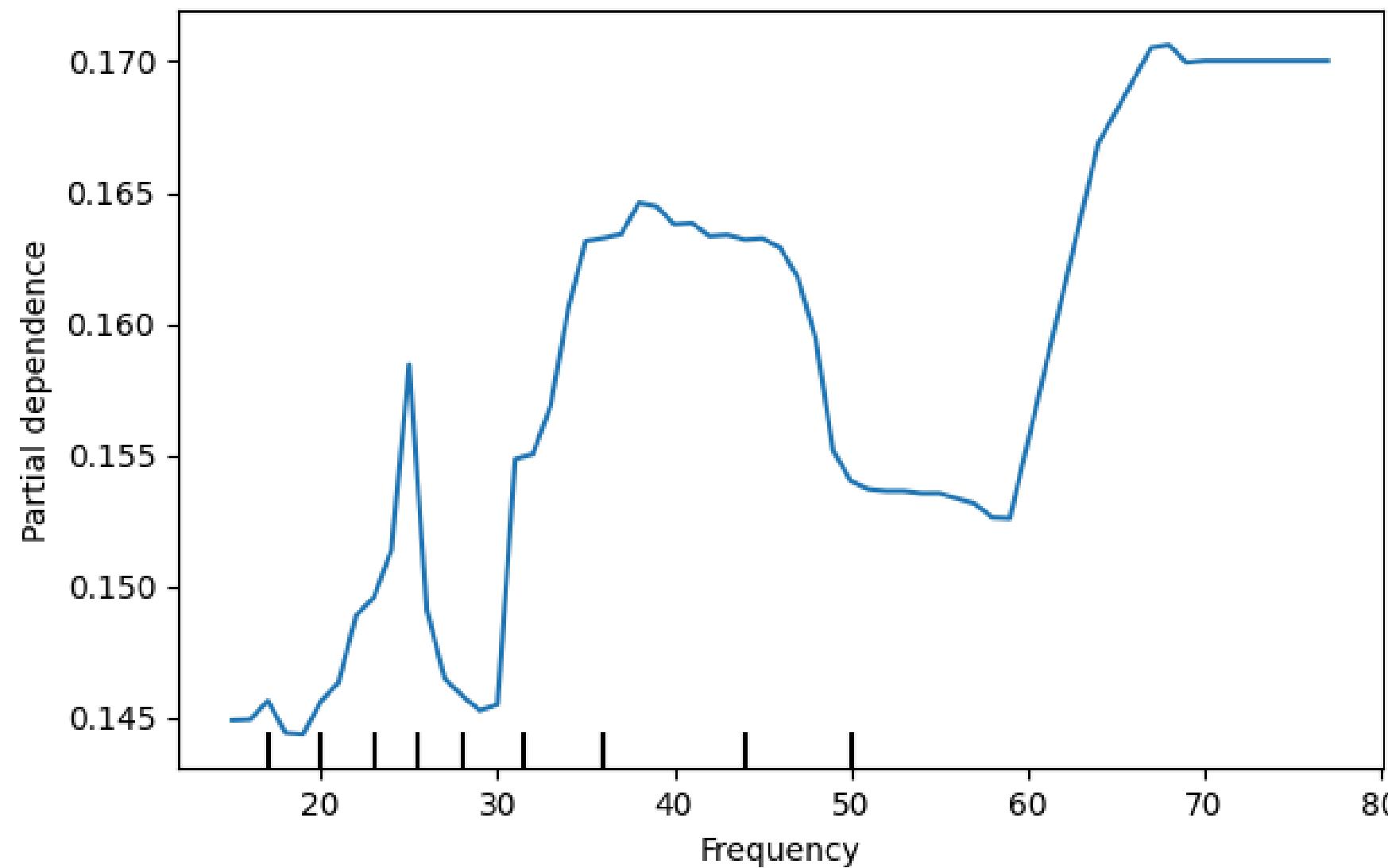
Partial Dependence Plot for Frequency - Target: Migraine With Typical Aura



- Much higher overall probability values.
- The pattern indicates that **regardless of migraine frequency**, patients are most likely to be classified as having Migraine With Typical Aura
- Dramatic spike around frequency 28-29, reaching (~0.695).
- Patients with this specific frequency have the highest likelihood of Typical Aura.

# MIGRAINE WITHOUT AURA

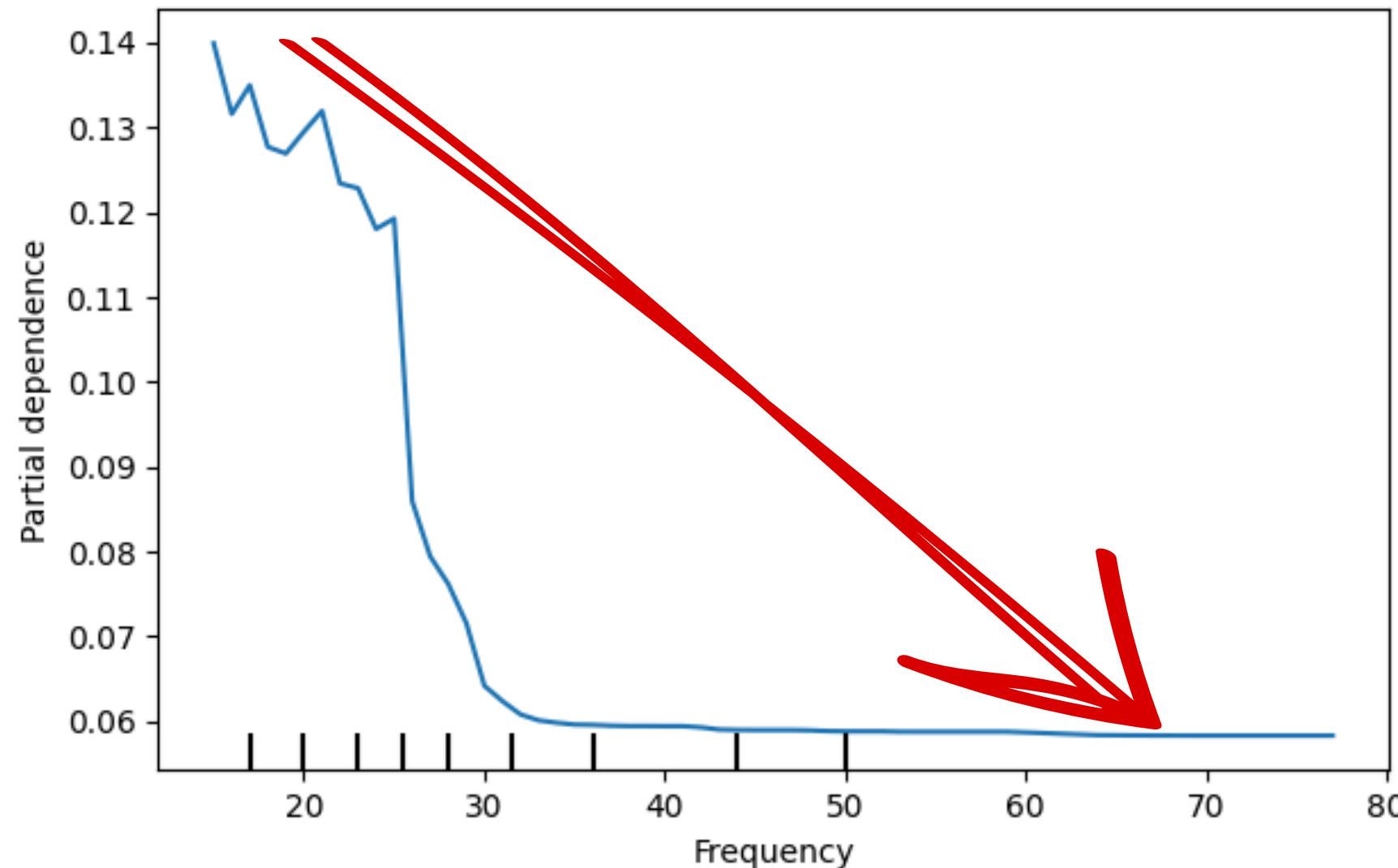
Partial Dependence Plot for Frequency - Target: Migraine Without Aura



- The bimodal pattern suggests there might be two **distinct phenotypes** within "Migraine Without Aura" - **moderate frequency** and **high frequency** sufferers.
- Patients with very high migraine frequency have the strongest association with Migraine Without Aura

# HEMIPLEGIC MIGRAINE VARIANTS

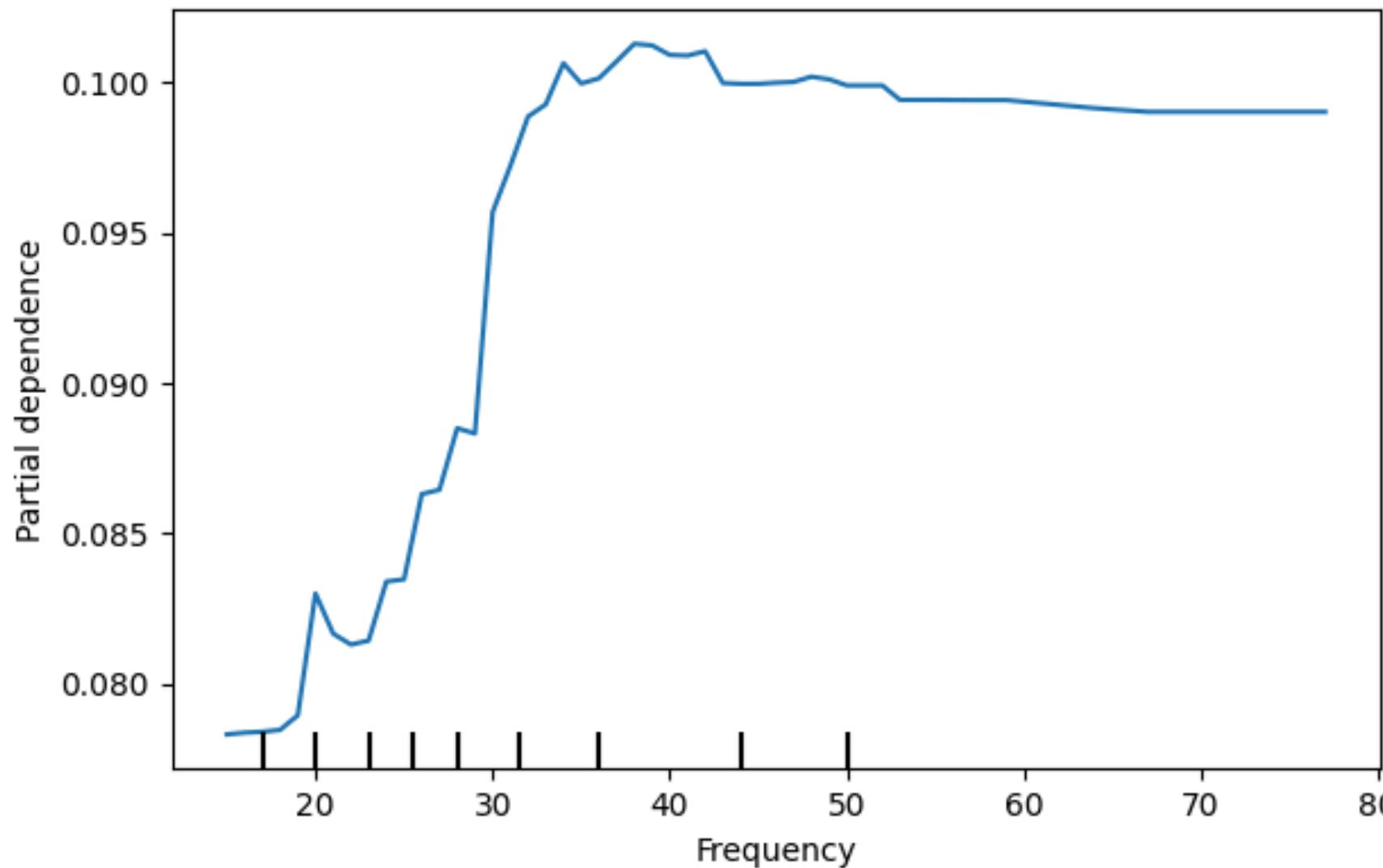
Partial Dependence Plot for Frequency - Target: Hemiplegic Migraine Variants



- This plot shows a dramatically different pattern from all the previous plots - a clear **inverse** relationship between frequency and probability.
- The highest probability occurs at the **lowest frequencies**, suggesting Hemiplegic Migraine Variants are associated with infrequent but severe attacks.
- Patients with fewer migraine attacks are more likely to have Hemiplegic Migraine Variants

# OTHER MIGRAINE SUBTYPES

Partial Dependence Plot for Frequency - Target: Other Migraine Subtypes

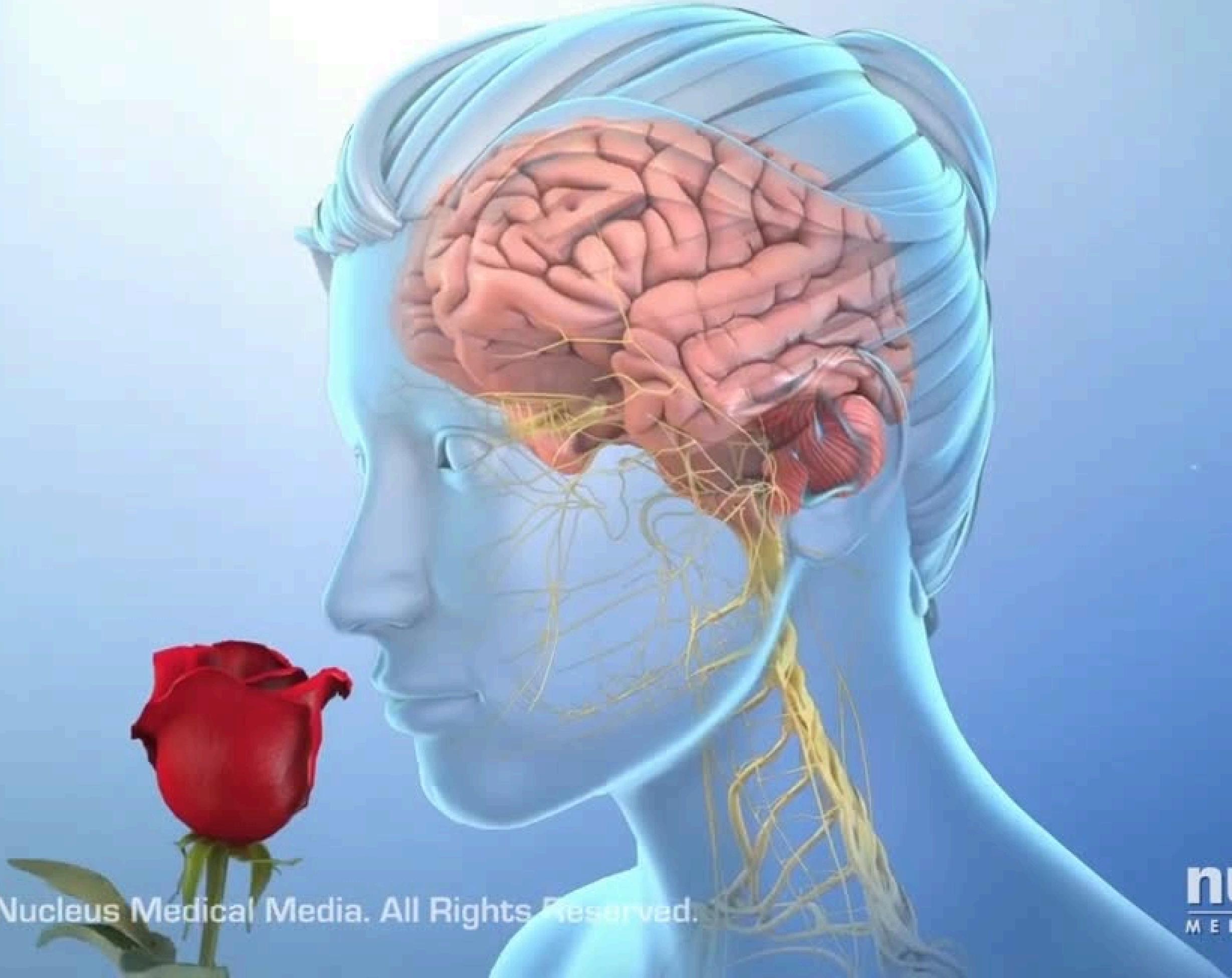


- Critical Frequency Range: Patients with migraine frequency around **30–50 attacks have the highest probability** of being classified as "Other Migraine Subtypes"

# ALL IN ONE FREQUENCY



	Migraine With Typical Aura	Hemiplegic Migraine Variants	Migraine Without Aura	Other Migraine Subtypes
<b>Frequency</b>	Any	<25	25-40	>40



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# REFERENCE

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A large, semi-transparent blue 3D molecular model is positioned on the left side of the slide. It features several thick, curved tubes representing bonds and small spheres representing atoms. A magnifying glass with a blue handle and a silver frame is focused on a cluster of three spheres, symbolizing research or analysis.

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# THANK YOU FOR YOUR ATTENTION

Presented By :  
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