Feasibility of Cough Sound Amplitude as a New Objective Cough Measure

T. deLaubenfels[1], R. Powers[1], J. Kroh[1], A. Marinovich[2], A. Sees[1]
[1]Strados Labs, Inc, Atlanta, GA, United States, [2]Strados Labs Inc, Philadelphia, PA, United States

This work was sponsored by Strados Labs

INTRODUCTION

- Cough is common in pulmonary fibrosis (PF) and has been hypothesized to contribute to fibrotic disease progression.
- Cough severity, characterized by both frequency and intensity (forcefulness of individual coughs), is associated with reduced quality-of-life and worsening outcomes.
- Traditionally, ambulatory cough monitors have only measured cough frequency and not intensity, missing a critical element of cough burden.
- As a wearable contact biosensor with constant distance, angle, and minimal interference from external effects, the RESP® Biosensor is uniquely suited for objective measures of cough sound intensity e.g. cough amplitude.
- The objective of this study is to assess the feasibility of monitoring cough amplitude with the *RESP* Biosensor.

METHODS

- Continuous, ambulatory 24-hour lung sound recordings were collected in real-world environments using the *RESP* Biosensor in a non-PF population presenting with chronic cough.
- N=63 24-hour recordings from unique subjects were analyzed. Cough events (n=31,923) were identified by trained respiratory therapists.

Cough Sound Intensity

- Expresses the **quantified sound intensity of cough events as peak sound amplitude.**
- Cough amplitude was calculated as the peak 12.5ms root mean square amplitude of the digitized audio signal within cough events (Fig. 1).
- The resulting measure is proportional to the peak sound pressure level generated by the cough.

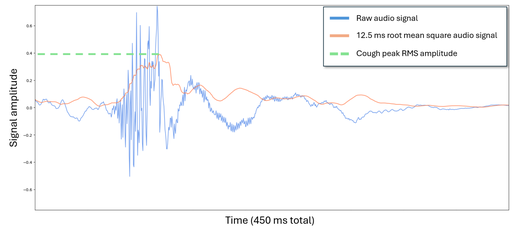

Figure 1: Cough Sound Intensity Within A Cough Sound Trace

RESULTS

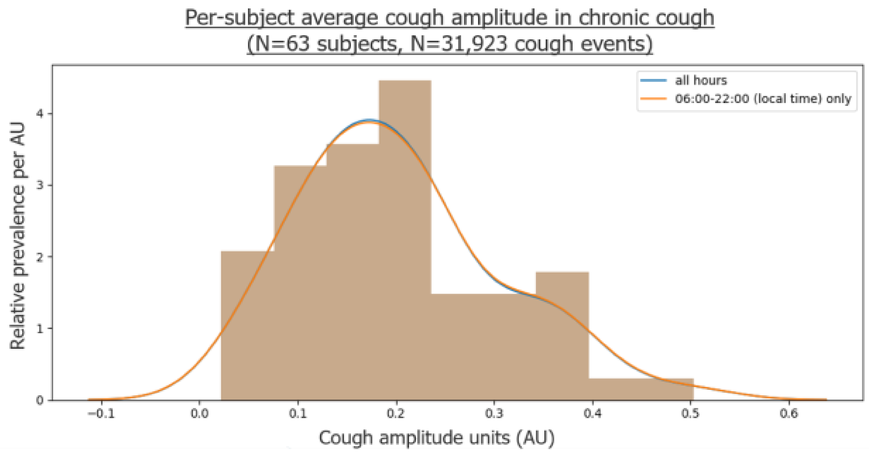

Figure 2 – Average **cough (sound) amplitude** values in 63 subjects with chronic cough.

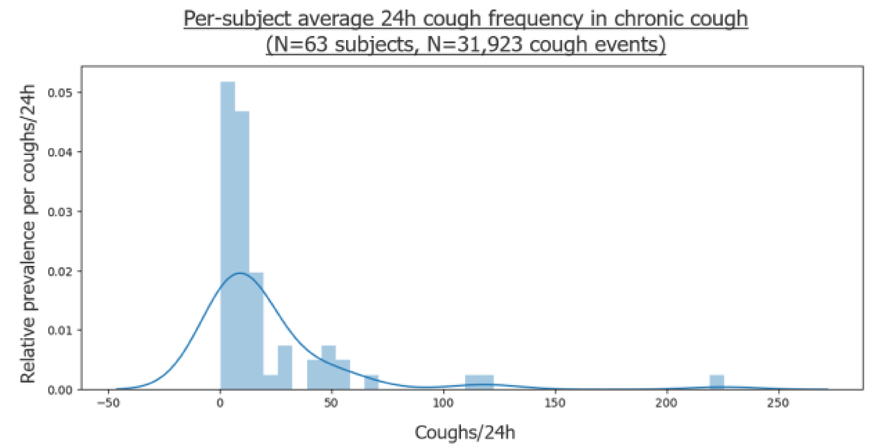

Figure 3 – Average 24-hour **cough frequencies** in 63 subjects with chronic cough

Mean 24-hour **cough amplitude** across subjects shows a bimodal, right-tailed distribution

- Skewness = **0.66**
- Kurtosis = **0.09**
- Mean = **0.2025** ± **0.1019** (arb. units)

Mean 24-hour **cough frequency** across subjects shows a highly right-tailed distribution

- Skewness = **3.80**
- Kurtosis = **17.05**
- Mean = **21.5** ± **5.1** coughs/h

- An arithmetic mean 24-hour cough frequency of 21.5 ± 35.1 coughs/hour was observed (geometric mean: 9.4 ± 4.0).
- Cough frequency was higher during waking hours, with 96.1% of events occurring between 06:00 and 22:00. In contrast, cough amplitude values showed similar distributions within the full 24-hour period vs waking hours, with respective arithmetic means of 0.1678 ± 0.1464 amplitude units (AU) (median 0.1206; min:max: [0.0003:0.817]) and 0.1657 ± 0.1463 AU (median 0.1168; min:max: [0.0003:0.817]).
- Cough frequency distribution across subjects was overall unimodal and highly right-tailed (skewness: 3.80, kurtosis: 17.05).
- Mean 24-hour cough amplitude across subjects showed a bimodal, right-tailed distribution (skewness = 0.66, kurtosis = 0.09), with an arithmetic mean of 0.2025 ± 0.1019 AU (geometric mean: 0.1748; median: 0.1865).

CONCLUSIONS

- Quantification of cough amplitude was feasible using the *RESP* Biosensor and showed characteristics distinct from cough frequency in a non-PF population with chronic cough.
- Cough amplitude may serve as a complementary objective measure to characterize the burden of cough in patients with PF.