

Poster: WearCOPD – Monitoring COPD Patients Remotely using Smartwatches

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1. INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a chronic lung disease that is characterized by airway obstruction, coughing, shortness of breath and increased sputum production. The World Health Organization estimates that over 3 million people died of COPD in 2012 and ranks it as the 4th leading cause of death [1].

An acute exacerbation of COPD is a sudden worsening of the disease. Acute exacerbations result in more frequent and severe coughing and increased difficulty breathing. If not treated quickly, hospitalization may be required which is expensive and decreases patient's quality of life. If untreated, an acute exacerbation can lead to death.

We present WearCOPD, an application that uses a smartwatch and smartphone to continuously monitor physiological signs from patients with the goal of predicting exacerbations before they happen. The questions we aim to answer with our study are:

1. Are COPD patients willing and able to use a smartwatch and phone?
2. Can acute exacerbations of COPD be detected using data collected from smartwatches and smartphones?
3. Can acute exacerbations of COPD be predicted using data collected from smartwatches and smartphones?
4. If acute exacerbations can be predicted, how far in advance can they be predicted?

2. DESIGN AND IMPLEMENTATION

WearCOPD consists of an Android smartwatch, smartphone and a remote server. The smartwatch is worn by patients and collects data from a step detector, heart rate sensor, accelerometer and microphone. Once per day, data is sent from the smartwatch to the smartphone. The smartphone prompts users to complete a daily questionnaire describing their health. After the questionnaire, patients are asked to blow into the microphone as a measure of their peak expiratory flow. At night, when the phone is charging, the

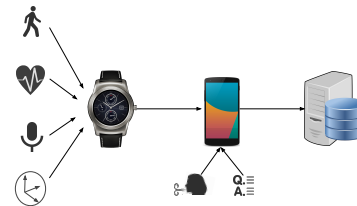


Figure 1: Data flow for the WearCOPD application

data collected during the day is sent to the remote server to be analyzed. The accelerometer and step count gives us an estimation of patients' physical activity. If patients are having difficulty breathing, we expect their physical activity to decrease. We also expect an increase in heart rate during exacerbations because the heart will have to work harder to supply the body with oxygen. The microphone will allow us to extract more complicated metrics such as coughing frequency and speech patterns (length of pauses in speech, overall amount of speech).

3. METHODS AND CURRENT RESULTS

Patients admitted to Toronto General Hospital or Sunnybrook Health Sciences Centre, Ontario, Canada with an acute exacerbation of COPD are approached and asked to participate in a three month trial. They are provided a smartwatch and smartphone. Currently, 11 patients have agreed to participate in the study and one has completed the 3 month term. Some common reasons for not wanting to participate are unfamiliarity with technology or feeling too sick to participate. With revisions to our software and improved recruitment methods, we have seen an increased participation rate. Of the patients who agreed to participate we have found they are consistent in wearing and charging the devices, which is a positive result for our first question.

So far we have collected over 400 hours of audio, almost 700,000 heart rate samples, over 6.5 million accelerometer samples and almost 300 questionnaire responses.

Our next steps include (1) recruiting more patients, (2) detecting coughs and wheezing in our audio and (3) looking for correlations between sensor data, questionnaire responses and expiratory flow rate.

4. REFERENCES

- [1] WHO | chronic obstructive pulmonary disease (COPD).

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