

# APPLYING MACHINE LEARNING (ML) TO ESTIMATE THE PREVALENCE OF FACIOSCAPULOHUMERAL MUSCULAR DYSTROPHY (FSHD) AND RELATED DISEASE BURDEN; FINDINGS FROM UNITED STATES CLAIMS ANALYSIS

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## BACKGROUND

- Facioscapulohumeral muscular dystrophy (FSHD) is a rare, progressive, and disabling neuromuscular disorder with no approved treatments.
- The prevalence of FSHD is poorly understood with estimates ranging from 16,000 – 38,000 patients in the United States (US).
- The objective of the study was to model the prevalence of FSHD and characterize its disease burden in the US.
- The ICD-10-CM code for FSHD was not introduced until recently, which may cause the number of FSHD-coded patients and their disease burden to be underestimated. Hence, machine learning (ML) algorithms were used in this study to estimate the likely prevalent population of FSHD.

## CONCLUSIONS

- The estimated US prevalence of FSHD through claims analysis and predictive ML modeling triangulates with the range estimated in the literature.
- The profiles for the FSHD-coded patients and the predicted patients closely mirror each other among key diagnoses and medical tests/procedures.
- Increased comorbidity rates suggest FSHD is associated with significantly lower quality of life and higher healthcare resource utilization compared to the control cohort.
- Due to the recent introduction of the FSHD-specific ICD-10 code, the number of FSHD-coded patients captured in claims is likely to increase which will allow for further understanding of the FSHD burden of disease.

## METHODS

### Data Source

- A de-identified, longitudinal, patient-level open-claims database of >300 million US patients was used for this study. Data from 2009 through 2021 were used to identify the FSHD cohort and develop a control cohort.

### Patient Population

- Patients who had ≥ 2 healthcare claims with primary or secondary ICD-10-CM code of G70.02 between October 1, 2018, to July 21, 2021, were first enrolled and identified as 'FSHD-coded patients'.
- The first date of ICD-10-CM code of G70.02 was not assumed to be the first diagnosis date for FSHD patients.
- A proprietary ML algorithm was applied using the longitudinal claims signature of the FSHD-coded patients to predict the likely FSHD patient population and estimate the prevalence of FSHD. The predicted FSHD patients from ML algorithm were classified as "FSHD-likely" patients if they had received a general/unspecified muscular dystrophy (MD) diagnosis at some point in their longitudinal medical claims. The receiver operating characteristic (ROC) curve was used to evaluate the performance of the ML algorithm when identifying FSHD-likely patients.
- The FSHD-coded and FSHD-likely patients were further included in the profiling analysis if they had 2 years of continuous enrollment before their first diagnosis of MD.

### Statistical Analysis

- A random control cohort was developed by matching age and gender with the FSHD-coded patients who were qualified for profiling analysis.
- Patient profiles including age and gender, comorbidities, and healthcare resource utilization were described and compared between the FSHD-coded, FSHD-likely and the control cohort.

## RESULTS

### Patient Profile

- 2,919 FSHD-coded patients were identified, and an estimated 22,586 patients were identified as likely FSHD patients in the U.S. using ML algorithm.
- The area under the ROC curve was 96%, demonstrating a strong predictive behavior of the algorithm and effectiveness in identifying patients of interest.
- A subset of 1,275 FSHD-coded and 16,593 FSHD-likely patients with a matched control cohort consisting of 14,588 patients were included in the profiling analysis.
- Gender was evenly distributed in the FSHD-coded patients, while slightly towards female (56%) in the FSHD-likely patients. More than 50% of patients were aged 55 and older at their first MD diagnosis in both FSHD-coded and likely patients.

### Comorbidities

- Figure 1 shows the prevalence of 10 grouped comorbidities for the FSHD patients (coded and likely patients) and the control cohort. Within the 10 grouped comorbidities, more than two third of the FSHD patients experienced top five grouped comorbidities (all musculoskeletal (MSK) pain, respiratory, all other pain, weakness, and mobility-related disorders), and two of them were pain related.
- The proportion of the FSHD-coded and likely patients having these key comorbidities was similar with less than 10% of percentage difference between each other, including any kind of MSK pain (86% vs. 92%), respiratory (81% vs. 89%), weakness (71% vs. 77%), and mobility-related disorders (66% vs. 68%).
- As expected, all FSHD-coded and likely patients were diagnosed with MD, whereas less than 1% of the control cohort had an MD diagnosis.
- The FSHD patients also had a higher rate of experiencing each of these 10 grouped comorbidities compared with the control cohort, especially 3-4 times higher for some forms of weakness, 6 times higher for mobility-related complications, and 7-8 times higher for MSK complications.
- For any kind of MSK pain, the most common form for both FSHD-coded and likely patients was back pain (61% and 70%), followed by head/neck, shoulder, and arm (53% and 65%).
- For mobility-related complications, there were 50% and 53% of the FSHD-coded and likely patients had gait abnormalities.

### Healthcare resource utilization

- More than 50% of the FSHD-coded and likely patients receiving physical therapy/occupational therapy (PT/OT), immunization, therapeutic injection, and any kind of mobility assistance (Figure 2).
- The FSHD-coded and likely patients had a similar proportion of patients receiving most of the key procedures and devices, and they were almost 3 to 6 times more likely to receive PT/OT, respiratory assistance, and mobility assistance compared to the control cohort (Figure 2).
- For mobility assistance, a greater percentage of the FSHD-coded (26%) and likely patients (24%) utilized a wheelchair than the control cohort (1%).
- Within the top 10 common workup/diagnostic tests, there were 7 workup/diagnostic tests received by more than 50% of both FSHD-coded and likely patients with a slightly higher rate for the likely patients (Figure 3).
- Most of the workup/diagnostic tests were received by less than 50% of the control cohort and there was a percentage decrease of 46% to 189% for all tests compared to the FSHD patients (Figure 3).
- The proportion of the FSHD-coded and likely patients receiving any form of genetic testing was low (8% and 11%) but more than 6 times greater than the control cohort.
- The top 5 specialists seen by FSHD-coded patients in 12 months before the first MD diagnosis and at the time of MD diagnosis are shown in Figure 4. The most common physician seen for both diagnosed and likely patients in the 12 months before the first MD diagnosis were primary care physicians (PCP) (58% and 69% respectively).
- The FSHD-coded patients most often receive their 1<sup>st</sup> MD diagnosis from a neurologist (27%), while the likely patients most often receive it from their PCP (34%).
- More than half of the FSHD-coded patients received their 1<sup>st</sup> FSHD coding from a neurologist or PCP.
- More than 25% of both FSHD-coded and likely patients received nursing or home health care at a 4-5x higher rate than the control cohort (Table 1).

Figure 1. The Prevalence of 10 Grouped Comorbidities of FSHD Patients and Their Controls

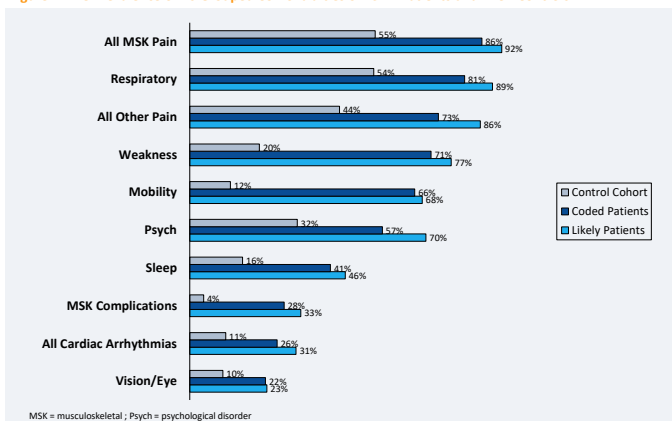


Figure 2. Common Procedure Utilized for FSHD Patients and Their Controls

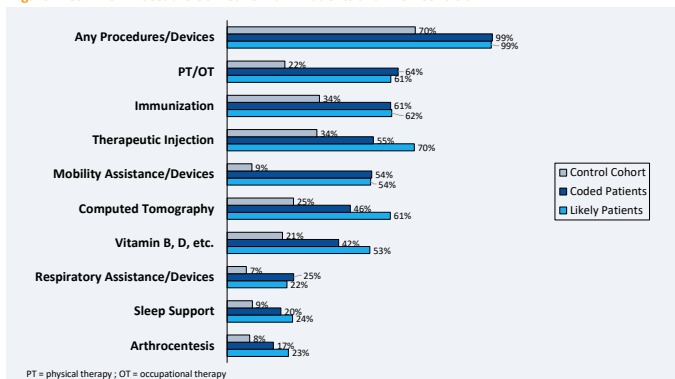


Figure 3. Top 10 Common Workup/Diagnostic Tests Utilized for FSHD Patients and Their Controls

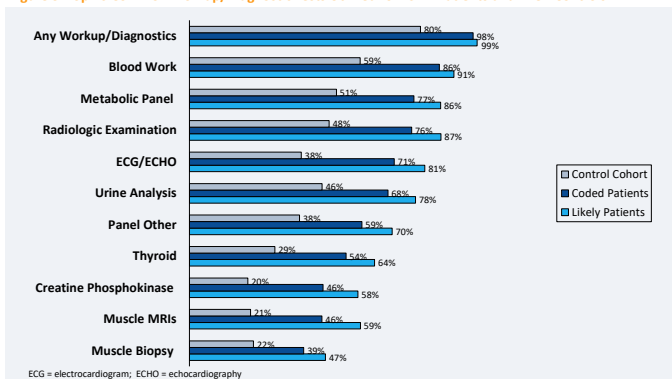


Table 1. Other Medical Service Utilization Rate of FSHD Patients and Their Controls

	FSHD-Coded Patients (N=1,275)	FSHD-Likely Patients (N=16,593)	Control Cohort (N=14,588)
Emergency Room/Ambulance	69%	81%	44%
Hospital Care/Discharge/Etc.	60%	73%	27%
Vision/Eye	41%	44%	22%
Nursing/Home Health	28%	37%	7%
Hearing/Ear	10%	10%	5%

Figure 4. Top 5 Specialists Seen by FSHD-Coded Patients (A) in 12 Months prior to 1st MD Diagnosis and (B) at 1st MD Diagnosis

