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An Expert Diagnostic System to Automatically Identify Asthma and Chronic Obstructive Pulmonary Disease in Clinical Settings

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Respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD), are affecting a huge percentage of the world's population with mortality rates exceeding those of lung cancer and breast cancer combined. The major challenge is the number of patients who are incorrectly diagnosed. To address this, we developed an expert diagnostic system that can differentiate among patients with asthma, COPD or a normal lung function based on measurements of lung function and information about patient's symptoms. To develop accurate classification algorithms, data from 3657 patients were used and then independently verified using data from 1650 patients collected over a period of two years. Our results demonstrate that the expert diagnostic system can correctly identify patients with asthma and COPD with sensitivity of 96.45% and specificity of 98.71%. Additionally, 98.71% of the patients with a normal lung function were correctly classified, which contributed to a 49.23% decrease in demand for conducting additional tests, therefore decreasing financial cost.

CHRONIC obstructive pulmonary disease (COPD) is a chronic inflammatory lung disease that causes obstructed airflow in the lungs[1,2]. Up to 75% of all COPD patients are not diagnosed. Currently, the COPD mortality rate exceeds that of lung cancer and breast cancer combined[3–6], as 200,000 to 300,000 deaths in Europe alone are COPD related. Similarly, asthma is a chronic inflammatory impairment of airways, which, as a result, becomes hyperactive and generates increased mucus, mucosal swelling and contraction of smooth airway muscles. These factors all contribute to airway obstruction. With respect to other chronic respiratory diseases, asthma has relatively low fatality rate, but the prevalence of asthma as well as the costs of asthma treatment and care has increased in recent decades[1,2].

A major challenge in chronic disease management, especially in non-specialized clinics, is the number of patients with chronic respiratory diseases, such as asthma or COPD, who are either inaccurately diagnosed or misdiagnosed for having other respiratory diseases such as the common cold, acute bronchitis or pneumonia[6,7]. Over the years, various evidence-based guidelines for the prevention, diagnosis and management of chronic respiratory diseases have been developed to assist medical professionals. The Global Initiative for Chronic Obstructive Lung Disease (GOLD)[8] and Global Initiative for Asthma (GINA)[9] has published guidelines for medical professionals based on their latest research and recommendations. Despite the availability of these guidelines, the lack of knowledge among non-specialized medical professionals is still a leading issue in the correct diagnosis of these respiratory diseases[10]. In 2008, Yawn and Wollan[10] showed that many primary medical professionals are unable to distinguish asthma from COPD and do not recognize that women are at a higher risk for COPD than men. When COPD symptoms are misdiagnosed as asthma, women receive the wrong treatment, and the correct COPD treatment is delayed. This misdiagnosis has serious adverse consequences in terms of disease burden and risk of future exacerbations.

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