

## Pulmonary Rehabilitation and Improved Survival for Patients With COPD

Carolyn L. Rochester, MD; Anne E. Holland, PT, PhD

**Chronic obstructive pulmonary disease** (COPD) is highly prevalent worldwide, is estimated to affect more than 16 million people in the US,<sup>1</sup> and is the fourth leading cause of death in the US.<sup>2</sup> COPD causes disabling physical and psychosocial symptoms for patients and adversely affects caregivers.



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Hospitalizations for COPD exacerbations are a key contributor to morbidity, mortality, and health care costs for individuals with COPD.<sup>3</sup> Evidence-based interventions that reduce mortality are needed and would be welcomed by patients with COPD and clinicians alike.

In this issue of *JAMA*, Lindenauer and colleagues<sup>4</sup> present a retrospective cohort study that examined the association between initiation of pulmonary rehabilitation within 90 days of hospital discharge and all-cause mortality at 1 year, based on claims data from 197 376 fee-for-service Medicare beneficiaries hospitalized for COPD. Among the study population, only 2721 patients (1.5%) initiated pulmonary rehabilitation within 90 days of their most recent hospital discharge. Patients completed a median of 9 sessions (interquartile range, 4-14) during the 90-day period, although details of the pulmonary rehabilitation received were not available.

Initiation of pulmonary rehabilitation within 90 days was associated with a lower risk of death over 1 year, with 198 deaths (7.3%) among patients who initiated pulmonary rehabilitation within 90 days and 38 104 deaths (19.6%) among patients who initiated pulmonary rehabilitation after 90 days or did not initiate this therapy (adjusted absolute risk difference [ARD], -6.7%; hazard ratio [HR], 0.63 [95% CI, 0.57-0.69]). The finding of lower mortality was evident if pulmonary rehabilitation was initiated early, within 30 days of discharge (ARD, -4.6%; HR, 0.74 [95% CI, 0.67-0.82]), or 61 to 90 days after discharge (ARD, -11.1%; HR, 0.40 [95% CI, 0.30-0.54]). Participation in every 3 additional pulmonary rehabilitation sessions in the first 90 days after discharge was associated with a lower hazard ratio for death (HR, 0.91 [95% CI, 0.85-0.98]).

Pulmonary rehabilitation is one of the most effective treatments for COPD and other chronic respiratory diseases including interstitial lung disease, cystic fibrosis, bronchiectasis, pulmonary hypertension, asthma, and lung cancer.<sup>5,6</sup> Pulmonary rehabilitation usually involves supervised exercise training of the upper and lower extremities, education, collaborative self-management training, and psychosocial intervention and is traditionally delivered to patients when they are medically stable.<sup>5,6</sup> However, pulmonary rehabilitation also is effective when provided early after COPD exacerbation<sup>7</sup> and is associated with improved exercise tolerance and quality of life and reduced risk of subsequent hospitalization.<sup>7</sup>

Despite its well-documented meaningful benefits for patients and health care systems, and recommendations for its use in international guidelines,<sup>3</sup> pulmonary rehabilitation is underutilized. For example, in the US, only an estimated 3% to 4% of Medicare beneficiaries with COPD receive pulmonary rehabilitation,<sup>8</sup> and less than 2% of individuals hospitalized with COPD exacerbation receive this therapy.<sup>4</sup> These numbers are likely even lower for patients with respiratory disorders other than COPD.

The reasons underpinning this failure to implement evidence-based care are well understood.<sup>9</sup> First, patients who could benefit from pulmonary rehabilitation are usually not referred to this service by health care professionals.<sup>9</sup> Human behavior often dictates that people do things when required and incentivized to do so. In the US, there are no health care system-driven incentives for physicians to refer patients to pulmonary rehabilitation, no relevant required national care quality metrics, and financial reimbursement of clinicians does not depend on whether their patients undertake pulmonary rehabilitation.

Second, uptake of pulmonary rehabilitation remains low; one-third of patients who are referred do not initiate a program.<sup>10</sup> Patients and their caregivers are frequently unaware of the benefits of pulmonary rehabilitation.<sup>11</sup> Patients with respiratory diseases encounter many barriers to participation, including disabling symptoms, comorbidities, transportation issues, and lack of geographic access to programs.<sup>12</sup>

Third, a critical reason for low participation in and delivery of pulmonary rehabilitation is that programs that provide this service are typically underfunded and underresourced.<sup>9</sup> In the US, Medicare reimbursements for pulmonary rehabilitation are minimal, and many programs struggle for survival or are not financially sustainable.<sup>13</sup> Many pulmonary rehabilitation programs accommodate fewer than 100 patients per year,<sup>14</sup> owing to limitations involving space, equipment, and staffing.

In contrast to the poor recognition and utilization of pulmonary rehabilitation, other therapies for COPD, such as bronchodilators, are valued and accepted. Pharmaceutical company advertisements, such as those on television, in airports, in health care professionals' offices, and elsewhere attract the attention of health care professionals and patients with COPD on a daily basis. This does not facilitate consideration of the relative value of nonpharmacologic COPD treatments such as pulmonary rehabilitation, which delivers benefits that match or exceed those of many bronchodilator therapies, with lower costs per quality-adjusted life-year.<sup>15</sup> These issues lead to an enormous gap between the proven benefits of pulmonary rehabilitation and its actual delivery to patients. Despite the best

efforts of advocates for this therapy, it has been difficult to find the right “lever” to alter this situation.

The significant relationship between initiation of pulmonary rehabilitation and survival demonstrated by Lindenauer et al<sup>4</sup> should capture the attention of clinicians, health care organizations, patients, and payers. While a signal for a survival benefit from pulmonary rehabilitation participation after COPD exacerbation has been reported in meta-analyses,<sup>7</sup> findings from previous studies are heterogeneous and few have evaluated survival. A major strength of the study by Lindenauer et al<sup>4</sup> is the large number of individuals with COPD who were included and who received care in clinical settings in hospitals across the US. However, limitations must be acknowledged. This investigation was not a randomized clinical trial; it is possible that patients who attended pulmonary rehabilitation within 90 days of hospitalization differed from those who did not in ways that affect future mortality. Patients who attended pulmonary rehabilitation were younger, lived closer to a program, were more likely to be men and non-Hispanic white, and had less comorbidity and lower risk of frailty. The authors addressed these differences using a smaller propensity-matched cohort (n = 2710) that demonstrated a similar survival benefit associated with pulmonary rehabilitation. However, as the authors acknowledge, the potential for unmeasured confounding remains.

The analysis also excluded patients with long stays in the acute hospital or skilled nursing facilities, for whom pulmonary rehabilitation may have important implications for readmissions and long-term independence, and excluded younger patients not covered by the US Medicare database. Hence, the relationship between pulmonary rehabilitation and mortality in these groups remains unknown. Also, the mechanisms by which pulmonary rehabilitation improves survival are not known, and as the authors acknowledge, the lack of availability of information on cause of death in this study precludes determining whether pulmonary rehabilitation was associated with reduced mortality from COPD compared with other causes. These are areas for further study.

In addition to the survival benefits, this study highlights another important issue regarding equity of access. In the propensity-matched analysis, covariate balance could not be achieved for important variables that reflected access to pulmonary rehabilitation for patients across the US. Patients who lived farther from a pulmonary rehabilitation program or who were admitted to a hospital in a rural area or with a smaller number of beds remained less likely to participate in pulmonary rehabilitation. Patients were excluded from this analysis if they were discharged from hospitals where pulmo-

nary rehabilitation was not provided, as there was no possibility they could have received this therapy. Lack of available programs creates unacceptable health care disparities, especially when a potential survival advantage is involved. Hopefully, the findings of the report by Lindenauer et al<sup>4</sup> will encourage that priority be given to pulmonary rehabilitation as a key component of COPD care.

Recommendations to enhance implementation, use, and delivery of pulmonary rehabilitation were articulated in the 2015 ATS/ERS Joint Policy Statement.<sup>9</sup> Some inroads have been made regarding these recommendations in recent years. For example, novel models such as telerehabilitation and home-based pulmonary rehabilitation are the subject of intensive research. A public awareness campaign has been developed to increase knowledge about pulmonary rehabilitation among patients and the general public.<sup>16</sup> The association between participation in pulmonary rehabilitation and better survival demonstrated by Lindenauer et al<sup>4</sup> provides a further strong mandate to increase the use of pulmonary rehabilitation in the management of COPD and other chronic respiratory diseases. Patients must be empowered to request and participate in this therapy routinely, including after COPD exacerbation, when increased symptoms and disability may magnify barriers to participation.

In addition, health system funding of pulmonary rehabilitation must be increased and sustained, with higher reimbursement and expansion of existing programs and with creation of programs in geographical areas where they are currently lacking.<sup>17,18</sup> The data presented by Lindenauer et al<sup>4</sup> should encourage the Centers for Medicare & Medicaid Services and other insurance payers (in the US and elsewhere) to require referrals of suitable patients to pulmonary rehabilitation as part of national health care quality metrics, and encourage accreditation organizations such as the Accreditation Council for Graduate Medical Education and others to increase training for health care professionals in the discipline of pulmonary rehabilitation.

It is time that one of the most effective treatments for patients with COPD and other chronic respiratory diseases be used routinely and proactively. In addition to improving exercise tolerance and quality of life and reducing symptoms, disease exacerbations, hospitalizations, and readmissions,<sup>5,6</sup> participation in pulmonary rehabilitation after hospitalization for COPD exacerbation, as the article by Lindenauer et al<sup>4</sup> in this issue of *JAMA* suggests, is associated with lower all-cause mortality. These findings should serve to encourage health care systems to increase funding for, and use of, pulmonary rehabilitation services for patients with COPD.

#### ARTICLE INFORMATION

**Author Affiliations:** Section of Pulmonary, Critical Care and Sleep Medicine, Department of Internal Medicine, Yale University School of Medicine, New Haven, Connecticut (Rochester); VA Connecticut Healthcare System, West Haven (Rochester); Department of Allergy, Immunology and Respiratory Medicine, Monash University, Melbourne, Victoria, Australia (Holland); Department of Physiotherapy, Alfred Health,

Melbourne, Victoria, Australia (Holland); Institute for Breathing and Sleep, Melbourne, Victoria, Australia (Holland).

**Corresponding Author:** Carolyn L. Rochester, MD, Section of Pulmonary, Critical Care and Sleep Medicine, Yale University School of Medicine, 333 Cedar St, Bldg LCI-105, New Haven, CT 06520 (Carolyn.rochester@yale.edu).

**Conflict of Interest Disclosures:** Dr Rochester reported serving as chair of the American Thoracic

Society (ATS) Assembly on Pulmonary Rehabilitation from 2015-2017, serving as cochair of the ATS/European Respiratory Society (ERS) Task Force on Policy in Pulmonary Rehabilitation, holding other leadership positions in the ATS Pulmonary Rehabilitation Assembly, and currently serving on the Planning and Evaluation Committee of the ATS; participating in the development of the *livebetter.org* website to increase public awareness of pulmonary rehabilitation developed by the

American Thoracic Society and the Gawlicki Family Foundation; participating in clinical research in chronic obstructive pulmonary disease (COPD) funded by AstraZeneca Inc; and previously serving on COPD-related scientific advisory boards for GlaxoSmithKline pharmaceuticals Inc and Boehringer Ingelheim. Dr Holland reported currently serving as an ATS board director and as chair of the Pulmonary Rehabilitation Assembly and that she was a coauthor on the ATS/ERS Policy Statement on Pulmonary Rehabilitation and senior author for the Australian and New Zealand Pulmonary Rehabilitation Guidelines.

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