ATS 2025 International Conference: Pulmonary Rehabilitation Sessions Summarized

Francois Fadell MD MBA,[1,2] Peter Rassam MSc,[3] Alan Hamilton PhD,[4,5] Dmitry Rozenberg MD PhD[3,6]

1. Division of Pulmonary and Critical Care Medicine, University at Buffalo, Buffalo, New York, USA
2. Veterans Affairs Health Care System Western New York, Buffalo, New York, USA
3. University Health Network, Toronto, ON Canada
4. Patient-Centered Research, COPD Foundation, Miami, Florida;
5. Department of Health Research Methods, Evidence, and Impact, Faculty of Health Sciences, McMaster University, Hamilton, Ontario, Canada
6. Temerty Faculty of Medicine, University of Toronto, Canada

Postgraduate Course (PG16): Cardiopulmonary Exercise Testing: Advances and Applications

This course focused on cardiopulmonary exercise testing (CPET), including physiological principles of CPET that determine the pulmonary, cardiovascular and neuromuscular responses to exercise, guideline updates, and advances in CPET. There were also sessions on interpretative strategies followed by practice-based learning in an interactive small group setting.

Mini Symposium Session (A18): Best Trials in Pulmonary Rehabilitation

Dowman et al. in their study: "High Intensity Interval Training in Patients with Interstitial Lung Disease", compared the benefits of high-intensity interval training (HIIT) to the moderate intensity continuous training (MICT) in Interstitial Lung Disease (ILD). They concluded that HIIT produces equivalent improvements to MICT in people with ILD. Clinically important improvements in cycle endurance, 6-minute walk distance (6MWD) and health related quality of life (HRQoL) were seen with no between-group difference. The study by Fontoura et al. "High-intensity Inspiratory Muscle Training in Patients with Pulmonary Hypertension: Randomized Clinical Trial" concluded that high-intensity IMT improves respiratory muscle strength, exercise capacity, dyspnea, and HRQoL in symptomatic patients with pulmonary hypertension (PH). Leonhard et al. in their study: "Effect of a Self-directed Lifestyle-based Weight Management Program Among Patients with Comorbid COPD and Sleep Apnea", concluded that among individuals with COPD and self-reported sleep apnea, a self-directed video-based weight management intervention did not lead to clinically meaningful improvements in 6MWD relative to usual care. However, a greater proportion of participants in the intervention group experienced clinically meaningful weight loss. They recommended that additional interventions are needed to improve function among patients with COPD and comorbid sleep apnea. Evans et al. in their randomized feasibility study: "Personalized Exercise-rehabilitation for People With Multiple Long-term Conditions (PERFORM): A Randomized Feasibility Study", aimed to determine the feasibility of a newly developed personalized exercise-rehabilitation program for people with multiple long-term conditions (PERFORM), and concluded that the PERFORM intervention was feasible, acceptable, and supports continuance to a fully powered multicenter RCT of the PERFORM intervention compared to usual care. Kwok et al. in their study: "Effects of Comorbidity on Program Completion in Chronic Obstructive Pulmonary Disease (COPD) Patients Undergoing Pulmonary Rehabilitation", concluded that depression, severe mental illnesses, and dementia hindered pulmonary rehabilitation (PR) program completion, whereas physical conditions had no strong associations. Also, cognitive impairments were observed to potentially reduce completion rates due to potential agoraphobic tendencies and mood-driven behaviors. Consequently, promoting home-based treatment modalities could reduce patient burden while maximizing care. In the study by Fuhr et al. "Evaluation of Program Adherence and Health Outcomes When Patients Self-select to Either In-person or Virtual Pulmonary Rehabilitation" concluded that more women selected virtual PR compared to in-patient PR; that virtual PR facilitated

greater program attendance with similar completion rates. Further, self-selected virtual PR is an effective alternative to in-person PR with similar improvements in health outcomes and program adherence. Adamson et al. in their study: "Are There Differences in the Characteristics of Patients Who opt for Home-based Pulmonary Rehabilitation Versus Centre-based Pulmonary Rehabilitation?" noted that those enrolled in a home-based course were more likely to be female, to have greater mental health burden and were less likely to receive walking and respiratory tests at assessment with worse test performance. Participant rurality had no difference in selection of the type of PR program. They concluded that there are important differences in patient characteristics that opt for home-based rather than center-based PR, which need be considered when designing and delivering home-based PR. Etruw et al. in their study: "A Feasibility and Pilot Randomized Clinical Trial Assessing the Integration of Digital Remote Patient Monitoring Within Pulmonary Rehabilitation" evaluated the feasibility of integrating digital remote patient monitoring (DRPM) into PR and concluded that it helps with continuous symptom tracking, early exacerbation detection, and may facilitate better adherence to disease management behaviors. It was well-received by participants with high adherence to daily readings. However, the high number of compliance calls to address missed readings suggests that DRPM may significantly burden staff. Kofod et al. in their study: "Adaptive Oxygen Delivery in Home Settings for Patients with Chronic Obstructive Pulmonary Disease on Long-Term Oxygen Therapy - A Pilot Randomized Crossover Feasibility Trial", assessed the feasibility of saturation-responsive automated oxygen adjustments at home, and concluded it is possible to titrate oxygen flow in a home setting and achieve almost perfect control of oxygen saturation, minimizing hypoxemia. The patients in this pilot study accepted the equipment and reported a clinically significant reduction in COPD symptoms on the COPD Questionnaire. Further, this suggests that the clinical implications of controlling oxygen saturation be evaluated in a larger study.

Mini Symposium (B21): Equity, Effectiveness and Experience in PR

This ATS session featured 10 abstracts that examined inequities in PR and introduced novel approaches to rehabilitation in emerging patient populations. The studies spanned health services research, global PR, long-COVID rehabilitation, cancer survivorship, and lived experiences.

Several abstracts highlighted systemic barriers to equitable PR access. A survey of Aboriginal Community Health Services in New South Wales highlighted limited respiratory services and no PR programs, due to funding, workforce, and space constraints. Additionally, Aboriginal patients' reluctance to access hospital PR due to racism, transportation, and geographical reasons, further underscores the systemic gaps in PR accessibility. A scoping review of PR in five Latin America countries revealed disparities in implementing PR components and inconsistent alignment of international guidelines. Similar themes emerged in a systematic review that showed that "global" PR studies are mostly conducted in high-income countries, with limited representation in low- and middle-income countries. Two studies identified disparities in healthcare utilization, with one reporting that Black and South Asian patients were more likely than White ethnicities to be hospitalized for dyspnea without an underlying diagnosis, and that underserved patients were less likely to have access to PR.

Three abstracts focused on long-COVID rehabilitation. Subgroup analysis of the ReLoAd RCT demonstrated that symptom-based rehabilitation produced greater improvements in HRQoL and mental health than usual care in individuals with fatigue- or somatic-dominant symptoms. A qualitative study of 132 patients randomized to either virtual rehabilitation or usual care highlighted strong patient motivation for rehabilitation, while another study supported the utility of the Fatigue Severity Scale as an outcome measure.

Two studies evaluated lung cancer survivorship. A 12-month follow-up of a 12-week multimodal home-based rehabilitation program showed sustained improvements in dyspnea, functional status, and

mental health. Complementing this, a rapid ethnographic study highlighted the physical and emotional barriers patients faced and emphasized the importance of physical activity in regaining independence after surgery.

Thematic Poster Session (A68): Expanding Horizons in Pulmonary Rehabilitation: Novel Applications, Outcomes, and Innovations

This thematic poster session focused on outcomes, innovations, and novel applications in PR, but also telerehabilitation and the effect of the COVID-19 pandemic on PR.

Lee et al. in their observational studies from the triNetX database reflected on the association between PR, health care utilization and survival among sleep apnea, bronchiectasis, COVID-19, and asthma populations. They concluded after propensity score matching analysis that PR was associated with reduced mortality in sleep apnea patients without significant impact on health care utilization. PR reduced mortality in bronchiectasis patients, but no association was observed with respiratory exacerbations, pneumonia, emergency visits, or hospitalizations. PR reduced all-cause mortality, emergency visits, inpatient admissions, and ICU admissions in COVID-19 patients, and reduced rates of asthma exacerbations; however, with no significant impact on all-cause mortality in asthma. Given the observational, retrospective nature of these studies and the potential for bias despite propensity score matching, factors other than PR participation may have contributed to the observed effect. Future research with large randomized controlled trials was recommended.

Huang et al. in their study: "Efficacy of Telerehabilitation: Results from a Single Center During the COVID Pandemic" added further evidence to the growing body of literature supporting the efficacy and benefits of providing PR via telemedicine. This was a retrospective analysis demonstrating that patients who underwent telerehabilitation had substantial improvements in exercise capacity and HRQoL. Borton et al. reflected on their study: "LAMFit: A Collaboratively Co-Designed Mobile Application for Home-based Exercise in Lymphangioleiomyomatosis (LAM)" which consisted of a collaborative co-design approach that enabled alignment of an application with users' needs. This allowed successful technological implementation and optimization of a digital-health solution that supports exercise for individuals with LAM. Hutter et al. in their study: "Development of a Smart Mask for at Home Patient Monitoring" concluded that a wearable mask can be a useful approach for breath-by-breath analysis in COPD patients to gain deeper understanding of their breathing physiology and it can also serve as a tool to monitor breathing exercises, track progress, and adjust the routines based on physiological responses. In the study by Bulgarelli Lopes et al. titled "Pulmonary Rehabilitation in Post Tuberculosis Patients: A Longitudinal Cohort Study" concluded that PR is crucial as an adjuvant treatment for TB rehabilitation leading to an improvement in 6MWT, Borg dyspnea, and O_2 saturation. Agarwal et al. in their study: "Role of a Protocolized Pulmonary Rehabilitation Program in Improving Performance Status in Patients with End-Stage Lung Disease Eligible for Lung Transplant", concluded that patients eligible for lung transplant benefit from a hybrid PR program, with improvement in Karnofsky Performance Status, HRQoL, sarcopenia, and eligibility for lung transplant listing. Jarosch et al. in their sub-analysis of the ReLoAd trial: "Long-Term Effects of a Symptom-Based Rehabilitation vs. Usual Care in People with Post COVID-19 Condition, Differentiated by Symptom Clusters: The Reload Randomized Controlled Trial" concluded that post-COVID patients with predominantly fatigue symptoms derived significant benefit from symptom-based rehabilitation for at least 3-months in improving HRQoL and exercise capacity. Unanyan et al. in their study: "Pulmonary Rehabilitation in Pediatric Patients Post-Acute Sequelae of COVID-19", confirmed that three parameters (6MWD, BORG dyspnea and BORG fatigue scores) showed improvement following PR, with fatigue scores showing statistical significance, and concluding further investigation is required to understand the impact of PR in this patient population. Prudente et al. in

their study: “Effects of Creatine Supplementation on Fatigue Related to Long COVID - Fatigue Study” pointed to an improvement in the Revised Piper Fatigue Scale, grip strength, and concluded that creatine supplementation may provide benefits in alleviating fatigue symptoms and improving peripheral muscle strength in patients with long COVID. Topcuoglu et al. in their study: “The Impact of Respiratory Muscle Strength and Functional Capacity on Diaphragm Mobility in Individuals with Chronic Obstructive Pulmonary Disease”, concluded that respiratory muscle strength and functional capacity are determinants of diaphragm mobility in individuals with COPD. Further, they highlighted that diaphragm mobility is associated with maximal inspiratory pressure and 6MWD. Ishimatsu et al. in their study: “Correlation Between Physical Activity and Modified GAP Score in Patients with Idiopathic Pulmonary Fibrosis in Japan” concluded that in patients with idiopathic pulmonary fibrosis (IPF), the number of daily steps could be associated with the modified gender-age-physiology score. Burkes et al. in their study: “Factors Associated with Positive Outcomes in Pulmonary Rehabilitation” did not find an identifiable factor prior to PR that predicted optimal outcomes, further suggesting that PR remains an effective therapy regardless of lung function severity, comorbidities, fitness levels, or disease knowledge. Iriyama et al. in their study: “The Influences of Adolescent and Current Exercise Habits on Clinical Profiles of Chronic Obstructive Pulmonary Disease” concluded that the relationship between physical activity and healthy body composition was more pronounced in patients with moderate to severe COPD, and although those exercising demonstrated higher diffusing capacity and vital capacity, but there was no significant morphological correlation with CT imaging parameters. Nuchovich et al. in their study: “Quality of Life Profile and Physical Capabilities of PiZZ Patients with Alpha-1 Antitrypsin Deficiency (AATD) Associated Lung Disease in a Large United States Cohort” concluded that HRQoL assessments in patients with AATD can assist with the appropriate expectations and management of AATD lung disease. They highlighted that the A1F Research Registry serves as a comprehensive tool to examine HRQoL for patients with AATD. Zafar et al. in their study: “Follow-up Rates in Pulmonary Rehabilitation After COPD Exacerbations: Addressing Gaps in Care” demonstrated that there was a low compliance rate with post-discharge PR amongst patients admitted with an exacerbation of COPD, indicating that gaps in care may be influenced by provider practices as much as patient-related factors, thus underscoring the importance of identifying barriers that prevent follow-up care. Shiraishi et al. in their study: “Relationship Between Diaphragm Excursion and Exercise Tolerance in Patients with Fibrotic Interstitial Lung Diseases (fILD)” concluded that maximum diaphragm excursion measured by ultrasonography is important in evaluating exercise tolerance in patients with fILD, warranting research regarding diaphragmatic mobility and exercise tolerance in fILD. Rabahi et al. in their study: “Ultrasonographic Evaluation of the Diaphragm and the Choice of Inhalation Device”, concluded a strong correlation between diaphragmatic excursion and peak inspiratory flow in COPD patients, and suggested that bedside diaphragmatic ultrasound may assist in selecting appropriate inhalation devices for personalized COPD treatment. Moy et al. in their study: “Center-based Pulmonary Rehabilitation Sites in the U.S. Veterans Health Administration Have Significantly Decreased Post COVID-19”, concluded that the Veterans Health care system had experienced a dramatic loss of center-based PR sites, thus supporting an urgent call to restore these sites to deliver optimal guideline-based care to Veterans.

Rapid Poster Discussion Session (B107): What’s New in Pulmonary Rehabilitation Assessment Strategies?

This ATS session featured 11 abstracts examining PR assessment strategies across chronic respiratory diseases and emerging patient populations. The abstracts explored functional capacity tests, physiological and mechanistic assessments, novel assessment tools, and patient perspectives.

Four abstracts highlighted advancements in functional performance testing. In fibrotic ILD, the one-minute sit-to-stand test (1STS) correlated with forced vital capacity, diffusion capacity, and 6MWD at

12 months, supporting its utility as a simple assessment measure. Likewise, the Short Physical Performance Battery (SPPB) showed improvements from PR in individuals with COPD and frailty, while no change occurred in the balance subscore, highlighting the potential need for balance training. Remote delivery of the 6MWT, 1STS, and SPPB showed strong concordance with in-person results, demonstrating their feasibility with home based PR. Lastly, a new equation predicting peak power output from 6MWD and physical characteristics showed potential utility for PH patients, in the absence of CPET.

Four abstracts focused on physiological and mechanistic assessments. CPET compared to 6MWT performed in stable PH patients demonstrated that the 6MWT may have a similar maximal response to CPET, while comparative testing in India demonstrated the potential suitability of a customized ramp treadmill CPET protocol as opposed to cycle ergometry. Additionally, CPET with cycle ergometry in Hypermobile Ehlers-Danlos Syndrome and Generalized Hypermobility Spectrum Disorder depicted heightened dyspnea, leg fatigue, and lower aerobic capacity in comparison to age-sex matched healthy controls. Beyond CPET, ultrasound assessments in lung-transplant recipients (post-LTx) showed greater diaphragm function than pre-LTx patients, which correlated with better functional performance and respiratory symptoms, underscoring the value of diaphragm muscle assessments.

Novel technologies and patient perspectives were also highlighted. A study of individuals with COPD undergoing inpatient PR found that scores on a five-item COPD Exacerbation Recognition Tool (CERT; 0-5, higher scores indicating worse status) increased prior to an acute exacerbation diagnosis, demonstrating its potential utility for earlier detection of exacerbations. Oscillometry emerged as a potential alternative to spirometry in neuromuscular disease populations in providing a less effort-dependent assessment of respiratory mechanics. Lastly, qualitative work in primary care highlighted patients' optimism toward artificial intelligence supporting spirometry interpretation, while emphasizing the importance of human involvement.

Poster Discussion Session (C108): Optimizing the Impact of PR

This ATS session featured 24 abstracts looking at healthcare utilization, emerging PR delivery models, clinical characteristics that influence rehabilitation, oxygen therapy, alternative models of care, and a method to increase PR engagement.

A retrospective cohort study across chronic respiratory diseases showed that completing PR was associated with fewer emergency visits and hospital admissions, while two additional abstracts in COPD and ILD reported that initiating PR was linked to reduced all-cause mortality. A study examining the number of PR sessions attended observed that PH patients had the lowest frequency of attended sessions across chronic respiratory diseases. Additionally, an RCT in COPD patients demonstrated that longer PR programs (12-weeks vs. 6 weeks) resulted in more improvements in cardiorespiratory function assessed with CPET.

Several abstracts examined emerging models of PR and other novel rehabilitation approaches. A systematic review and meta-analysis demonstrated similar PR-related outcomes between telerehabilitation and in-person PR, while another study demonstrated that home-based PR may improve HRQoL as depicted by improvements in the chronic respiratory questionnaire physical subscore for individuals with fILD. A pilot study demonstrated that a web-based pedometer may be a novel approach in implementing maintenance strategies to preserve functional improvements after PR completion. Furthermore, early post-hospitalization rehabilitation (8 weeks) following acute exacerbations in COPD patients showed increased daily step counts compared to baseline, as assessed with accelerometer data. Other novel interventions included a 3-month behavior-change program that

increased physical activity in COPD following exacerbations, and a 12-week HIIT protocol that improved left ventricular diastolic function in deployment-related respiratory disease.

Various abstracts evaluated traits that could influence rehabilitation outcomes. In IPF, a 12-week tailored nutritional counseling intervention depicted a novel personalized approach to reducing fat mass and improving HRQoL and pulmonary function. Regarding skeletal muscle in COPD, sarcopenia was found to be prevalent in COPD patients, while another study delineated the potential role of gut *Veillonella* in protecting against sarcopenia. Further, in COPD patients, balance training was identified as a potential tool in PR programs to improve functional outcomes. In other populations, maximal inspiratory pressure was observed to be a potential measure to assess respiratory muscle function in PH patients, while a 6-week prehabilitation program improved functional capacity in individuals with obesity. Lastly, a systematic review and meta-analysis concluded that self-management programs tailored to the individual were more successful at improving symptom-related treatable traits than non-personalized approaches.

Three abstracts were related to oxygen therapy. Two studies conducted semi-structured interviews with patients. Semi-structured interviews in individuals with fILD using ambulatory oxygen therapy demonstrated both its benefits, including improvements in physical and mental health, and potential barriers. Interviews with COPD patients revealed optimism regarding their automated home oxygen therapy. Lastly, a study evaluated a novel oxygen delivery device (iROSE) and demonstrated increased oxygen output compared to conventional nasal cannulas in healthy participants, thus providing a potential strategy for patients with hypoxia.

Two studies investigated expanding the scope of healthcare providers in the context of PR. A study in Australia found that while physiotherapists and accredited exercise physiologists were interested in providing PR, they both expressed barriers regarding funding. Additionally, another study demonstrated that a Respiratory Therapist Care Manager for COPD and asthma in primary care resulted in decreased ED visits and hospitalizations over a 12-month follow-up period. Lastly, one study evaluated whether low PR uptake and completion rates could be mitigated with financial incentives.

Scientific Symposium (C7): Next Steps: Enhancing Research Trials in Pulmonary Rehabilitation to Improve Real World Implementation
Chairs: Narelle S. Cox (Monash University), Christopher Mosher (Duke University)

The symposium addressed gaps between PR research evidence and real-world implementation. Despite strong evidence recommendations from 2023 ATS guidelines, less than 3% of eligible patients globally access PR. The session explored novel trial designs, economic evaluations, implementation science, and strategies for including underserved populations.

Patient Perspective: A patient in her 70s with IPF, shared her transformative experience with PR. After two rounds of 18 sessions each, she achieved significant improvements: 6MWT results of 92-96% predicted, ability to walk 4-5 miles without dyspnea, and maintain oxygen saturation in the high 90s without supplemental oxygen. Her forced vital capacity improved to 2.36 liters (91%) over five years. She emphasized PR's role in building physical endurance, teaching breathing techniques, and creating supportive community connections.

Moving Beyond Evidence (Jerry Krishnan) Dr. Krishnan challenged the PR community to shift focus from proving efficacy to effective implementation strategies. He identified PR as a "complex health intervention" with 13 essential elements across 4 domains, requiring different approaches

compared to simple interventions. Applying the Diffusion of Innovations Theory, he emphasized that adoption is a social process requiring engagement with emotional and social levers.

Key insights included recognizing that patients and providers are not decision-makers in healthcare organizations. Decision-makers assess interventions by whether they work in their system, save costs, require personnel, and fit within competing priorities. Dr. Krishnan advised reframing PR's value for different audiences, using spheres of influence to reach decision-makers indirectly, and recognizing that implementation requires communication.

Economic Evaluation (Angela Burge) Dr. Burge demonstrated PR's strong economic evidence, tracing back to 1969 research showing marked savings. Recent studies consistently show PR's cost-effectiveness, with Griffiths' 2001 foundational study revealing 64% probability of cost-effectiveness at zero willingness to pay. Economic modeling studies examining 10-30% increases in PR referrals showed improved outcomes and cost-effectiveness even when program costs increased five-fold.

Critical findings revealed that participants bear nearly three-quarters of center-based program costs when considering travel and time. A key implementation barrier is the disconnect between who pays for PR programs and who realizes downstream cost savings. Dr. Burge emphasized the need for broader collaboration to address funding challenges, strategic study design, and multi-stakeholder engagement to translate economic evidence into improved PR access.

Implementation Science (Stephanie Robinson) Dr. Robinson outlined how implementation science can translate PR research into routine practice. Implementation science examines metrics beyond traditional clinical outcomes. She presented her team's experience with a web-based pedometer-mediated physical activity intervention for COPD patients, using the Practical Robust Implementation Sustainability Model.

Key findings identified facilitators (alignment with disease management goals, flexibility, fit with remote care trends) and barriers (external physical activity limitations, time constraints, insufficient digital literacy training, need for electronic health record integration). Dr. Robinson emphasized considering implementation science early in intervention development and leveraging hybrid trial designs to accelerate research to guide clinical practice translation.

Hearing from the Seldom Heard (Jennifer Apollo) Jennifer Apollo presented research addressing PR accessibility for underserved populations through a five-year PCORI-funded study. The study enrolled 209 African American and Hispanic patients with advanced COPD, comparing telehealth-based PR delivered to patients' homes versus standard clinic-based care.

Results showed telehealth PR significantly improved accessibility by eliminating transportation barriers and achieving higher initial engagement. However, both arms showed similar hospital readmission rates with no significant difference in primary outcomes. Critical barriers included medical clearance requirements, physician skepticism about PR effectiveness, and completion challenges.

Jennifer emphasized the need to redesign PR trials to better reflect real-world conditions and diverse populations. Recommendations included expanding inclusion criteria, incorporating social determinants of health, developing hybrid telehealth models, and creating culturally tailored materials.

Key Takeaways from Symposium: The symposium highlighted that while PR's clinical and economic evidence is robust, bridging the implementation gap requires strategic stakeholder engagement,

addressing funding misalignments, incorporating implementation science principles, and prioritizing health equity. Success depends on moving beyond traditional randomized controlled trials toward more pragmatic, inclusive, and implementation-focused approaches.

Scientific Symposium (A87): Virtual Pulmonary Rehabilitation: Can We Get to Consensus?

The ATS Pulmonary Rehabilitation Assembly hosted a scientific symposium examining the rapidly evolving landscape of virtual pulmonary rehabilitation (PR) programs. Co-chaired by Marilyn Moy (VA Boston Healthcare System) and Linda Nici (Warren Alpert Medical School of Brown University), the session addressed critical questions about standardizing virtual PR delivery in the post-COVID era.

Background and Rationale: While conventional in-person PR remains the standard of care for chronic lung disease patients, virtual programs have proliferated since the COVID pandemic as a means to improve access and provide alternative treatment options. However, the current virtual PR landscape is highly heterogeneous, creating an urgent need for quality metrics and minimum standards to guide existing and future programs.

The symposium aimed to help attendees: (1) define a framework incorporating essential components of virtual PR, (2) apply these components to enhance existing virtual programs or develop new ones, (3) identify high-quality virtual PR program aspects for patient referrals. The symposium featured three structured pro/con debates addressing fundamental virtual PR implementation questions:

Delivery Platform: Christopher Mosher (Duke University) advocated for 2-way live videoconferencing, while Narelle Cox (Monash University) argued for asynchronous delivery methods.

Exercise Components: Carolyn Rochester (Yale University School of Medicine) presented the case for aerobic gym equipment utilization, contrasted by Jennifer Alison (University of Sydney) who supported minimal equipment and ground-based walking training approaches.

Outcome Assessments: Richard Casaburi (Lundquist Institute for Biomedical Innovation) argued that primary functional outcomes should measure exercise capacity, while Thierry Troosters (KU Leuven) advocated for physical activity or balance/frailty measures for primary outcome assessment.
This symposium provided essential guidance for clinicians and researchers navigating the complex decision-making process involved in virtual PR program development and implementation. The discussions were grounded in existing literature and aimed to establish a foundation for more standardized, high-quality virtual PR programs that can effectively serve patients with chronic lung diseases.

Clinical Year in Review (D1): Pulmonary Rehabilitation

Dr. Tania Janaudis-Ferreira (McGill University) reviewed recent key publications in PR research.

Validation of Constant Work Rate Cycling Endurance Time in COPD: A recent validation study[1] confirmed constant work rate cycling endurance time as a measure of exercise endurance for COPD patients in regulatory decision-making contexts. Analyzing data from several studies (5,654 participants), researchers demonstrated construct validity through similar peak physiological and perceptual responses between constant work rate and incremental cycling protocols. Bronchodilator therapy significantly increased endurance time, particularly in patients with severe airflow limitation,

while exercise training showed consistent improvements across all disease severities. Test-retest reliability was confirmed, and responsiveness was demonstrated with significant endurance time increases following active treatment versus placebo. The minimum important difference was estimated at approximately one minute. The authors concluded that constant work rate cycling endurance time is a valid, reliable measure of exercise endurance in COPD for evaluating treatment benefits and informing regulatory decisions, but not for routine clinical use.

[1]Casaburi R et al. AnnalsATS. 2024; 21(5), 727-739

PR and Mortality: This retrospective analysis of the Korean Health Insurance Review and Assessment Service database examined PR implementation and outcomes in COPD patients from 2015-2019.[2] Despite only 1.43% of COPD patients received PR, annual implementation rates increased substantially from 0.03% to 1.4% following health insurance coverage introduction. The PR group demonstrated significantly improved clinical outcomes compared to controls, including reduced moderate-to-severe exacerbations, prolonged time to first exacerbation, and decreased mortality rates. Although direct medical costs were initially higher in the PR group, costs diverged over time between groups. This nationwide study strengthens evidence supporting supervised, hospital-based PR's clinical benefits, particularly regarding mortality reduction. Despite proven benefits, PR uptake remains low, highlighting implementation challenges.

[2] Choi JY, et al. Chest. 2024;165(2):313-322.

Telerehabilitation for COPD: A multinational randomized controlled trial investigated long-term telerehabilitation and unsupervised home exercise training as alternatives to standard care for COPD patients.[3] This novel 2-year study randomized participants from Norway, Australia, and Denmark into three groups: telerehabilitation (individualized treadmill training with physiotherapist supervision plus self-management), unsupervised treadmill training, or standard care. The primary endpoint was combined hospitalizations and ED presentations over the study duration.

Both intervention groups had significantly lower hospitalization and ED visit rates compared to controls. Participants in telerehabilitation and unsupervised training groups maintained superior health status for one year and achieved clinically meaningful improvements in exercise capacity that were sustained long-term. These findings suggest that home-based interventions can effectively reduce healthcare utilization while improving functional outcomes, thus potentially expanding PR access. Telerehabilitation may offer particular advantages for patients requiring closer monitoring who are unsuitable for unsupervised training.

[3] Zanaboni P, et al. Am J Respir Crit Care Med. 2023;207(7):865-875.

PR Guidelines: The ATS's clinical practice guideline addresses PR for adults with chronic respiratory diseases, emphasizing its proven benefits despite widespread underutilization[4]. The guideline encompasses six PICO questions critical for clinical practice, targeting specific patient populations including COPD, ILD, and PH.

Strong recommendations (moderate-quality evidence) support PR for stable COPD patients, post-hospitalization COPD exacerbations, adults with ILD, and offering patients choice between center-based PR or telerehabilitation. Conditional recommendations (low-quality evidence) include PR for PH patients and either supervised maintenance PR or usual care following initial PR in COPD.

The guideline acknowledges PR's benefits for anxiety, depression, and fatigue, though these outcomes weren't formally addressed. The authors emphasize PR's critical role in evidence-based care for COPD, ILD, and PH patients, while noting that novel delivery models beyond telerehabilitation require further investigation. Continued stakeholder dialogue regarding healthcare funding remains essential for developing widespread PR infrastructure.

[4] *Rochester CL, et al. Am J Respir Crit Care Med. 2023; 208(4), e7-e26.*

PR for Long COVID (1): The PHOSP-R randomized controlled trial evaluated exercise-based rehabilitation interventions in 181 hospitalized COVID-19 survivors (mean age 59) with persistent symptoms exceeding 12 weeks. Participants were randomized to face-to-face rehabilitation, remote rehabilitation, or usual care, completing an eight-week program of prescribed exercise and education.[5] The primary endpoint was change in Incremental Shuttle Walking Test (ISWT) distance.

Both intervention arms demonstrated significant improvements in ISWT compared to usual care, with no significant difference in HRQoL or self-reported symptoms. Naïve and memory CD8+ T cells significantly increased following face-to-face rehabilitation, suggesting potential immunomodulatory benefits. The study also demonstrated safety of both delivery modalities.

[5] *Daynes E, et al. Eur Respir J. 2025;Feb 20:2402152-2402152.*

PR for Long COVID (2): This randomized controlled trial evaluated an 8-week virtual rehabilitation program for 132 individuals with Long COVID (mean age 48 years).[6] Participants were randomized to virtual rehabilitation (personalized aerobic and resistance exercises, with education) plus usual care versus usual care alone. While the primary outcome of functional mobility (AM-PAC mobility score) showed no significant between-group differences, the intervention group demonstrated higher rates of minimal detectable change in mobility and improvements in health status, fatigue, and dyspnea scores.

Notably, 78% of participants were outpatients, inactive, and 93.2% experienced post-exertional malaise at baseline. Adherence was 96% for supervised sessions with 96% retention. Exercise progression proved challenging due to persistent symptoms in 39% of participants. Forty-five mild-to-moderate adverse events occurred in 30 participants, with higher incidence among those with cardiac comorbidities and elevated post-exertional malaise scores. Despite mixed effectiveness, 83% of participants would recommend the training program.

[6] *Janaudis-Ferreira T, et al. medRxiv (preprint). 2024.*

ACKNOWLEDGEMENTS:

Dmitry Rozenberg receives research support from the National Sanitarium Association Chair in Respiratory Rehabilitation at West Park Health Care Center (University Health Network).