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Editorial

Artificial Intelligence in COPD

The term artificial intelligence (AI) refers to a set of algorithms (rules) that enable computers to learn, analyze data and make decisions based on that knowledge.[1] These algorithms can perform tasks that would typically require human intelligence, such as recognizing patterns, understanding natural language, problem-solving and decision-making.[1] This is not a new term (research into AI started in the fifties of last century) but due to exponentially growing computer power and cloud storage has now literally explode.[2] Initial AI prototypes were based on so-called "*machine learning*", where algorithms allow computers to learn from examples without being explicitly programmed.[1] A more recent type of AI is so-called "*deep-learning*", which is a subset of machine learning that uses "artificial neural networks" as models and does not need feature engineering.[1]

AI is being explored or even applied already in many different aspects of our daily life, often without us even noting it. The heath care sector is one of the fields where AI applications are being investigated more intensively.[3] In theory, AI in medicine can have an impact for clinicians (e.g., via rapid, accurate image interpretation or potential for reducing medical errors), health-care systems (e.g., by improving workflow) and for patients (e.g., by enabling them to use their own data to promote health, or to access the healthcare system more rapidly and efficiently).[4,5] Yet, by definition health data is multimodal (including physical measurements and natural-language narratives in the electronic health records, often full of acronyms not immediately understandable) and longitudinal (patients with chronic diseases are often followed-up over time), so only a fraction of health care data is available in a structured form that can be automatically processed by AI, and manual curation is both costly and hard to scale.[6] To address these limitations, we are entering now into a new era so-called "multimodal generative AI", which can extract predictive signals by self-supervision working at the web scale with the potential to accelerate progress to precision health (not disease) by accessing structured health data and scaling insight generation to the population-level.[6] However, AI in healthcare faces significant challenges, such as bias, privacy and security issues, and lack of transparency in how algorithms work (Blackbox). Despite this, its ability to improve the quality of medical care and even strengthen relationships between patients and healthcare professionals is very much promising.[4,5,7]

Chronic obstructive pulmonary disease (COPD) is a major public health problem because its high prevalence (about 10% of adults in the general population suffer it, albeit most of them do not know that and are therefore not treated), raising incidence (in relation to the ageing of the population), associated morbi-morbidity (currently COPD is the third global cause of death) and associated personal, familiar and societal impact.[8] There are many potential aspects of COPD where AI can make a significant impact, including addressing the unacceptable rate of underdiagnosis,[9,10] facilitating the interpretation of lung function tests,[11] providing clear and easy therapeutic guide to practicing clinicians (see AvoMD in the current webpage of the Global Initiative for Obstructive Lung Disease (www.goldcopd.org)), and/or supporting and helping patients directly,[5] among others.[12,13]

In this issue of *Archivos de Bronconeumologia*, Casal-Guisande et al. explores the potential role of machine learning to cluster patients hospitalized because of an exacerbation of COPD ($n = 524$) in the Pulmonary Department of two third-level hospital in northwest Spain based on their social and clinical characteristics, in order to relate them to relevant clinical outcomes, such as early hospital readmissions and mortality.[14] Based on a very large number of demographic, clinical and socio-economic variables (see Table 1 in the original article[14]), this AI driven analysis identified four clusters of patients with different clinical and social characteristics associated with different relevant clinical outcomes, including length of stay, early hospital readmissions and mortality (Table 1). Not surprisingly Clusters A and C formed by younger individuals were associated to better outcomes than Clusters B and, particularly, D who were formed by older patients with cardiovascular (Cluster B) or other comorbidities and high dependency level (Cluster D). Authors then used a supervised (hence, not unbiased) machine learning model (Random Forest) to develop an Intelligent Clinical Decision Support System (ICDSS) capable of assigning patients to these four clusters using only five key variables (age, body mass index, number of hospitalizations in the previous year, and number of basic and instrumental activities with dependency) from the very large list of variables analyzed originally.[14] The ICDSS developed showed a very high sensitivity and specificity (all areas under the receiving operating curves (AUC) were higher than 0.90).[14] Collectively, these results show that AI (machine learning) can identify clusters of COPD patients hospitalized because of an exacerbation of their disease that relate to different resource utilization and prognosis, thus potentially helping to guide their therapeutic management. This study, therefore, nicely illustrates the potential of AI in COPD, likely applicable too other chronic diseases, such heart failure or diabetes, with the final goal of providing better, personalized care to patients and to optimize the use of healthcare resources.

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Table 1
Clinical Characteristics and Associated Outcomes of the Four Clusters Identified by AI (Machine Learning) in the Study by Casal-Guisande et al.[14]

Cluster	Key Clinical Characteristics	Associated Outcomes		
		Hospital Stay	Hospital Readmissions at 30 and 90 Days After Discharge	Mortality in Hospital and During Follow-up
A	Younger males, milder COPD, low dependency, predominantly from rural areas.	Low	Low	Low
B	Older males, cardiovascular diseases, good socio-economic status, predominantly from urban areas.	Intermediate	Intermediate	Intermediate
C	Younger individuals (both genders) with significant psychosocial impact.	Low	Low	Low
D	Older males, high dependency level, multiple comorbidities.	High	High	High

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