# SpiroSmart

## aka Spiro AI aka Fresh Air

jake garrison

# iOS App

**Login to clinic or account**


**Enter patient info or select existing**


**Learn how it works and how to perform the maneuver**


# Performing Maneuver Trial

**Ground control to major tom**


Instructional video

**Countdown 3...2...1...blast**

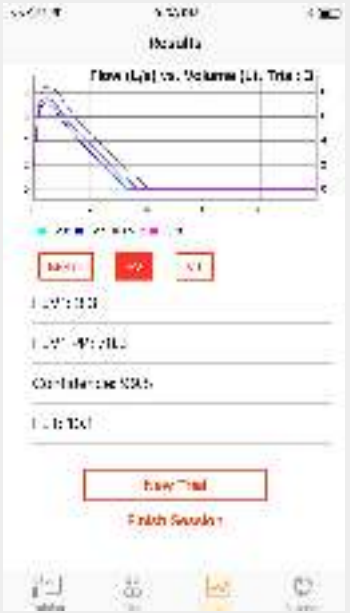

**Fog effect to encourage extended exhaling...and maybe to remind user to clean screen**

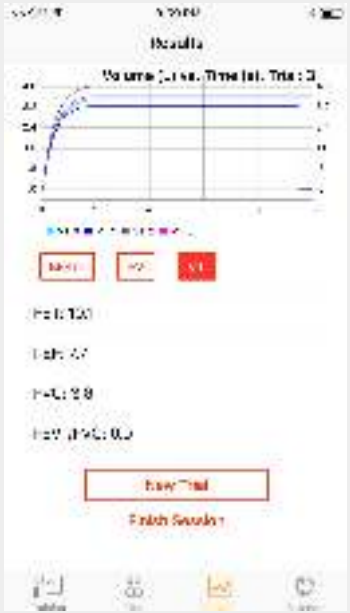
# Trial Results

**Whoops, rejected... try again**


**Percent predicted: how you compare to the standard given your height, weight, age ect**


**Overlay spirometry curves for all trials in session (for reproducibility). Scalar metrics printed in table below**




**Not all from same trial

# Other Things

**Some navigation buttons**

**View trends for patient over multiple sessions (work in progress)**


**Future**

Check patient correct posture and technique via computer vision on front camera

Choose best trial from all trials in session and compute reproducibility of trials within session

Better trend reporting

Better evaluation

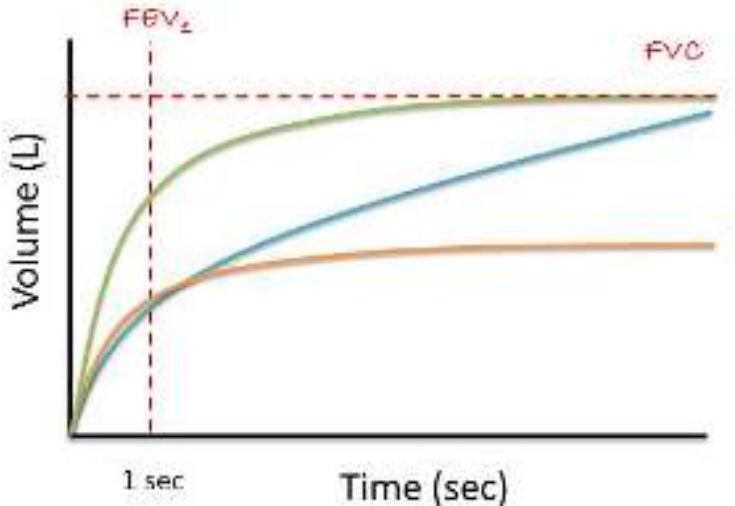
# Metrics

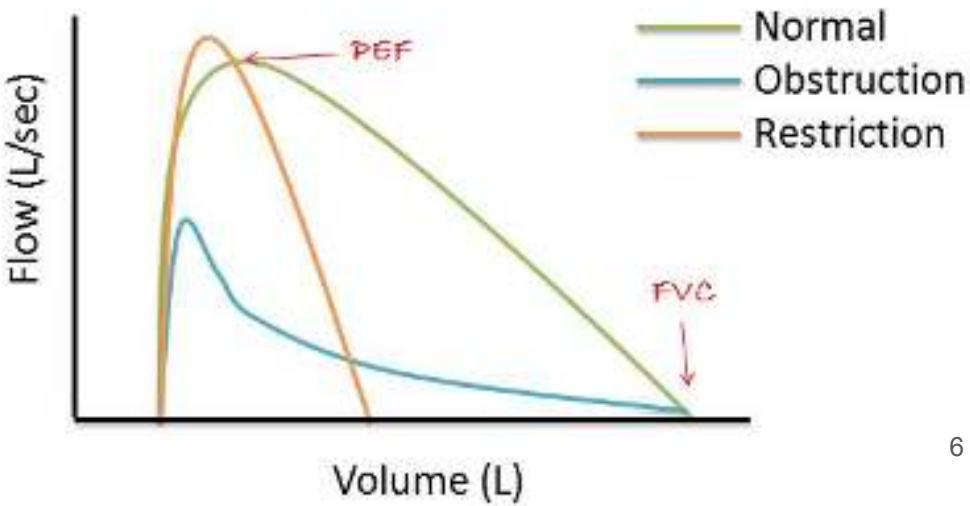
| Metric | Units | Description |
|---|---|---|
| ***FEV1*** | Liters | Exhaled volume in first second |
| ***PEF*** | Liters/second | Peak flow |
| ***FVC*** | Liters | Total exhaled lung volume |
| ***FET*** | Seconds | Total exhale duration |

## *Predicted Normal*

*Depends on:*

- Age
- Height / Weight
- Gender / Ethnicity

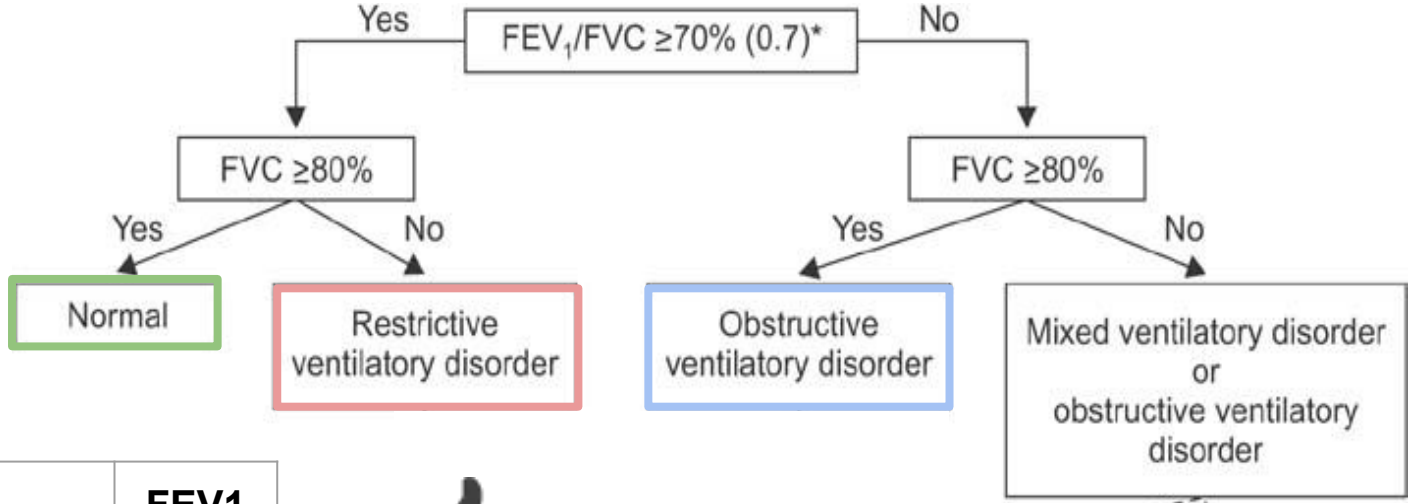


# *Interpretation*

***Given:*** *Spirometry results and patient information...*

**Diagnosis Decision Tree**




| *Condition* | FEV1 | FVC | $\frac{FEV1}{FVC}$ |
|---|---|---|---|
| ***Obstructive*** | ⇩⇩ | ⇩ | ⇩ |
| ***Restrictive*** | ⇩ | ⇩⇩ | ⇧ |

***Healthy if…***

- FEV1/FVC > 70%
- FEV1 > 80% predicted
- FVC > 80% predicted

# Current AI Model

**Audio Recording**

Trimming Model

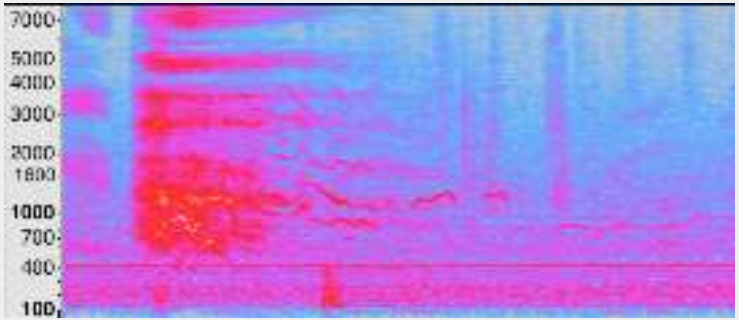
Confidence Model

***Accept***

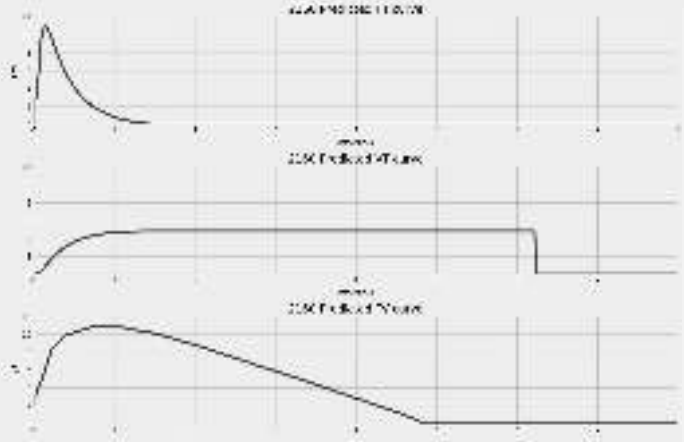
Prediction Model

**Spirometry Report**

***Reject***




*Time frequency display of input audio*



*AI derived spirometry curves and output*

FEV1: 3.3

FEV1 PP: 70.2

Confidence: 99.8

FET: 10.1

PEF: 7.7

FVC: 3.6

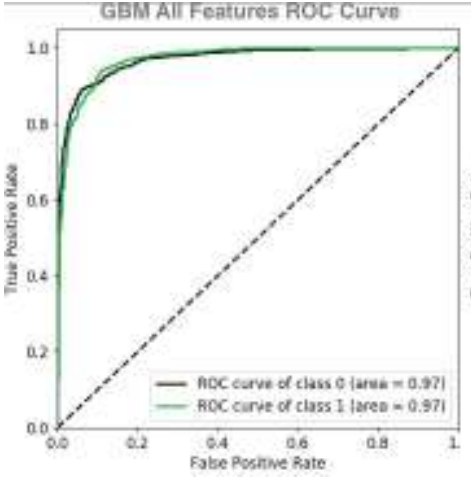
FEV1/FVC: 0.9

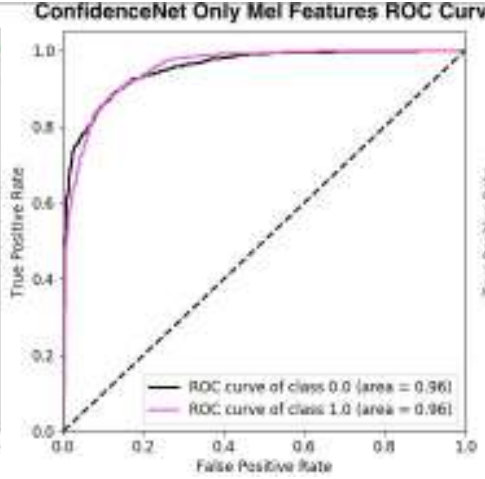
# *Confidence Model Results*

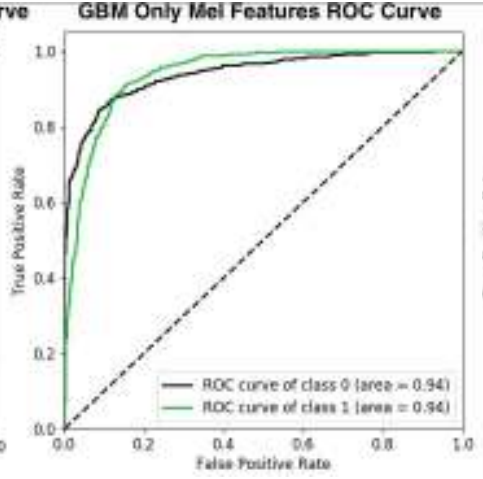
***Evaluation Set:*** 200 difficult accept/reject (balanced)

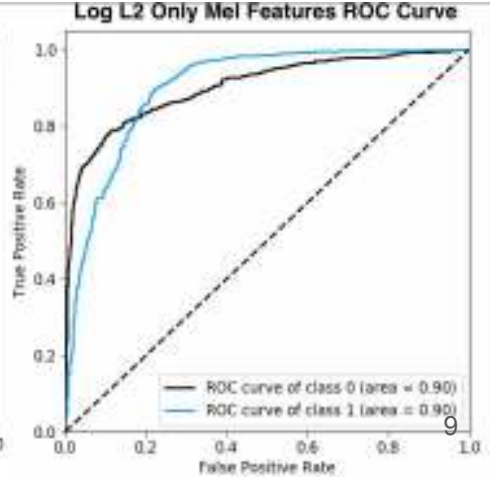
*important*

| Model | Features | Accuracy | Fscore | Precision | Recall |
|---|---|---|---|---|---|
| **ConfidenceNet** | only mels | 0.852 | 0.850 | 0.814 | 0.888 |
| **GBM** | only mels | 0.843 | 0.837 | 0.813 | 0.863 |
| **Log L2** | only mels | 0.821 | 0.821 | 0.775 | 0.873 |
| **GBM** | all | **0.895** | **0.891** | **0.870** ★ | **0.914** |
| **Log L2** | all | 0.850 | 0.845 | 0.819 | 0.873 |



# *Prediction Model Results*

### *Evaluation Set:*

700 unseen patients somewhat evenly distributed health wise

**Absolute Error**

| Model | Features | FEV1 | FVC | PEF | FET |
|---|---|---|---|---|---|
| **Mean Tracking** | NA | 0.78 | 0.68 | 1.90 | 1.73 |
| ★ **CurveNet** | only mels | **0.48** | **0.50** | 1.39 | 1.72 |
| **ScalarNet** | only mels | 0.50 | 0.52 | **1.33** | 1.79 |
| **Lin L2** | only mels | 0.63 | 0.62 | 1.69 | 1.70 |
| **GBM** | only mels | 0.56 | 0.54 | 1.51 | 1.69 |
| **Lin L2** | all | 0.60 | 0.57 | 1.69 | 1.65 |
| **GBM** | all | 0.52 | 0.54 | 1.53 | 1.61 |

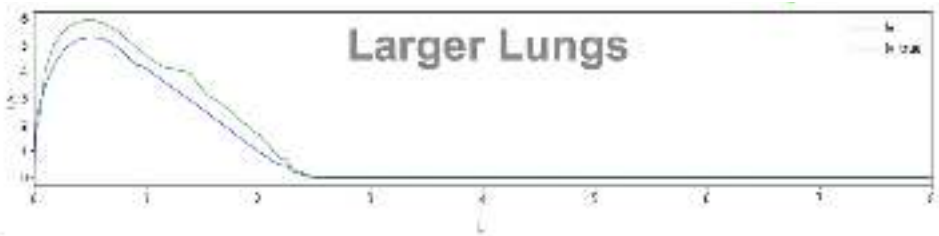
**Metric Information**

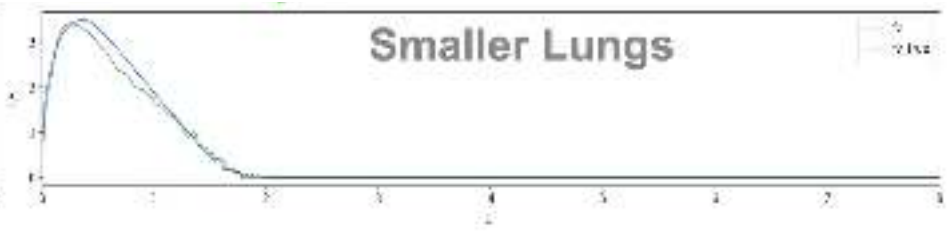
| Metric | Unit | Mean | Min | Max |
|---|---|---|---|---|
| ***FEV1*** | L | 1.8 | 0.25 | 6.2 |
| ***FVC*** | L | 2.5 | 0.41 | 6.8 |
| ***PEF*** | L/s | 4.7 | 0.75 | 11.5 |
| ***FET*** | s | 7.4 | 1.6 | 15.2 |

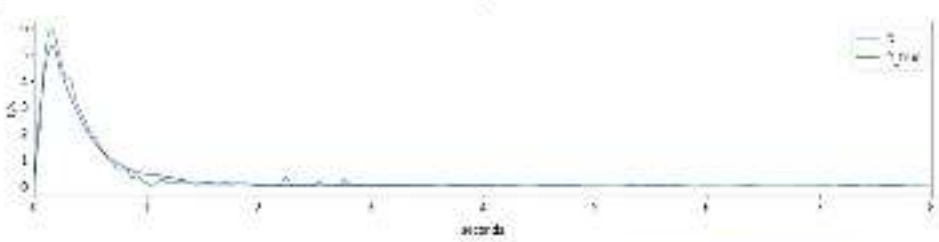
# *CurveNet:* Good Output

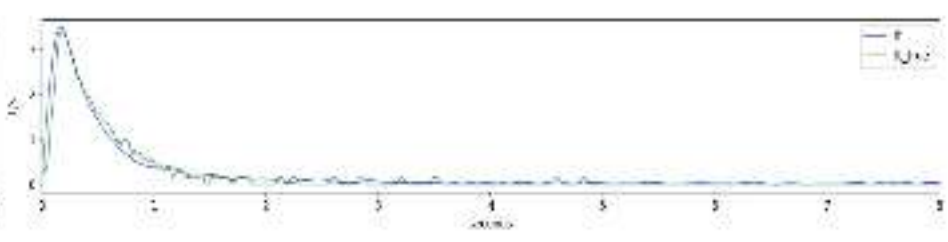
1. flow volume
2. flow time
3. volume time

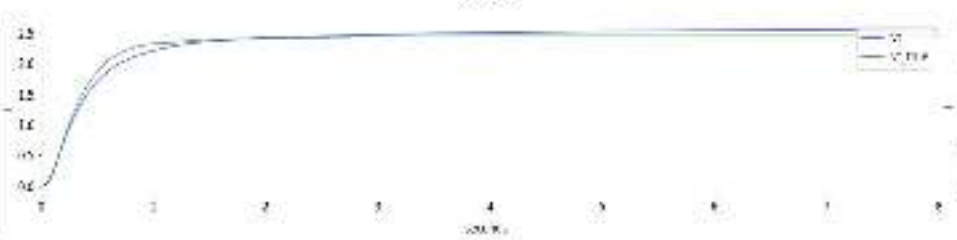
**groundtruth**
**predicted**

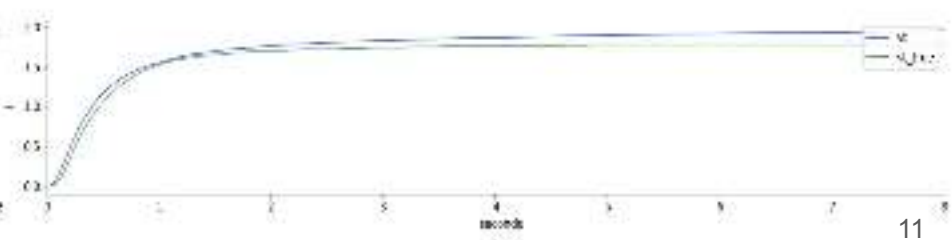




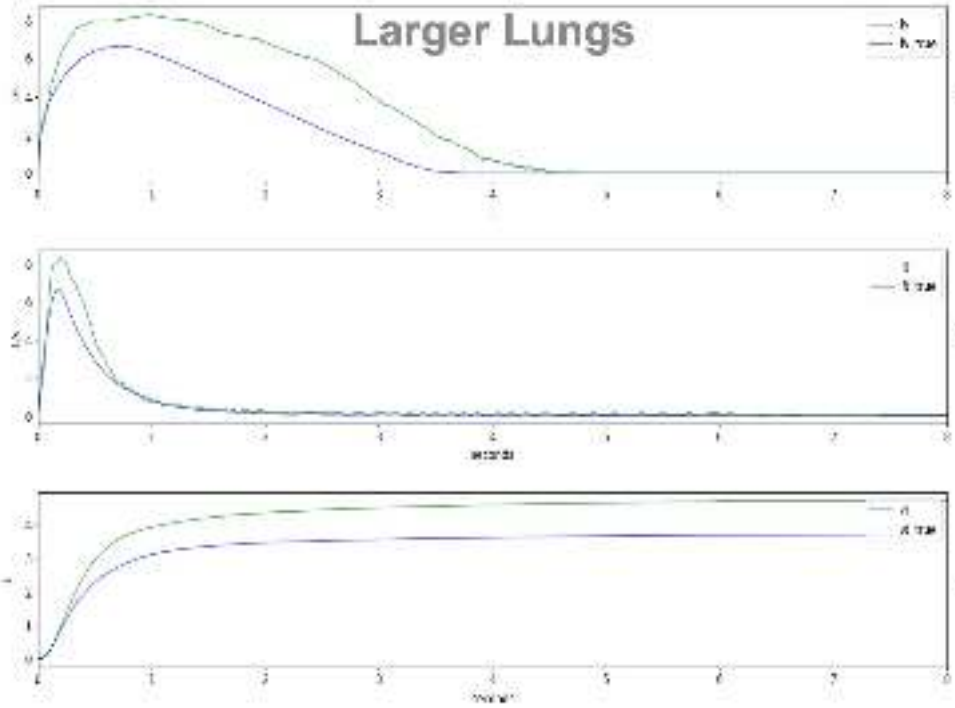


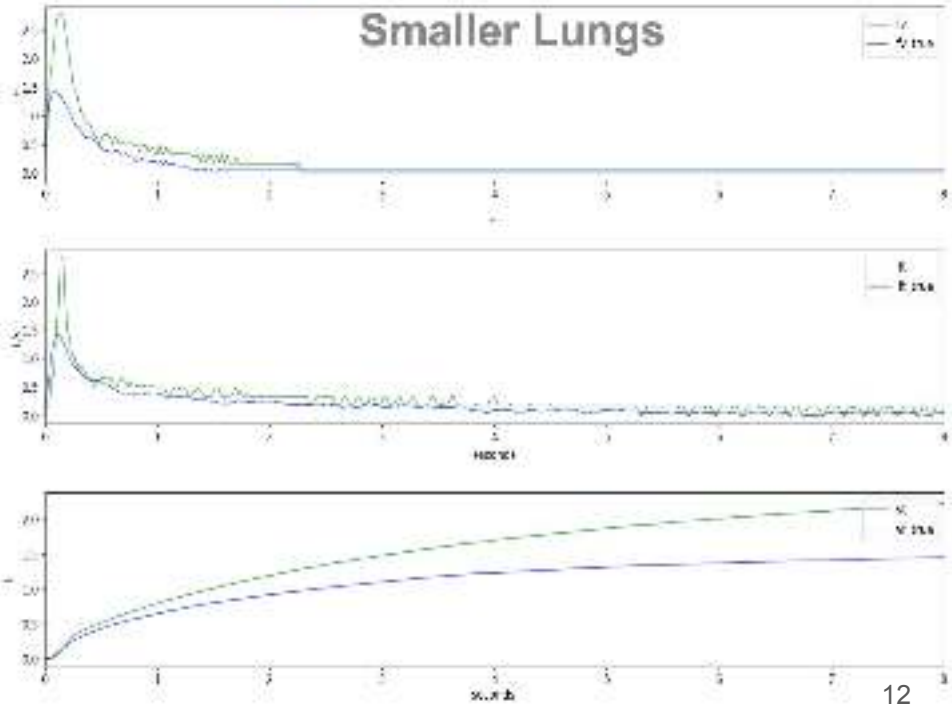


# *CurveNet:* Underestimated

1. flow volume
2. flow time
3. volume time

**groundtruth**
**predicted**



# *CurveNet:* Overestimated

1. flow volume
2. flow time
3. volume time

**groundtruth**
**predicted**