CONFEREECE ABSTRACT

Telehealth and machine learning for COPD patient care

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Introduction: COPD is a highly prevalent chronic disease which is already the 4th cause of death worldwide, and its prevalence will keep increasing. The rate of hospitalizations of COPD patients remains constant as opposed as other chronic diseases such as chronic cardiac failure, in which the hospitalization rates are decreasing. In our hospital we have developed a telehealth program named telEPOC which is aimed to monitorize COPD patients that have been frequently admitted to hospital. The main goal of this program is to reduce the number of admissions to the hospital, and its results so far have been very satisfactory. It has also been shown that this program improves the quality of life of patients with respect to those in the control group. However, we have not been able to reduce to zero the number of COPD hospitalizations. Therefore, we wondered if it would be possible to predict COPD exacerbations, which would enable us to take appropriate actions to avoid such exacerbations or reduce their negative effects. Machine Learning is the most important branch of Artificial Intelligence and it is focused in developing software that enables computers to learn complex patterns from data, and use them to predict the outcome of previously unseen events. Therefore, this technology enables us to use Electronic Health Records of patients to make personalized predictions about their future.

Objectives: telEPOC database is composed by daily reports sent by the patients. According to these daily reports, an alarm system composed by three levels of exacerbation (green, yellow and red) is established. The telEPOC program presents a great opportunity to apply Machine Learning to predict COPD exacerbations, due to the high quality of the data it generates and the great advantage that such predictions will bring to physicians in daily practice. In this work we show an Early Warning System (EWS), based on Machine Learning, that is capable of predicting when a patient of the telEPOC program is going to exacerbate. Also, we find the configuration to make the system optimal both from the medical and computational points of view. Besides we will identify the most informative factors to predict the exacerbations.

Methods: The system records the following variables for each patient on a daily basis: heart rate, temperature, oxygen saturation, respiratory rate, steps walked and a questionnaire form
about symptoms (sputum, disnea, cough, general health status). On this data the Random Forests Algorithm was applied to predict when a patient will present a red alarm. We used a 10-fold cross validation to estimate the performance of the model.

**Results and Conclusions:** We achieved an Area under the ROC curve of 0.87 for the task of predicting whether a patient will suffer an exacerbation within the next three days. The EWS was capable of making reliable predictions with enough time in advance when a patient is going to present a red alarm. The more informative variables for this prediction were the heart rate and the number of walked steps.

**Keywords:** copd; machine learning; hospitalizations; early warning system; telehealthcare