

# Journal of Pulmonary Medicine and Respiratory Care

## Review Article

# Clinical Outcomes of pulmonary rehabilitation programs in Patients with chronic obstructive pulmonary disease

Iyer R<sup>1\*</sup>, Nair A<sup>2</sup> and Sharma N<sup>3</sup>

<sup>1</sup>Department of Respiratory Care, Shannon Institute for Advanced Pulmonary Medicine, Sri Lanka

<sup>2</sup>Department of Pulmonary Medicine, Guadalupe Institute of Pulmonary Medicine, Nepal

<sup>3</sup>Department of Respiratory Care, Guadalupe Institute of Pulmonary Medicine, Nepal

\*Address for Correspondence: Rohan Iyer, Department of Respiratory Care, Shannon Institute for Advanced Pulmonary Medicine, Sri Lanka; E-mail: [rohan.iyer@shannon.edu](mailto:rohan.iyer@shannon.edu)

Received: 19 January 2026; Accepted: 11 April 2026; Published: 2 July 2026.

Citation of this article: Iyer R, Nair A, Sharma N (2026) Clinical Outcomes of pulmonary rehabilitation programs in Patients with chronic obstructive pulmonary disease. J Pulm Med Respir Care, 1(1): 01-06. DOI: [10.5281/zenodo.22815208](https://doi.org/10.5281/zenodo.22815208)

Copyright: © 2026 Rohan Iyer, et al. This is an open access article distributed under the [Creative Commons Attribution License](#), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## Abstract

**Background:** Pulmonary rehabilitation (PR) is a guideline-recommended, multidisciplinary intervention combining supervised exercise training, education, and self-management support for COPD, yet real-world referral and completion rates remain low despite consistent evidence of benefit.

**Objective:** This review synthesizes published evidence on clinical outcomes of PR programs in COPD, covering exercise capacity, dyspnea, quality of life, exacerbation risk, and program-design factors.

**Methods:** We synthesized randomized controlled trials, meta-analyses, and major society statements addressing supervised PR, home-based and tele-rehabilitation models, exercise modalities, and maintenance strategies in stable and post-exacerbation COPD.

**Findings:** PR produces clinically important gains in six-minute walk distance and peak exercise capacity, meaningful reductions in dyspnea and improvements in quality of life, and when initiated after an acute exacerbation, is associated with fewer readmissions and lower mortality; benefits attenuate over 12-24 months without maintenance.

**Conclusions:** Pulmonary rehabilitation remains among the most effective non-pharmacological interventions in COPD, and expanding access through home-based, tele-rehabilitation, and early post-exacerbation delivery models is central to closing the gap between efficacy and real-world uptake.

**Keywords:** pulmonary rehabilitation; COPD; exercise capacity; quality of life; exacerbation

## 1. Introduction

Chronic obstructive pulmonary disease (COPD) produces a self-reinforcing cycle in which airflow limitation causes dyspnea on exertion, dyspnea drives avoidance of activity, and inactivity accelerates skeletal muscle deconditioning that itself worsens exercise-related breathlessness independent of lung function. Pulmonary rehabilitation (PR) was developed to interrupt this cycle, and it has become the most consistently effective non-pharmacological intervention available for COPD, built around supervised exercise training combined with education, nutritional counseling, and self-management support delivered by a multidisciplinary team [1,2]. The physiological rationale is well established: COPD causes measurable peripheral and respiratory muscle dysfunction, including fiber-type shift and reduced oxidative capacity, that responds to structured training largely independent of the severity of airflow obstruction itself [3,4]. Because the limitation to exercise in COPD is as much peripheral and deconditioning-related as ventilatory, training can improve functional capacity without any change in forced expiratory volume, the central premise underlying PR's clinical effect.

The evidence base supporting PR in COPD is unusually deep, spanning multiple Cochrane systematic reviews, large multicenter randomized trials, and joint statements from the American Thoracic Society and European Respiratory Society [5,6,1]. Despite this, referral to and completion of PR remains strikingly low in routine practice, with only a small minority of eligible patients enrolling, and completion rates among those referred often falling below half [7,8]. This review synthesizes what the literature has established about the clinical outcomes of PR in COPD, organized around exercise capacity, dyspnea and quality of life, exacerbation and hospitalization risk, delivery-model factors, and durability of benefit, with attention to the gap between demonstrated efficacy and real-world implementation.

## 2. Physiological rationale and program structure

Modern PR programs are built around individualized, progressive endurance and resistance training, typically delivered two to three sessions per week over six to twelve weeks, alongside education on self-management, breathing strategies, nutrition, and psychosocial support [2,9]. The joint ATS/ERS statement on key concepts in PR emphasizes exercise training as the cornerstone component, with education and self-management serving as adjuncts that improve adherence and extend benefit rather than substituting for supervised training [2]. Endurance training at intensities calibrated to individual tolerance produces greater adaptation than fixed low-intensity protocols, and interval training is an effective alternative for patients too breathless to sustain continuous moderate-intensity exercise, achieving comparable effect with lower peak ventilatory demand [10,11].

Resistance training targeting large muscle groups addresses the peripheral muscle dysfunction common in COPD, and combined aerobic-resistance protocols are now generally preferred because they produce greater gains in strength and lean mass without sacrificing cardiorespiratory benefit [3,12]. Ground-based walking training, which more closely mimics daily functional demands than cycle ergometry, improves quality of life and exercise capacity comparably to traditional programs, and is attractive for centers without laboratory-based equipment [13]. The mechanism by which these programs relieve dyspnea, beyond deconditioning reversal, includes reduced dynamic hyperinflation and improved ventilatory efficiency, consistent with exertional dyspnea in COPD arising from mismatch between ventilatory demand and the hyperinflated respiratory system [14].

## 3. Effects on exercise capacity

The six-minute walk test and incremental or endurance cycle ergometry are the most widely reported outcome measures in PR trials, and the Cochrane systematic review

of PR for COPD, encompassing dozens of randomized trials, found consistent, clinically important improvements in exercise capacity following supervised programs versus usual care, with pooled effect sizes exceeding the minimal clinically important difference for six-minute walk distance [5]. Earlier Cochrane reviews reached the same conclusion, and the consistency of the effect across successive updates is part of why PR carries such a strong grade of recommendation in COPD guidelines [6,15]. The field-walking test literature has itself been formally standardized, with joint ERS/ATS technical statements establishing protocol requirements and interpretation thresholds that most contemporary PR trials now follow [16,17].

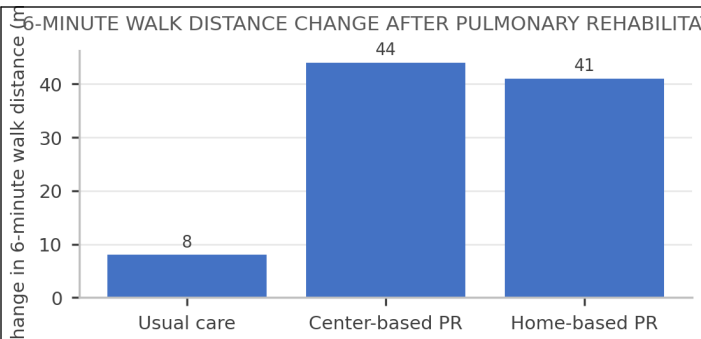


**Figure 1:** Mean change in six-minute walk distance from baseline with usual care versus supervised center-based and home-based pulmonary rehabilitation programs, illustrating that home-based delivery achieves gains comparable to center-based programs and both substantially exceed the minimal clinically important difference [5,30].

Improvements are not limited to submaximal walking tests. Endurance cycle time to symptom limitation, a more sensitive measure of exercise tolerance than peak workload, improves substantially after PR, often by a greater relative margin than walking distance, reflecting the training-induced increase in capacity to sustain submaximal work [4,18]. Improvement magnitude correlates with adherence and completed session count, reinforcing that gains reflect a genuine training effect, and randomized comparisons of individualized versus fixed-intensity prescriptions in older patients have shown that tailoring intensity to functional status further

improves the size of the gain achieved [19].

**4. Dyspnea and health-related quality of life**

Beyond exercise capacity, PR produces measurable improvements in patient-reported dyspnea and disease-specific health status, most commonly assessed with the Chronic Respiratory Questionnaire and the St George's Respiratory Questionnaire, both of which show changes exceeding established minimal clinically important difference thresholds in most trials reviewed [20,2]. The COPD Assessment Test, developed more recently as a shorter, more accessible instrument, has since been widely adopted in PR outcome reporting and shows similarly consistent improvement across completers [21]. Griffiths and colleagues, in one of the earlier large UK multicenter trials of outpatient multidisciplinary PR, demonstrated significant one-year improvements in health status and walking distance versus usual care, instrumental in establishing PR's place in national guidelines [22].

Quality-of-life benefit appears at least partly independent of baseline disease severity, with patients across a wide range of airflow obstruction reporting meaningful gains, supporting current guidance that eligibility should rest on functional limitation and symptom burden rather than spirometric severity alone [23,24]. Reductions in dyspnea during daily activities translate into broader gains in self-efficacy and reduced anxiety and depressive symptoms, outcomes increasingly recognized as central to why PR is valued beyond any single physiological measure [2,12].

**Table 1:** Patient-reported outcome instruments commonly used to assess pulmonary rehabilitation benefit in COPD, with typical direction of change and reported minimal clinically important difference [2,21,20].

| Instrument                              | Domain assessed                    | Typical change after PR             | Reported MCID         |
|-----------------------------------------|------------------------------------|-------------------------------------|-----------------------|
| Chronic Respiratory Questionnaire (CRQ) | Dyspnea, fatigue, emotion, mastery | Improvement across all four domains | 0.5 points per domain |

| Instrument                                   | Domain assessed              | Typical change after PR               | Reported MCID |
|----------------------------------------------|------------------------------|---------------------------------------|---------------|
| St George's Respiratory Questionnaire (SGRQ) | Symptoms, activity, impact   | Decrease (improvement) in total score | 4 points      |
| COPD Assessment Test (CAT)                   | Global symptom burden        | Decrease (improvement) in total score | 2 points      |
| 6-minute walk distance (6MWD)                | Functional exercise capacity | Increase in distance walked           | 25-30 meters  |

5. Exacerbation, hospitalization, and survival outcomes

The most clinically consequential evidence concerns PR's effect on exacerbation frequency, hospital readmission, and mortality, particularly when initiated soon after an acute exacerbation. Man and colleagues, in an early randomized study, found that community-based PR begun shortly after hospital discharge reduced subsequent admissions and improved health status versus usual care, establishing the post-exacerbation window as a high-yield period for enrollment [25]. The Cochrane review of PR following exacerbations confirmed this across a larger evidence base, reporting reductions in readmission and improvements in quality of life and exercise capacity, with some trials also suggesting a mortality benefit, though with heterogeneity in program timing and intensity [26].

Large observational analyses using national claims data have reinforced these trial findings at population scale. Lindenauer and colleagues, analyzing Medicare beneficiaries hospitalized for COPD, found that PR initiated within three months of discharge was associated with significantly lower one-year mortality than no PR, an association that persisted across sensitivity analyses addressing confounding by indication [27]. Stefan and colleagues, examining the same population, found early PR initiation also associated with reduced all-cause and COPD-specific rehospitalization risk [28]. Camillo and colleagues, following PR completers over several years,

found that baseline functional exercise capacity and its improvement during the program independently predicted longer-term survival [29].

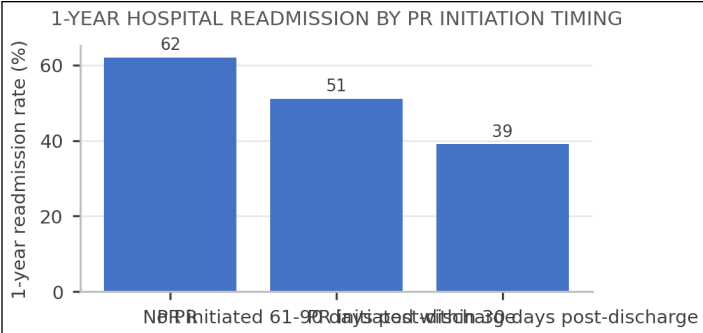


**Figure 2:** One-year all-cause hospital readmission rate among patients hospitalized for a COPD exacerbation, stratified by whether and how soon pulmonary rehabilitation was initiated after discharge, showing a graded reduction in readmission risk with earlier PR enrollment [27,28].

6. Program delivery models and access

Despite this evidence, PR referral and completion rates remain low, and a substantial literature has examined why. Keating and colleagues' systematic review of barriers to attendance identified transportation difficulties, comorbid illness burden, lack of perceived benefit, and scheduling conflicts as recurring obstacles, motivating alternative delivery models that reduce the burden of traditional center-based attendance [8]. Home-based PR, delivered with minimal equipment and periodic supervision, has been shown in randomized equivalence trials to produce outcomes statistically indistinguishable from center-based programs on walking distance and health status, offering a scalable alternative for patients unable to attend regularly [30].

Telerehabilitation extends this logic by delivering supervised or semi-supervised training remotely, and the Cochrane review of telerehabilitation for chronic respiratory disease found outcomes broadly comparable to center-based programs, while noting that evidence quality and long-term follow-up remain more limited [31]. Vasilopoulou and colleagues evaluated a home-based maintenance telerehabilitation program after initial PR

and found that ongoing remote supervision reduced acute exacerbations, hospitalizations, and emergency visits versus usual follow-up [32]. Self-management interventions, often bundled with PR, have shown independent reductions in hospital utilization when structured around individualized action plans and case-manager contact, as in Bourbeau and colleagues' trial, though the Cochrane review of self-management for COPD found effects varying with program intensity and structure [33,34].

| Table 2: Comparison of pulmonary rehabilitation delivery models by setting, supervision intensity, and reported outcome equivalence relative to standard center-based programs [30,31,32]. |                                    |                                 |                                                        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|---------------------------------|--------------------------------------------------------|
| Delivery model                                                                                                                                                                             | Supervision                        | Typical setting                 | Outcome relative to center-based PR                    |
| Center-based PR                                                                                                                                                                            | Direct, in person                  | Hospital or outpatient clinic   | Reference standard                                     |
| Home-based PR                                                                                                                                                                              | Periodic in-person or phone review | Patient's home                  | Statistically equivalent on 6MWD and SGRQ              |
| Telerehabilitation                                                                                                                                                                         | Remote, real-time or asynchronous  | Patient's home via video/device | Broadly comparable, less long-term evidence            |
| Maintenance telerehabilitation                                                                                                                                                             | Remote, lower intensity            | Post-PR follow-up               | Reduced exacerbations and ED visits vs usual follow-up |

7. Maintenance and durability of benefit

A persistent limitation is that gains achieved during a structured program tend to erode over the following one to two years without ongoing reinforcement. Ries and colleagues' randomized maintenance trial found that a structured maintenance program following initial PR preserved a meaningfully larger fraction of the exercise-capacity gain than usual follow-up alone, demonstrating that durability depends on continued activity reinforcement [35]. Beauchamp and colleagues' systematic review of optimal PR duration and maintenance strategies concluded that longer initial

programs and structured maintenance both extend benefit duration, though the format and intensity that best sustains gains remains incompletely defined [36].

Guell and colleagues' long-term follow-up found that benefits in exercise tolerance and quality of life, while attenuating, remained detectable at two years relative to a non-rehabilitated comparison group [20]. Ambrosino and Strambi's review emphasized that combining pharmacological bronchodilation with exercise training, and integrating maintenance activity into ordinary routines rather than treating it as a separate intervention, offers the most realistic path to sustaining gains, a conclusion echoed in recent workshop reports on modern PR design [37,9]. Taken together, this evidence indicates PR should be conceptualized as the intensive initiation phase of a longer-term strategy rather than a fixed-duration episode, a framing reflected in current ATS/ERS policy guidance on implementation [7,24].

8. Conclusion

The clinical outcomes literature on PR in COPD is remarkably consistent: supervised, multidisciplinary programs produce clinically important improvements in exercise capacity, dyspnea, and quality of life, and when delivered soon after an acute exacerbation, are associated with fewer readmissions and improved survival [5,26,27]. These benefits arise from a well-characterized mechanism, training-induced reversal of peripheral muscle deconditioning and improved ventilatory efficiency, rather than change in the underlying airflow obstruction, which is why PR benefits patients across the spectrum of severity [3,23]. The principal unmet challenges are not efficacy but durability and access: gains erode without structured maintenance, and referral and completion rates remain far below what the evidence justifies, driven by barriers that home-based and telerehabilitation models are only beginning to close [36,31,8]. Closing that gap, through earlier post-exacerbation enrollment, flexible delivery formats,

and structured long-term maintenance, remains the central priority for improving outcomes in COPD [7,9].

## 9. References

1. Nici, L., Donner, C., Wouters, E., Zuwallack, R., Ambrosino, N., Bourbeau, J., et al. (2006) American Thoracic Society/European Respiratory Society statement on pulmonary rehabilitation. *American Journal of Respiratory and Critical Care Medicine*, 173(12): 1390-1413. DOI: [10.1164/rccm.200508-1211ST](https://doi.org/10.1164/rccm.200508-1211ST)
2. Spruit, M.A., Singh, S.J., Garvey, C., ZuWallack, R., Nici, L., Rochester, C., et al. (2013) An official American Thoracic Society/European Respiratory Society statement: key concepts and advances in pulmonary rehabilitation. *American Journal of Respiratory and Critical Care Medicine*, 188(8): e13-e64. DOI: [10.1164/rccm.201309-1634ST](https://doi.org/10.1164/rccm.201309-1634ST)
3. Maltais, F., Decramer, M., Casaburi, R., Barreiro, E., Burelle, Y., Debigare, R., et al. (2014) An official American Thoracic Society/European Respiratory Society statement: update on limb muscle dysfunction in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine*, 189(9): e15-e62. DOI: [10.1164/rccm.201402-0373ST](https://doi.org/10.1164/rccm.201402-0373ST)
4. Troosters, T., Casaburi, R., Gosselink, R., Decramer, M. (2005) Pulmonary rehabilitation in chronic obstructive pulmonary disease. *American Journal of Respiratory and Critical Care Medicine*, 172(1): 19-38. DOI: [10.1164/rccm.200408-1109SO](https://doi.org/10.1164/rccm.200408-1109SO)
5. McCarthy, B., Casey, D., Devane, D., Murphy, K., Murphy, E., Lacasse, Y. (2015) Pulmonary rehabilitation for chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews*, 2015(2): CD003793. DOI: [10.1002/14651858.CD003793.pub3](https://doi.org/10.1002/14651858.CD003793.pub3)
6. Lacasse, Y., Goldstein, R., Lasserson, T.J., Martin, S. (2006) Pulmonary rehabilitation for chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews*, 2006(4): CD003793. DOI: [10.1002/14651858.CD003793.pub2](https://doi.org/10.1002/14651858.CD003793.pub2)
7. Rochester, C.L., Vogiatzis, I., Holland, A.E., Lareau, S.C., Marciniuk, D.D., Puhan, M.A., et al. (2015) An official American Thoracic Society/European Respiratory Society policy statement: enhancing implementation, use, and delivery of pulmonary rehabilitation. *American Journal of Respiratory and Critical Care Medicine*, 192(11): 1373-1386. DOI: [10.1164/rccm.201510-1966ST](https://doi.org/10.1164/rccm.201510-1966ST)
8. Keating, A., Lee, A., Holland, A.E. (2011) What prevents people with chronic obstructive pulmonary disease from attending pulmonary rehabilitation? A systematic review. *Chronic Respiratory Disease*, 8(2): 89-99. DOI: [10.1177/1479972310393756](https://doi.org/10.1177/1479972310393756)
9. Holland, A.E., Cox, N.S., Houchen-Wolloff, L., Rochester, C.L., Garvey, C., ZuWallack, R., et al. (2021) Defining modern pulmonary rehabilitation: an official American Thoracic Society workshop report. *Annals of the American Thoracic Society*, 18(5): e12-e29. DOI: [10.1513/AnnalsATS.202102-146ST](https://doi.org/10.1513/AnnalsATS.202102-146ST)
10. Puhan, M.A., Busching, G., Schunemann, H.J., van Oort, E., Zaugg, C., Frey, M. (2006) Interval versus continuous high-intensity exercise in chronic obstructive pulmonary disease: a randomized trial. *Annals of Internal Medicine*, 145(11): 816-825. DOI: [10.7326/0003-4819-145-11-200612050-00006](https://doi.org/10.7326/0003-4819-145-11-200612050-00006)
11. Gloeckl, R., Marinov, B., Pitta, F. (2013) Practical recommendations for exercise training in patients with COPD. *European Respiratory Review*, 22(128): 178-186. DOI: [10.1183/09059180.00000513](https://doi.org/10.1183/09059180.00000513)
12. Garvey, C., Bayles, M.P., Hamm, L.F., Hill, K., Holland, A., Limberg, T.M., et al. (2016) Pulmonary rehabilitation exercise prescription in chronic obstructive pulmonary disease: review of selected guidelines. *Journal of Cardiopulmonary Rehabilitation and Prevention*, 36(2): 75-83. DOI: [10.1097/HCR.0000000000000171](https://doi.org/10.1097/HCR.0000000000000171)
13. Wootton, S.L., Ng, L.W., McKeough, Z.J., Jenkins, S., Hill, K., Eastwood, P.R., et al. (2014) Ground-based walking training

- improves quality of life and exercise capacity in COPD. *European Respiratory Journal*, 44(4): 885-894. DOI: [10.1183/09031936.00046114](https://doi.org/10.1183/09031936.00046114)
14. O'Donnell, D.E. (2006) Hyperinflation, dyspnea, and exercise intolerance in chronic obstructive pulmonary disease. *Proceedings of the American Thoracic Society*, 3(2): 180-184. DOI: [10.1513/pats.200508-093DO](https://doi.org/10.1513/pats.200508-093DO)
  15. Vogelmeier, C.F., Criner, G.J., Martinez, F.J., Anzueto, A., Barnes, P.J., Bourbeau, J., et al. (2017) Global strategy for the diagnosis, management, and prevention of chronic obstructive lung disease 2017 report: GOLD executive summary. *American Journal of Respiratory and Critical Care Medicine*, 195(5): 557-582. DOI: [10.1164/rccm.201701-0218PP](https://doi.org/10.1164/rccm.201701-0218PP)
  16. Holland, A.E., Spruit, M.A., Troosters, T., Puhan, M.A., Pepin, V., Saey, D., et al. (2014) An official European Respiratory Society/American Thoracic Society technical standard: field walking tests in chronic respiratory disease. *European Respiratory Journal*, 44(6): 1428-1446. DOI: [10.1183/09031936.00150314](https://doi.org/10.1183/09031936.00150314)
  17. Singh, S.J., Puhan, M.A., Andrianopoulos, V., Hernandez, N.A., Mitchell, K.E., Hill, C.J., et al. (2014) An official systematic review of the European Respiratory Society/American Thoracic Society: measurement properties of field walking tests in chronic respiratory disease. *European Respiratory Journal*, 44(6): 1447-1478. DOI: [10.1183/09031936.00150414](https://doi.org/10.1183/09031936.00150414)
  18. Casaburi, R., ZuWallack, R. (2009) Pulmonary rehabilitation for management of chronic obstructive pulmonary disease. *New England Journal of Medicine*, 360(13): 1329-1335. DOI: [10.1056/NEJMct0804632](https://doi.org/10.1056/NEJMct0804632)
  19. Sewell, L., Singh, S.J., Williams, J.E., Collier, R., Morgan, M.D. (2005) Can individualized rehabilitation improve functional independence in elderly patients with COPD? *Chest*, 128(3): 1194-1200. DOI: [10.1378/chest.128.3.1194](https://doi.org/10.1378/chest.128.3.1194)
  20. Guell, R., Casan, P., Belda, J., Sangenis, M., Morante, F., Guyatt, G.H., et al. (2000) Long-term effects of outpatient rehabilitation of COPD: a randomized trial. *Chest*, 117(4): 976-983. DOI: [10.1378/chest.117.4.976](https://doi.org/10.1378/chest.117.4.976)
  21. Jones, P.W., Harding, G., Berry, P., Wiklund, I., Chen, W.H., Kline Leidy, N. (2009) Development and first validation of the COPD Assessment Test. *European Respiratory Journal*, 34(3): 648-654. DOI: [10.1183/09031936.00102509](https://doi.org/10.1183/09031936.00102509)
  22. Griffiths, T.L., Burr, M.L., Campbell, I.A., Lewis-Jenkins, V., Mullins, J., Shiels, K., et al. (2000) Results at 1 year of outpatient multidisciplinary pulmonary rehabilitation: a randomised controlled trial. *Lancet*, 355(9201): 362-368. DOI: [10.1016/S0140-6736\(99\)07042-7](https://doi.org/10.1016/S0140-6736(99)07042-7)
  23. Spruit, M.A. (2016) COPD and exercise: does it make a difference? *Breathe*, 12(2): e38-e49. DOI: [10.1183/20734735.003916](https://doi.org/10.1183/20734735.003916)
  24. Nici, L., ZuWallack, R. (2012) An official American Thoracic Society workshop report: the Integrated Care of The COPD Patient. *Proceedings of the American Thoracic Society*, 9(1): 9-18. DOI: [10.1513/pats.201201-014ST](https://doi.org/10.1513/pats.201201-014ST)
  25. Man, W.D., Polkey, M.I., Donaldson, N., Gray, B.J., Moxham, J. (2004) Community pulmonary rehabilitation after hospitalisation for acute exacerbations of chronic obstructive pulmonary disease: randomised controlled study. *BMJ*, 329(7476): 1209. DOI: [10.1136/bmj.38258.662720.3A](https://doi.org/10.1136/bmj.38258.662720.3A)
  26. Puhan, M.A., Gimeno-Santos, E., Cates, C.J., Troosters, T. (2016) Pulmonary rehabilitation following exacerbations of chronic obstructive pulmonary disease. *Cochrane Database of Systematic Reviews*, 2016(12): CD005305. DOI: [10.1002/14651858.CD005305.pub4](https://doi.org/10.1002/14651858.CD005305.pub4)
  27. Lindenauer, P.K., Stefan, M.S., Pekow, P.S., Mazor, K.M., Priya, A., Spitzer, K.A., et al. (2020) Association between initiation of pulmonary rehabilitation after hospitalization for COPD and 1-year survival among Medicare beneficiaries. *JAMA*, 323(18): 1813-1823. DOI: [10.1001/jama.2020.4437](https://doi.org/10.1001/jama.2020.4437)
  28. Stefan, M.S., Pekow, P.S., Priya, A., Lagu, T., Zhao, Y., Lindenauer, P.K. (2021) Association between initiation of

- pulmonary rehabilitation and rehospitalizations in patients hospitalized with chronic obstructive pulmonary disease. American Journal of Respiratory and Critical Care Medicine, 204(9): 1015-1023. DOI: [10.1164/rccm.202012-4389OC](https://doi.org/10.1164/rccm.202012-4389OC)
29. Camillo, C.A., Langer, D., Osadnik, C.R., Pancini, L., Demeyer, H., Burtin, C., et al. (2016) Survival after pulmonary rehabilitation in patients with COPD: impact of functional exercise capacity and its changes. International Journal of Chronic Obstructive Pulmonary Disease, 11: 1355-1364. DOI: [10.2147/COPD.S107785](https://doi.org/10.2147/COPD.S107785)
  30. Holland, A.E., Mahal, A., Hill, C.J., Lee, A.L., Burge, A.T., Cox, N.S., et al. (2017) Home-based rehabilitation for COPD using minimal resources: a randomised, controlled equivalence trial. Thorax, 72(1): 57-65. DOI: [10.1136/thoraxjnl-2016-208514](https://doi.org/10.1136/thoraxjnl-2016-208514)
  31. Cox, N.S., Dal Corso, S., Hansen, H., McDonald, C.F., Hill, C.J., Zanaboni, P., et al. (2021) Telerehabilitation for chronic respiratory disease. Cochrane Database of Systematic Reviews, 2021(1): CD013040. DOI: [10.1002/14651858.CD013040.pub2](https://doi.org/10.1002/14651858.CD013040.pub2)
  32. Vasilopoulou, M., Papaioannou, A.I., Kaltsakas, G., Louvaris, Z., Chynkiamis, N., Spetsioti, S., et al. (2017) Home-based maintenance tele-rehabilitation reduces the risk for acute exacerbations of COPD, hospitalisations and emergency department visits. European Respiratory Journal, 49(5): 1602129. DOI: [10.1183/13993003.02129-2016](https://doi.org/10.1183/13993003.02129-2016)
  33. Bourbeau, J., Julien, M., Maltais, F., Rouleau, M., Beaupre, A., Begin, R., et al. (2003) Reduction of hospital utilization in patients with chronic obstructive pulmonary disease: a disease-specific self-management intervention. Archives of Internal Medicine, 163(5): 585-591. DOI: [10.1001/archinte.163.5.585](https://doi.org/10.1001/archinte.163.5.585)
  34. Zwerink, M., Brusse-Keizer, M., van der Valk, P.D., Zielhuis, G.A., Monninkhof, E.M., van der Palen, J., et al. (2014) Self management for patients with chronic obstructive pulmonary disease. Cochrane Database of Systematic Reviews, 2014(3): CD002990. DOI: [10.1002/14651858.CD002990.pub3](https://doi.org/10.1002/14651858.CD002990.pub3)
  35. Ries, A.L., Kaplan, R.M., Myers, R., Prewitt, L.M. (2003) Maintenance after pulmonary rehabilitation in chronic lung disease: a randomized trial. American Journal of Respiratory and Critical Care Medicine, 167(6): 880-888. DOI: [10.1164/rccm.200203-245OC](https://doi.org/10.1164/rccm.200203-245OC)
  36. Beauchamp, M.K., Janaudis-Ferreira, T., Goldstein, R.S., Brooks, D. (2013) Optimal duration of pulmonary rehabilitation for individuals with chronic obstructive pulmonary disease: a systematic review. Chronic Respiratory Disease, 8(2): 129-140. DOI: [10.1177/1479972311404256](https://doi.org/10.1177/1479972311404256)
  37. Ambrosino, N., Strambi, S. (2004) New strategies to improve exercise tolerance in chronic obstructive pulmonary disease. European Respiratory Journal, 24(2): 313-322. DOI: [10.1183/09031936.04.00063204](https://doi.org/10.1183/09031936.04.00063204)