

# **FAIR FORWARD HACKATHON**

**PRESENTED BY:  
COMMUNITY HEALTH  
GROUP**





# AGENDA

Introduction

Our Approach

What Predicts Quality of Life

The Frustration Gap

The Smoking Gun

The Solution

Conclusion

# THE QUALITY-OF-LIFE BLACK BOX

Our goal was to understand Quality of Life and factors that contributed to it.

Our Approach:

We attacked this problem in two ways: a predictive *Supervised* model and an explanatory *Unsupervised* model. What we found is that we've been failing a specific group of patients for a reason we've now uncovered



# WHAT PREDICTS QUALITY-OF-LIFE?



First, a predictive Random Forest model was built to find the key drivers of QoL. The model achieved an  $R^2$  of **0.489**.. This model gave us our first clues. It proved the two most important predictors are

- Patient Satisfaction
- Service Type.



But this gave us a circular problem: to improve QoL, you must 'improve satisfaction.' This isn't an answer; it's a puzzle."

# METHOD FOR SUPERVISED APPROACH

## 1. DATA COLLECTION

└─> 347 patients with complete records

## 3. TRAIN-TEST SPLIT

└─> Training: 80% (278 patients)

└─> Testing: 20% (69 patients)

## 2. DATA PREPROCESSING

└─> Feature engineering

└─> Categorical encoding

└─> Missing value handling

└─> Feature scaling

## 4. MODEL TRAINING

└─> Linear Regression

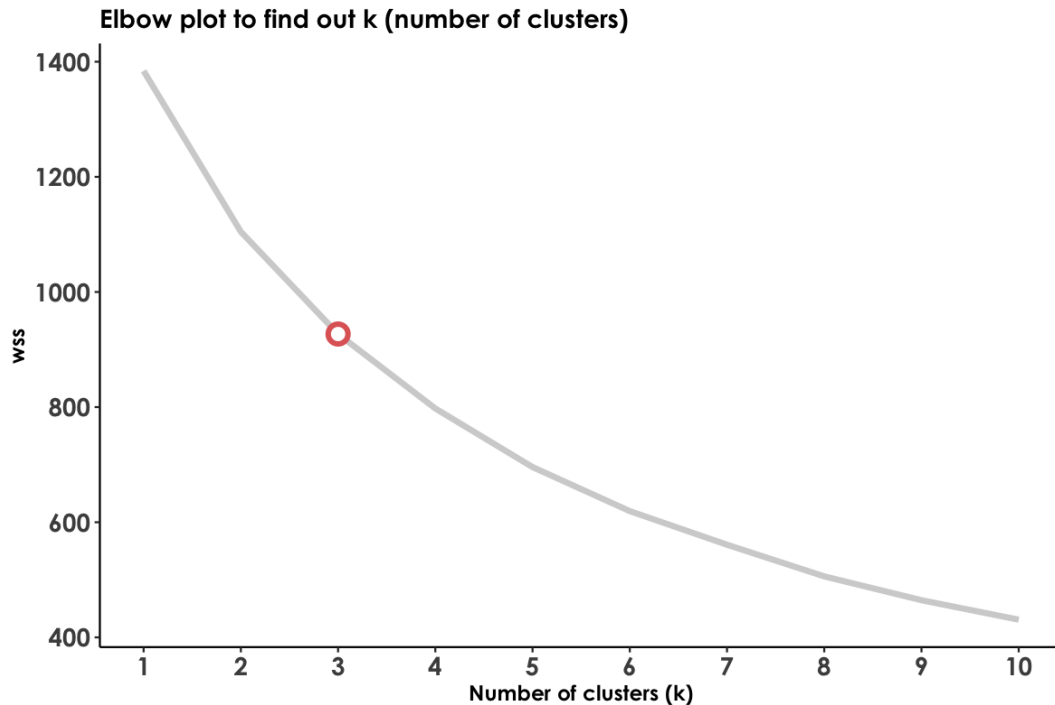
└─> Random Forest

## 5. MODEL EVALUATION

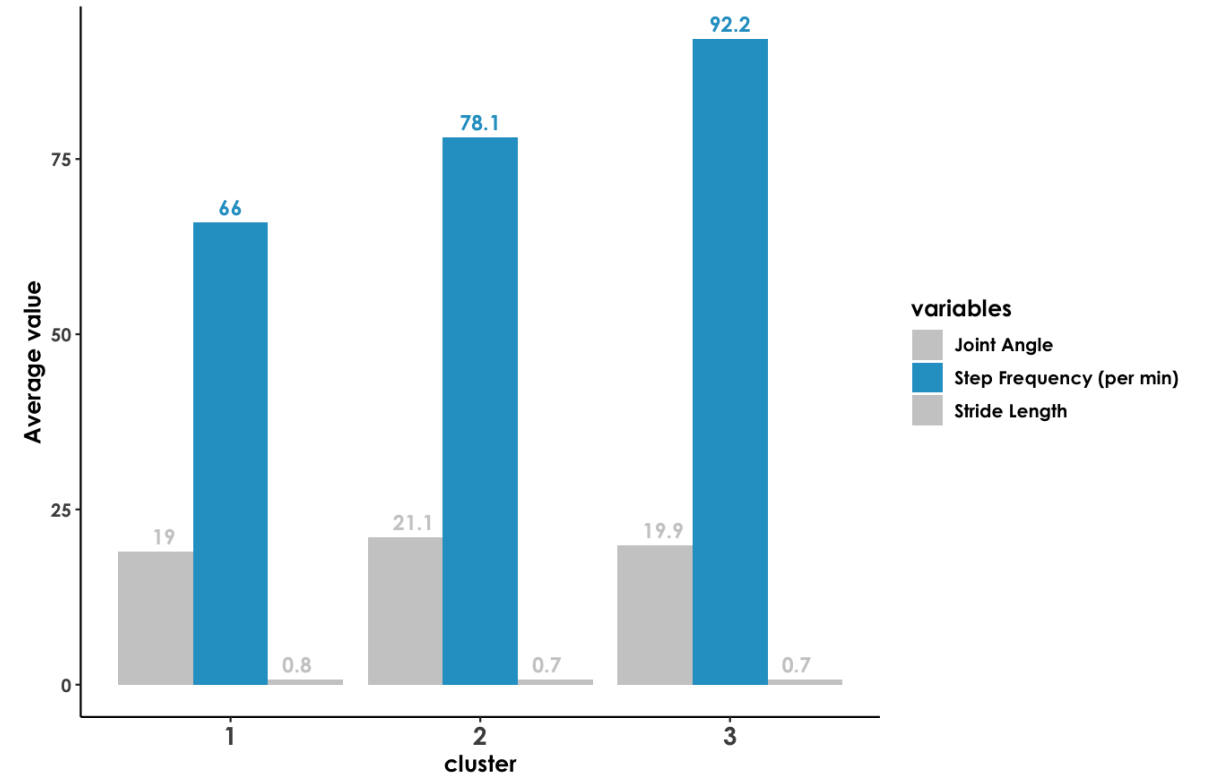
└─> RMSE, MAE,  $R^2$  metrics

# OUR METHOD - UNSUPERVISED

## Finding the 3 Patient Profiles



1. **The Method:** We used an **unsupervised k-Means** model to find natural groups in the patient's "movement DNA" (the 4 biomechanical variables).
2. **The "Elbow":** The Elbow Plot clearly showed **k=3** was the optimal number of clusters, confirming our 3-group model.



3. **The Discovery:** The model's #1 sorting factor was Step Frequency (Walking Speed).

4. **The Profiles:** This automatically sorted all patients into three distinct, data-driven groups:

- Cluster 1: "Slow Walkers"
- Cluster 2: "Steady Walkers"
- Cluster 3: "Fast Walkers"

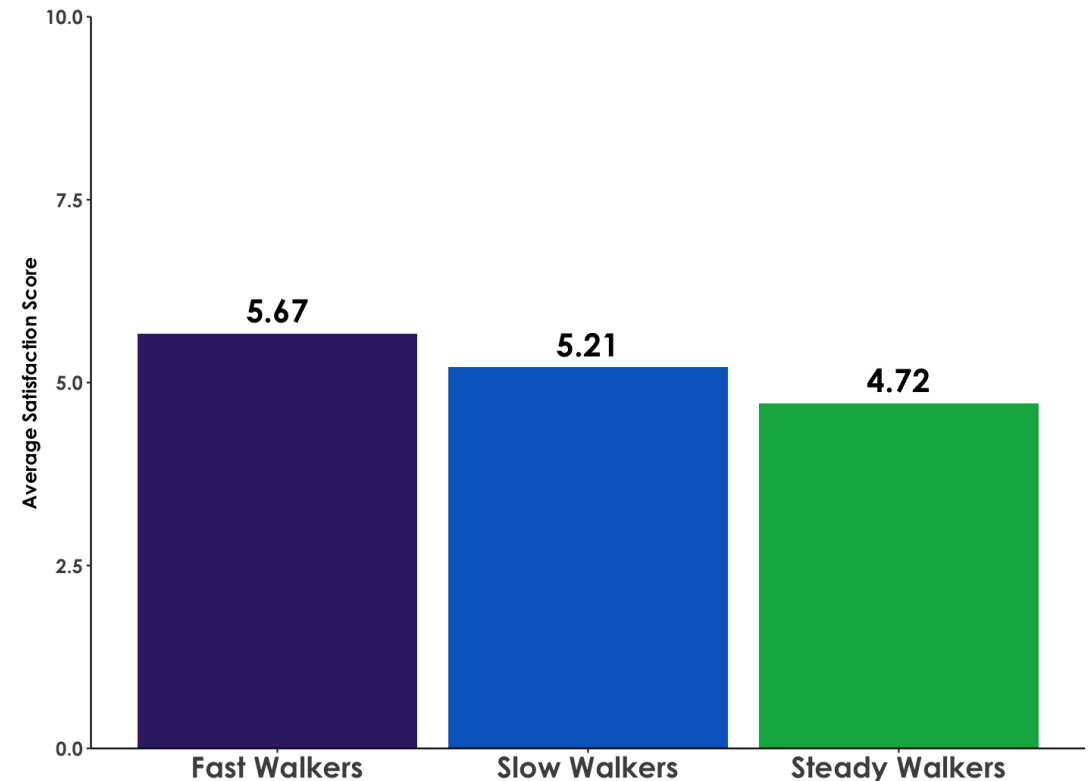


# WHO ARE THESE UNSATISFIED PATIENTS?

To solve the puzzle, we ran an *unsupervised* k-Means model to find the hidden patient profiles.

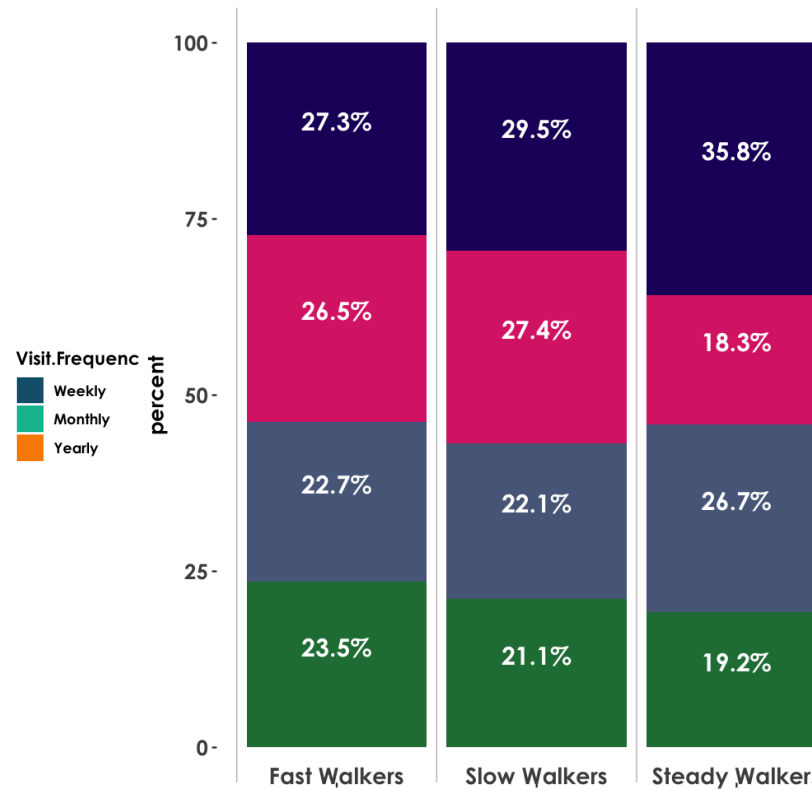
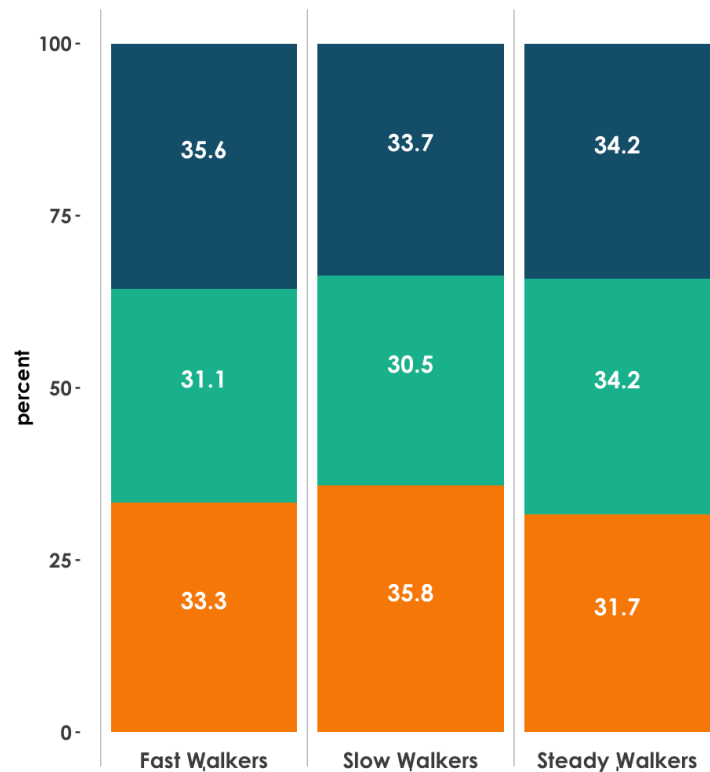
We found 3 distinct groups based on walking speed: 'Slow,' 'Steady,' and 'Fast Walkers'."

**Key Insight:** This model *immediately* found the problem group. On this Patient Satisfaction chart, you can see the '**Frustration Gap**', our 'Steady Walkers' (Cluster 2) are the *least satisfied* group."



# WHY ARE THEY FRUSTRATED?

To find out **why** Cluster 2 was frustrated, we first had to clear the noise



**Finding 1:** Visit Frequency is **not** the story. All three clusters have an identical, even split of visits.

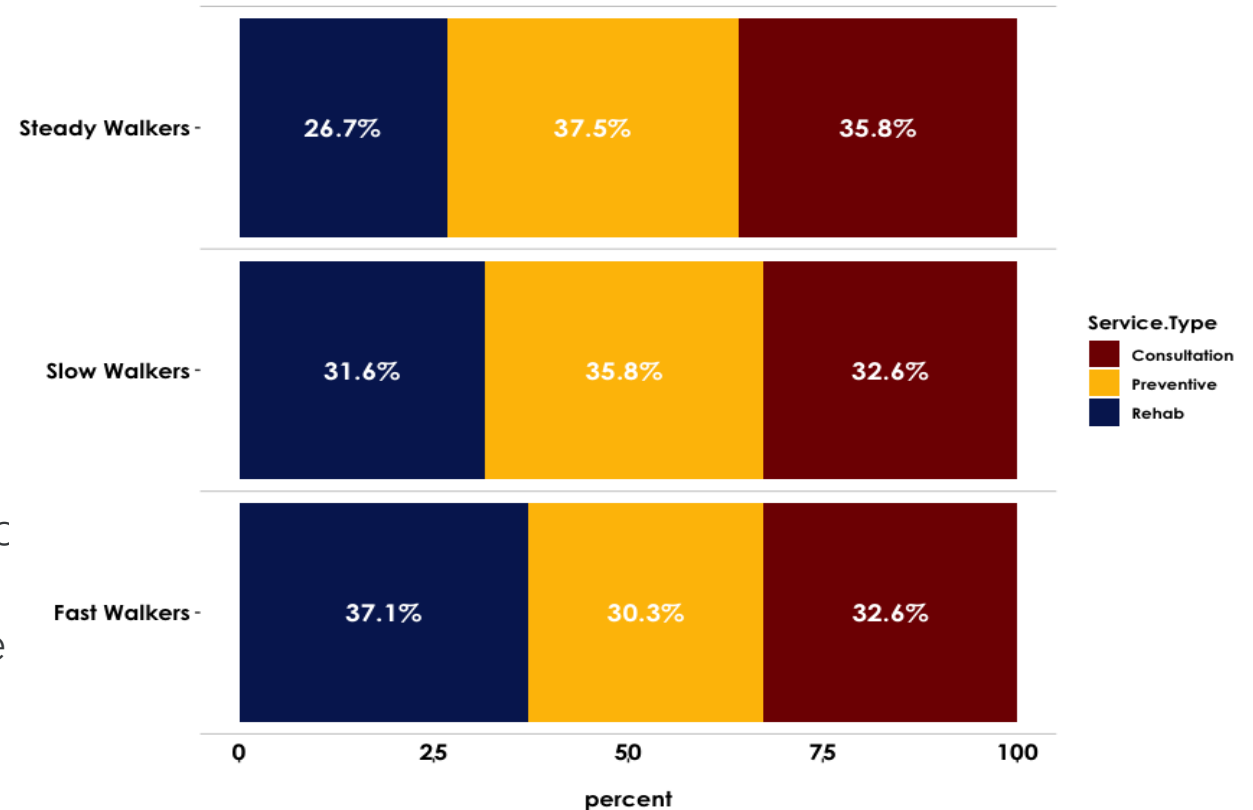
**Finding 2:** SES is **not** the story. All three clusters have the same, even mix of socioeconomic status.



# THE SMOKING GUN

We've now identified the *who* (the 'frustrated' Cluster 2) and the *what* (the problem is Patient Satisfaction and Service Type). This slide shows how they connect

Our 'frustrated' Cluster 2 is the *exact group* that receives the **least 'Rehab' (26.7%)**. This confirms c models' findings: Service Type is a key predictor, and we've just found the group that's getting the wrong one.



# THE SOLUTION: A TARGETED TRIAGE

We now have a complete picture. We know *who* is unhappy (Cluster 2) and *why* (they have a 'Rehab Gap'). Our final piece of analysis, the EMG plot, shows us *how* to fix it

Our EMG plot proves a 'one-size-fits-all' rehab fails. We can now build a 2-Track Triage System:

- **Track 1 (Low EMG):** Strength Training.
- **Track 2 (Mod/High EMG):** Physical Therapy for pain/balance."



# CONCLUSION



**Our Supervised ML model** told us to focus on Patient Satisfaction and Service Type (the main drivers of quality-of-life)

**Our unsupervised k-means clustering model** found the 'frustrated' patients and proved they have a 'Rehab Gap.'

**Our combined solution** is to use our EMG Triage model to give this 'frustrated' group the targeted rehab they need. This will fix the 'Rehab Gap,' which will raise Patient Satisfaction, will ultimately improve Quality of Life.

[LINK TO OUR REPO](#)

