



European Respiratory Society International Congress 2017: highlights from the Clinical Assembly

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ABSTRACT This article contains highlights and a selection of the scientific advances from the European Respiratory Society's Clinical Assembly (Assembly 1 and its six respective groups) that were presented at the 2017 European Respiratory Society International Congress in Milan, Italy. The most relevant topics from each of the groups will be discussed, covering a wide range of areas including clinical problems, rehabilitation and chronic care, thoracic imaging, interventional pulmonology, diffuse and parenchymal lung diseases, and general practice and primary care. In this comprehensive review, the newest research and actual data as well as award-winning abstracts and highlight sessions will be discussed.



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Introduction

The Clinical Assembly of the European Respiratory Society (ERS) is the largest of the now 13 assemblies. A vast number of abstracts are presented through this assembly and the six groups of which it consists. It is impossible for any delegate to follow all scientific and clinical advances and breakthroughs presented during this conference. This review aims to provide the esteemed reader with an overview of a few of the most interesting presentations of each group, deemed noteworthy by the authors of this manuscript.

Group 1.1: Clinical Problems

Chronic obstructive pulmonary disease management, physical activity and biomarkers

The current management of chronic obstructive pulmonary disease (COPD) was discussed in oral presentations and posters sessions with particular focus on the changes of the 2017 Global Initiative for Chronic Obstructive Lung Disease (GOLD) classification compared to GOLD 2011. Special attention was also paid to quality of life, physical activity and biomarkers.

Self-administered COPD Assessment Test (CAT) questionnaires had significantly higher scores than those reported with physician assistance (8.0 *versus* 12.6, considerably higher than the minimal clinically important difference of 2 points) [1]. Although the CAT questionnaire is validated for self-assessment, and physician assistance may underestimate symptoms and the impact of the disease, on the other hand, it may clarify misunderstanding of the questions. Paper versions of CAT and Evaluating Respiratory Symptoms in COPD questionnaires are associated with higher scores than their electronic version (10.0 *versus* 8.6 and 6.8 *versus* 5.0, $p < 0.001$) [2]. LINDQVIST *et al.* [3] showed that the CAT score increases rapidly with progression of lung parenchymal damage measured by ventilation and perfusion tomography while obstructive bronchitis plays a minor role.

Physical activity remains an important field of research in COPD. As suggested by DEMEYER *et al.* [4], every step counts, as both the quantity and intensity of physical activity correlate with mortality, and the strength of this observation is comparable across GOLD stages. Dual long-acting β_2 -agonist plus long-acting muscarinic antagonist bronchodilator therapy was shown to significantly improve physical activity in the ACTIVATE study [5] as well as in a meta-analysis of eight randomised controlled trials (RCTs) [6]. Severe exacerbation symptoms were associated with reduced physical activity both in outpatients [7] and hospitalised patients, as seen in the REACH trial [8]. CHIARADIA *et al.* [9] addressed the impact of iron deficiency on daily physical activity, showing that it almost halved the number of steps per day (3628 *versus* 7072). Sedentary lifestyle causes changes in muscle thickness [10] and it was proposed that COPD patients with more physical activity may represent a separate phenotype [11].

A large number of abstracts addressed the topic of biomarkers. The analysis of 42 142 COPD patients from a large database confirmed the association between high eosinophil counts ($\geq 0.45 \times 10^9$ cells-L⁻¹) and increased risk of exacerbations irrespective of treatment regimen [12]. A small study reported, on the other hand, fewer and shorter hospitalisations in patients with $\geq 4\%$ peripheral blood eosinophils during exacerbations and normal eosinophils at baseline [13]. Mepolizumab reduced the rate of moderate/severe exacerbations and increased time to first moderate/severe exacerbation in patients with eosinophilic COPD [14].

Asthma control, biomarkers and asthma-COPD overlap syndrome

Asthma was extensively covered at the ERS Congress, with several studies exploring biomarkers and some interesting findings from large cohort studies.

Small exploratory studies showed the association of asthma control with inflammatory biomarkers such as serum interleukin (IL)-6 [15] and IL-13 [16]. Significantly elevated IL-27 protein levels have been described by PABREJA *et al.* [17] in eosinophilic asthma but not in neutrophilic and paucigranulocytic asthma, suggesting a functional role of IL-27 in the eosinophilic endotype. Patients with asthma and high blood eosinophil counts ($\geq 0.35 \times 10^9$ cells-L⁻¹) have increased risk of exacerbations despite stable treatment with medium- or high-dose inhaled corticosteroids and good adherence [18].

A large population-based prospective cohort study reported that incident asthma-COPD overlap is associated with lifestyle and socioeconomic status factors such as smoking, ever use of hormone therapy, unemployment and being divorced, whereas physical activity and high education were associated with lower risk [19]. Patients with asthma-COPD overlap syndrome (ACOS) have high prevalence (two to three times higher) of insomnia and respiratory symptoms than those with asthma or COPD alone [20]. In a population-based cohort of 1037 young adults, high blood eosinophil counts were associated with airflow obstruction independently of asthma and smoking [21]. Eosinophilia was linked to lung function decline and development of progressive airflow obstruction from age 21 to 38 years in young adults without a respiratory diagnosis or symptoms. In a study by DE LA CRUZ CASTRO *et al.* [22], patients with asthma and/

or rhinitis suffered significantly more traffic accidents than the healthy population in the control group. The accident rate was related to the severity of asthma and rhinitis.

Group 1.2: Pulmonary Rehabilitation and Chronic Care

The abstracts presented in the field of pulmonary rehabilitation (PR) and chronic care provided a rich array of information regarding methodological issues in patients' and outcomes assessment, new therapeutic interventions and models of care delivery, and alternative target populations. The most highly rated abstracts of the group, which were presented in a competitive oral presentation session, are summarised below.

Exercise training is widely regarded as the cornerstone of PR programmes, and is highly beneficial in patients with chronic lung disease for improving clinical symptoms, exercise tolerance and health status; however, the benefits obtained may be influenced by the type of lung disease and exercise training. KUMAR *et al.* [23] performed a RCT in 60 patients with non-cystic fibrosis bronchiectasis (NCFB) and reported significant improvements in exercise and aerobic capacity, depression and anxiety levels, and quality of life in the PR group compared to the control group. The authors concluded that PR should be part of routine care for NCFB patients. Also investigating patients with bronchiectasis, COLE *et al.* [24] performed a propensity-matched study comparing the completion rates and outcomes of outpatient PR between patients with this condition and those with COPD. They demonstrated that PR in patients with bronchiectasis provided similar improvements in exercise capacity and health status compared to COPD patients. Moreover, completion rates were similar (74%) in both patient groups.

In another patient category, in cystic fibrosis (CF), KALTSAKAS *et al.* [25] investigated the effectiveness of two different types of exercise training: high-intensity interval exercise (IE) and moderate-intensity constant-load exercise (CLE). The study included 24 ambulatory CF patients and showed that IE is equally effective as CLE. Since oxygen saturation was higher during IE and intensity of dyspnoea was lower than during CLE, IE may be the preferred exercise training modality for CF patients.

ARIZONO *et al.* [26] performed a randomised crossover study to investigate the effect of Supplemental oxygen *versus* room air on exercise capacity in 46 idiopathic pulmonary fibrosis (IPF) patients with exercise-induced hypoxaemia. Oxygen Supplementation increased endurance time and minimal oxygen saturation compared with room air, and this effect was independent of the mean pulmonary arterial pressure in these patients.

Since availability of hospital-based PR is limited in parts of the world, and general uptake and completion of those programmes are poor, KALLARAJU *et al.* [27] performed a matched case-control study comparing the efficacy of PR in 154 COPD patients undergoing an unsupervised home-based programme and 154 patients participating in outpatient supervised PR. Improvements in exercise capacity were more pronounced in the outpatient supervised PR group, while changes in health status were similar between groups. In general, compliance to the programmes was low. COERTJENS *et al.* [28] also demonstrated improvements in exercise capacity after PR consisting of a combination of strength and endurance training in a group of 20 "critical" patients with COPD. They reported a good correlation between changes in stair climbing test and 6-min walk distance, and suggested that strength training may present greater repercussion in functional tests.

Finally, ANDRIANOPOULOS *et al.* [29] investigated whether cognitively impaired patients with COPD are characterised by impaired cerebral blood flow regulation. This might result in inadequate cerebral oxygen availability to meet the increased metabolic demands during exercise that could be associated with the manifestations of cognitive impairment. They demonstrated that cognitively impaired patients preserve the capacity to maintain cerebral oxygen availability unchanged during submaximal exercise compared to cognitively normal patients with COPD. The authors concluded that rehabilitative exercise training in cognitively impaired patients with COPD, who exhibit mild to moderate exercise-induced reduction in oxygen saturation measured by pulse oximetry, is deemed safe.

Group 1.3: Chest Imaging

At the 2017 ERS International Conference, interesting data on several imaging techniques for a wide variety of diseases were presented. One of the emphases of the presented abstracts was on COPD and emphysema. MINESHITA *et al.* [30] measured the ratio of cardiac/lung area in expiratory plain chest radiographs and correlated this parameter with airflow limitations in patients with COPD. They found a strong correlation between these two parameters, particularly in patients with severe and very severe COPD (GOLD III and IV).

ROBBIE *et al.* [31] analysed serial computed tomography (CT) examinations to measure the volume loss of lung parenchyma in patients with IPF. They evaluated serial CT parameters of lung volume loss and

pulmonary function tests against mortality. Particularly, the change in anterior junction distance predicted mortality more strongly than the change in annual percentage forced vital capacity (FVC).

Spatiotemporal ventilation heterogeneity (VH) is one of the essential features of asthma. BELL *et al.* [32] used imaging biomarkers of VH extracted from parametric response maps of registered inspiratory and expiratory CT scans in asthma patients. They concluded that their newly developed imaging biomarker based on stratified axial CT analysis could contribute to VH discrimination. CT measurements of lung density are potential intermediate study endpoints for clinical studies. However, the clinical associations of variations in lung density and changes in forced expiratory volume 1 s (FEV₁) in smokers with and without COPD are not well understood. DIAZ *et al.* [33] demonstrated that a decline in lung density was associated with an increase or decrease in FEV₁, based on disease severity. This FEV₁-CT lung density relationship should be taken into account when using CT imaging as an endpoint in longitudinal COPD studies. TSCHIRREN *et al.* [34] examined the shape of the central airways in order to evaluate phenotypes of COPD. They showed that central airway shapes change significantly across the vital capacity with distinctly different shape changes detectable across GOLD statuses.

A few more innovative abstracts focused on use of magnetic resonance imaging (MRI) in different diseases. EDDY *et al.* [35] used hyperpolarised noble gas MRI before and after bronchodilator inhalation to evaluate ventilation reversibility in asthma and COPD patients with potential ACOS. Regardless of FEV₁ reversibility, their data revealed that one third of patients showed a reversibility of post-dilator ventilation defects. HUGHES *et al.* [36] used distribution of coefficient of variation (CoV) values in patients with CF, asthma and normal controls by histogram analysis of hyperpolarised ventilation MRI to examine ventilation heterogeneity. They reported different CoV metrics in all three cohorts; however, CoV distributions appear to change with disease severity and may be used to assess disease progression. Furthermore, using hyperpolarised gases, diffusion weighted imaging can also be obtained. CHAN *et al.* [37] evaluated estimates of lung morphometry from two models of gas diffusion in healthy controls, and IPF and COPD patients. Both models (stretched exponential model and cylinder model) showed a strong nonlinear relationship. The authors assume that this results from inherent differences in model assumptions.

Similarly, WEATHERLEY *et al.* [38] investigated microstructural metrics and regional gas exchange in patients with IPF, which can both provide information on early functional deterioration before it is detectable by diffusing capacity measurement.

Finally, nuclear medicine methods were also presented. SINGH *et al.* [39] examined patients with sarcoidosis by using ⁶⁸Ga-DOTA-NOC positron emission tomography (PET)/CT as a predictor of disease activity. They found that DOTA-NOC PET/CT emerged as a useful tool to detect clinical activity and treatment response in sarcoidosis patients.

Group 1.4: Interventional Pulmonology

Due to technological advancements and innovations, several new interventional procedures have been developed for a wide range of diagnostic and therapeutic purposes for patients with lung cancer, interstitial lung disease (ILD) and severe obstructive lung diseases. Some of these interventions have been incorporated into recent guidelines whereas the position of others is still under investigation. The broad interest of ERS Congress attendees in interventional pulmonology was reflected by the large attendance at the second ever ERS Live Endoscopy session this year in Milan-Ancona.

Lung cancer/malignant pleural effusion

Lung cancer staging guidelines state that endosonography is the initial test of choice for mediastinal nodal tissue staging [40]. Several abstracts were related to optimise nodal staging approaches including the use of endobronchial ultrasound (EBUS) followed by the introduction of the EBUS scope into the oesophagus (EUS-B) for additional nodal sampling. In the multicentre SCORE study, 229 patients with resectable (suspected) non-small cell lung cancer (NSCLC) were prospectively evaluated. A systematic EBUS investigation of all mediastinal nodes followed by an oesophageal nodal evaluation (EUS-B) *versus* an EBUS targeted nodal “hit and run” approach increased the sensitivity and negative predictive value of N2-N3 disease from 79% to 87% and 85% to 91%, respectively [41]. The STAGE study reported on the role of combined EBUS and EUS-B staging in 94 patients with NSCLC in whom curative stereotactic ablative radiotherapy was considered [42]. After complete hilar and mediastinal endosonographic staging, 11% of the patients were up-staged from N0 to N1; whereas in the N1 and N2-3 groups 85% and 65% of the patients, respectively, were down-staged to cN0.

To date, the diagnostic characteristics of needle biopsies for lung cancer diagnostics are limited by a substantial false-negative rate. The concept of so-called smart needles that are able to detect metastasis in

“real time” by acting as a “live microscope” might overcome this drawback. Needle-based confocal laser endomicroscopy is a promising technique for this purpose. With a sensitivity of 90% and diagnostic accuracy of 89%, metastatic mediastinal lymph nodes were differentiated from reactive nodes using an endosonographic approach [43].

Malignant pleural effusions (MPEs) are common and many open questions remain on their optimal management. The IPC-Plus trial randomised 154 malignant pleural effusion patients over 4 years to examine whether administering talc *via* an indwelling pleural catheter (IPC) leads to a greater chance of pleurodesis when compared to using an IPC alone. Talc was administered after 10 days once significant trapped lung had been excluded, with participants managed as outpatients. The data showed that those receiving the intervention were around twice as likely to have achieved pleurodesis by 5 weeks than those who did not, without any suggestion of harm to the patient from the IPC itself [44]. The investigators of the PROMISE Study managed to develop and prospectively validate a prognostic score for MPE patients to estimate risk of 3-month mortality. They studied differential protein expression from five separate and independent patient cohorts in order to establish a prognostic and therapeutic score for MPE [45].

Interstitial lung disease

Specific ILD diagnosis, made by a multidisciplinary team (MDT) taking clinical, imaging and pathology features into account, is key to determining prognosis and treatment. Several abstracts presented data on transbronchial lung cryobiopsy (TBLC), a relatively novel bronchoscopic technique by which large alveolar tissue samples can be obtained. In 90 patients with suspected ILD and the need for a tissue diagnosis, the diagnostic yield of TBLC in obtaining a histological diagnosis was 73.3% [46]. For those patients (n=11) in which TBLCs were taken from two different lobes, histological diagnostic yield was 91% indicating an additive diagnostic impact of this strategy. Pneumothorax occurred in 22.4% of patients and no severe bleeds were reported. Novel bronchoscopic imaging techniques that are able to visualise the alveolar compartment might contribute to ILD diagnosis, improve the diagnostic yield of TBLC or even prevented the need to take biopsy samples. Optical coherence tomography (OCT) is a laser-based, high-resolution imaging technique. In 11 ILD patients, OCT imaging-based alveolar compartment characteristics were identified and compared to histological biopsies taken by the cryo technique. OCT imaging in these patients was able to visualise thickening/loss of alveolar septa, microscopic honeycombing and bronchiectasis to a more detailed level than high-resolution CT scanning [47].

Obstructive lung disease

Several endoscopic approaches are studied in patients with severe obstructive lung diseases, including endobronchial valves, coils, application of steam and targeted lung denervation. Most novel techniques are still in various stages of study evaluation.

The REACH study, a RCT, compared endoscopic valve therapy (n=66) to optimal medical management (n=35) in 101 subjects with advanced heterogeneous upper or lower lobe predominant emphysema. Absent interlobar collateral ventilation (CV) was confirmed by CT fissure analysis. Patients treated by valves experienced a target lobe volume reduction of 66% at 6 and 12 months of follow-up. Compared to the control group, the treatment group achieved a significant and clinically meaningful improvement in FEV₁ during follow up visits over 1 year. The most common complications observed in the treatment group were COPD exacerbations (21%) and pneumothoraces (11%). Therefore, the REACH trial is the first RCT that demonstrated 12 months of sustained, clinically meaningful benefit in patients with severe emphysema and absent CV following valve placement [48]. The combination of quantitative CT (QCT) and Chartis measurements might further improve bronchoscopic lung volume reduction response rates. In another study in 318 severe emphysema patients, QCT-determined thoracoscopic lung volume reduction (TLVR) was analysed and the minimal important difference (MID) in TLVR was calculated using an anchor-based method using FEV₁, residual volume and SGRQ. The combined MID in TLVR was established at -563 mL (-22.4%) at 6 months follow-up [49].

Bronchial thermoplasty (BT) is an endoscopic treatment for severe asthma that aims to impact airway remodelling and, as such, differs from immune-modulating therapies for asthma. In the PAS-2 registry, reduction in severe asthma exacerbation (45%), hospitalisations (55%) and emergency department visits (40%) was observed in 190 BT-treated patients after 3 years follow-up. These outcomes mirror the AIR-2 trial results in “real-world practice” in a more severe asthma population [50]. Next to clinical outcome, the impact of BT on airway remodelling could be detected in both biopsies (mucin 5A and protein arginine N-methyltransferase 1 expression and airway smooth muscle reduction) and QCT (reduction in wall thickness and air trapping) [51–54].

Group 1.5: Diffuse Parenchymal Lung Disease

Most abstracts and sessions on diffuse parenchymal lung disease were focused on IPF, from single-centre or registry reports on long-term analysis on safety and efficacy of the two available antifibrotic drugs [55–58]. Great relevance was also given to the presentation of the results of clinical phase II trials and data on quality of life of patients affected by IPF.

Targeted medicine in ILD demands better phenotyping and endotyping of patients, and therefore a better knowledge of different potential pathogenic mechanisms. Multiple genetic biomarkers, such as specific transforming growth factor- β , single-nucleotide polymorphisms and telomeres, have been associated with poor clinical outcomes in IPF [59–62], while certain microRNAs may be used to improve diagnostic accuracy and evaluation of treatment response. Non-primarily fibrotic pathogenic pathways, including the inflammasome, may also represent promising therapeutic targets [63, 64].

Furthermore, among risk factors for IPF development, exposure to air pollution has been evaluated in 2093 incident IPF cases in Northern Italy [65]. Increasing NO₂, but not O₃, concentrations were associated with increased incidence of IPF.

Early diagnosis, especially in IPF, is a challenging issue since a delay can impact long-term disease outcomes. Primary care physicians should receive an adequate training to better recognise crackles/clubbing or radiological findings, as stated by RIVERA ORTEGA *et al.* [66]. In relation to patients' signs and symptoms, VAN MANEN *et al.* [67] reported a prevalence of clubbing up to 41% in patients with fibrotic ILDs, but this sign showed no correlation with disease severity.

Functional imaging techniques, like hyperpolarised ³He gas MRI or ¹⁸F-fluorodeoxyglucose PET/CT, show that regional morphological changes can be correlated with respiratory impairment, and have a potential role as predictors of disease outcome and treatment response [68, 69]. A study by ROBBIE *et al.* [70] also showed that annual anterior junction distance change at CT scan was a better predictor of mortality than annual FVC change.

In recent years, a new diagnostic tool, transbronchial cryobiopsy (TCB), has been increasingly used in clinical practice. A study by POLETTI [71] showed that the diagnostic accuracy of TCB increased when two samples, rather than one, were taken from different segments. In another real-life report, WÄLSCHER *et al.* [72] reported pneumothorax in 11% and mild to moderate bleeding in 28% of cases, as main complications, but no cases of acute exacerbations. Through MDT discussion, final diagnoses were reached in 86% of cases. Similar real-life results, with a diagnostic yield of 87.5%, were also reported by MARTINS MORAIS *et al.* [73].

Multidisciplinary discussion, the gold standard approach for ILD diagnosis, has also been matter of debate. WALSH *et al.* [74] compared the diagnostic performance of 404 physicians from all over the world to a panel of 34 IPF experts. Regular multidisciplinary discussion meeting attendance improved the prognostic accuracy of experienced non-university practitioners to levels achieved by IPF experts.

Acute exacerbation is one of the most feared complications in patients with ILDs due to its poor prognosis. Data on extracorporeal membrane oxygenation, in comparison to mechanical ventilation and noninvasive oxygen therapy, showed a favourable effect on survival in a multivariate analysis [75].

Results from two innovative phase II trials in IPF were presented during the ERS Congress. The PRAISE RCT on pamrevlumab has been presented by RICHELDI *et al.* [76]; this anti-connective tissue growth factor monoclonal antibody has been shown to stabilise FVC in 48 weeks of treatment and reduce mortality in treated patients *versus* placebo during 12 months observation. Data from a phase Ib trial on a selective JNK inhibitor (c-Jun N-terminal kinase, CC-930001) showed it to be associated with an overall lack of FVC decline and acceptable safety over 12 weeks of treatment in patients with IPF [77]. The INJOURNEY trial on nintedanib and pirfenidone in combination has shown that nintedanib plasma trough concentrations are not influenced by add-on pirfenidone [78]. Furthermore, combination treatment was well tolerated overall and the safety profile was similar to that expected with either treatment alone [79].

The evidence for wide use of rituximab in the management of connective tissue disease-associated ILD is growing. In 31 cases of rheumatoid arthritis-associated ILD, rituximab was able to stabilise lung functional decline and joint manifestations in a consistent proportion of patients [80]; in inflammatory myopathies, clinical and radiological stability was achieved in five out of seven patients. Neither study reported any severe adverse event [81].

Patients' quality of life was one of the major topics in ILD at this conference. Depression and anxiety have been reported to be highly prevalent in IPF (up to 39% according to TZOUVELEKIS *et al.* [82]) and to negatively impact on disease severity, quality of life and burden of symptoms [83]. Despite their clinical

relevance, these conditions are highly misdiagnosed and might be accompanied by disregard of patients' expectations about treatment and lower compliance, as reported by MOOR *et al.* [84].

Group 1.6: General Practice and Primary Care

The rich and wide-ranging primary care programme at the ERS Congress 2017 began with the primary care day on Saturday, September 9. The value of multidisciplinary working for community management of chronic diseases was promoted by Jaime Correia De Sousa and its importance further emphasised by Antonio Caviglia who shared how in some settings, respiratory care remained largely specialist led, with primary care practitioners used predominantly to implement the management plan received. Ideas to improve connectivity between patients, community and healthcare teams were shared by Sinthia Bosnic-Anticevich, and the potential for telehealth and digitised health systems to impact healthcare delivery highlighted by Klaus Phanareth and Aziz Sheikh, respectively.

Lung disease in low-resource countries

Further perspectives on healthcare delivery came from authors reporting from low-resource countries. Asthma and COPD were found to have considerable impact on healthcare use and spending in four low-resource settings [85], with wide variation in beliefs and understanding of the causes and consequences of lung disease between countries [86]. Encouragingly, VAN GEMERT *et al.* [87] were able to teach communities about lung health and the damaging effects of biomass and tobacco smoke by broadening existing educational programmes.

Self-management

Across all health settings, optimising delivery of supported self-management for airway disease was an important research theme. Patients prefer tailored self-management, thoughtful of their language and culture [88], and allowing their personal needs to be discussed [89]. The support provided by a healthcare professional is important for stimulating and continuing self-management [90], though the level of support required is likely to vary between patients. Internet [91] and telephone-based [92] self-management interventions were not successful in improving health outcomes, but may offer advantages for some patient groups.

THOMAS *et al.* [93] demonstrated that a self-guided breathing retraining intervention delivered by DVD and booklet were effective in improving the quality of life of adults with incompletely controlled asthma, whilst healthcare costs were reduced compared to usual care.

Predicting future risk

Identifying at-risk individuals was the subject of several studies. A systematic review completed by BEULO *et al.* [94] identified past exacerbation and persistent symptoms as strong predictors of future asthma attack in children aged 5–12 years. HONKOOP *et al.* [95] developed a risk prediction score to determine the chance of future uncontrolled asthma in adults.

KASTELYN *et al.* [96] considered the value of the COPD Assessment Test (CAT) in predicting future exacerbations. In patients with severe obstructive disease (FEV₁ <50% predicted), a CAT score >20 was the most useful predictor of an exacerbation in the next year. A further predictive model derived by HENNY *et al.* [97] found that IgG2 and thrombocytes were potentially useful predictors of future COPD exacerbation.

Overall, the quality and depth of primary care respiratory research from around the world was very impressive, stimulating much debate and making us look forward to the ERS Congress 2018 in Paris, France.

Concluding remarks

The authors of this article hope that this comprehensive summary of the impressive amount of lung research and advances in pulmonary care presented through the Clinical Assembly of the ERS creates curiosity to follow up on topics of interest to each individual reader.

It was our goal to stimulate discussion and exchange of scientific novelties and clinical developments. We also hope to have encouraged the readership to attend the ERS International Congress 2018 in Paris.

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