

Therapeutic Consequences for Physical Therapy of Comorbidity Highly Prevalent in COPD: A Multi-case Study

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Abstract

Introduction: Comorbidities are prevalent in patients with chronic obstructive pulmonary disease (COPD), but current physical therapy guidelines do not incorporate clear actions related to multimorbidity. Comorbidity (e.g. diabetes mellitus) may require adaptations in intervention strategies, as comorbidity negatively affect treatment results of the index disease (e.g. COPD) or treatment for one disease (e.g. cardiopulmonary endurance training for COPD) may negatively interact with the treatment or natural course of a coexisting disease (e.g. severe osteoarthritis of the knee). Therefore, insight of considerations required when applying physical therapy in comorbid-COPD patients and suggestions to enhance and accelerate clinical reasoning may be helpful for health care providers to obtain optimal treatment and results.

Case description: Two case studies illustrated possible consequences of COPD (index disease) and comorbidity for physical therapy in a primary care setting. Avoidable and inescapable problems were both unfolded in different steps in the clinical decision-making process.

One very severe COPD patient (FEV₁ = 46% predicted, with chronic respiratory failure) with decompensated heart failure, using a beta-adrenergic blocker, demonstrated the danger of missing relevant information about a comorbid condition and related medication during the intake and its consequences for physical therapy. Another mild COPD patient (FEV₁ = 86% predicted) with multiple inter-related comorbidities showed the importance of monitoring outcomes of multiple diseases and adjustments to the plan-of care and interventions.

Discussion: Dealing with comorbidity in COPD management needs a patient-centred rather than a disease-oriented approach in order to obtain optimal treatment and results. Physical therapists should improve their skills and knowledge of high prevalent comorbidities, be fully informed, monitor more than COPD-outcomes alone and adequately adjust interventions. General practitioners and physicians can improve the level of information given in their referral of a patient to a physical therapist, by providing information on all coexisting diseases and related medication.

Keywords: Physical therapists; Physical therapy modalities; Comorbidity; Chronic obstructive pulmonary disease; Decision making; Epidemiology

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease; PT: Physical Therapist; GOLD: Global Initiative for Chronic Obstructive Lung Disease; GP: General Practitioner; HOAC: Hypothesis-Oriented Algorithm for Clinicians; VAS: Visual Analogue Scale for Pain; MRC: Medical Research Council Scale for Dyspnea; SpO₂: Transcutaneous Oxygen Saturation; CPET: Cardiopulmonary Exercise Test; ECG: Electrocardiography; DM II: Diabetes Mellitus Type 2; BMI: Body Mass Index; CIRS: Cumulative Illness Rating Scale; ICED: Index of Coexisting Disease; DO-IT Task Force: Designing Optimal Interventions for physical Therapy Task Force; CCQ: Clinical COPD Questionnaire; FITT Factors: Frequency, Intensity, Time and Type of Training

Introduction

In physical therapy, the impact of coexisting diseases other than the primary disease the patients are treated for (index disease), on the treatment and the outcome of an individual patient has become more recognised nowadays. Generally, comorbidity has two definitions. Firstly, it can indicate a medical condition existing simultaneously with

but independently of another condition in a patient. Secondly, it can indicate a medical condition in a patient that causes, is caused by, or is otherwise related to another condition in the same patient (e.g. due to shared risk factors like smoking) [1].

In patients with chronic obstructive pulmonary disease (COPD) a combination of both definitions seems to apply [2]. Although little is published in the area, comorbidity is highly prevalent in patients with COPD, with studies reporting 73-84% of patients with one or more comorbidities [3,4]. Cardiovascular disease is probably the

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most frequent comorbidity in COPD patients, because 16% have coronary artery disease and 12% have congestive heart failure. Other comorbidities that occur frequently in combination with COPD include asthma (26%), metabolic syndrome (13% have diabetes) and lung cancer. Additionally, both osteoporosis and depression are major comorbidities, although often under-diagnosed [2,5].

Twenty-five percent of COPD patients have been treated by physical therapists (PTs) in The Netherlands in 2003 [6]. Because comorbidities have a significant influence on prognosis [2], they should be taken into account routinely. The impact of comorbidities should be clarified, given the implications that comorbidities have for clinical reasoning—the whole thinking and decision-making process by which PTs collect cues, process the information, come to an understanding of a patient's situation, plan and implement interventions, evaluate outcomes and reflect and act on the process [7,8]. Although, it is known that comorbidities are prevalent in COPD, current guidelines hardly reflect or address the multimorbidity issue. Moreover, it is often not feasible or sensible to combine different disease-specific self-contained guidelines in physical therapy, since treatment might interact negatively with the treatment or natural course of a coexisting disease (e.g. high-intensive cardiopulmonary endurance or strength training for COPD might not be possible if there is severe osteoarthritis of the knee [9] or might increase the risk for adverse events) [10].

The aim of this article is to illustrate consequences of COPD and comorbidity for physical therapy using two case examples. Insight in the requirements for physical therapy in comorbid-COPD patients and suggestions to enhance and accelerate clinical reasoning may be helpful for all health care providers to obtain optimal treatment and results.

An Illustration in Physical Therapy Practice

The two individual cases presented, are participants in a cohort study of COPD patients treated in a primary care setting. The first case demonstrates the danger of missing a relevant comorbid condition and

its consequences for physical therapy. The second case describes the complexity of interference between different comorbidities and COPD that a PT has to deal with in daily practice.

Case 1

“MB” is a 70-year-old retired woman diagnosed with COPD GOLD IV (diagnosed in 2008). The presenting sign that caused her to seek medical attention from her general practitioner (GP) included a-specific low back pain, which hampered her to walk for five consecutive minutes. She was referred to physical therapy for these complaints. The PT started with collecting initial data, generating patient-identified problems and examination (Table 1). Because the patient's primary goal was to be able to sit and walk for thirty minutes without experiencing back pain, the PT firstly aimed at reducing the low back pain and improving the activities of sitting and walking by physical therapy. After an exercise programme of eight weeks—including education, active mobilisation exercises for the lumbar spine and endurance training—goals were evaluated and reassessment took place. The a-specific low back pain was significantly decreased (Table 1). However, during endurance training the patient was not able to walk for more than six minutes continuously or twelve minutes with intervals (alternately walking and resting with intervals of 2-1-2 minutes). At the end of the training she did not complain about low back pain anymore, but about dyspnea during exercise as the limiting factor in therapy (Table 1).

After reassessing outcomes and achievement of the short-term goals (pain relief and improving functions of sitting and walking), a new working hypothesis of reduction of dyspnea due to COPD and improvement of exercise capacity and physical activity became the primary goal of interest. Again, the PT collected data and registered all coexisting diseases and medication with the help of the patient (Table 1). “MB” told the PT that she suffered from hypotension and depression and used a white/red-coloured anti-depressive drug. Apart from a

Assessment in time	Interview/history-taking	Related PT goals	Emerging problems during PT‡
0 weeks	A-specific low back pain, VAS = 7/10 Walking < 5 min	Reduce pain, VAS < 7 Sit and walk > 30 min	Non-reported dyspnea overlooked; not all comorbidities and medication known to PT
8 weeks	A-specific low back pain, VAS = 1/10 Walking ≤ 6 min Dyspnea, MRC = 4/5		
8 weeks*	COPD GOLD IV - FEV ₁ /FVC = 0.41 - FEV ₁ = 46% of predicted, chronic respiratory failure - Resting SpO ₂ = 95% - Dyspnea, MRC = 4/5 - Walking ≤ 6 min - Nicotine addiction, 67.5 pack years - Physical activity, daily walking 15 min Depression Hypotension, 79/53 mmHg, resting heart rate = 57 beats/min Medication: - Oral corticosteroids - Bronchodilators - Long term oxygen therapy (2.0 l/min) - Anti-depressive drug - Vitamin pill - Stomach protective drug	Reduce dyspnea, MRC < 4 Improve exercise capacity & physical activity in daily life, walk > 30 min	Patient information as source for comorbidity and medication is not sufficient → information from referring physician and pharmacy needed!
9 weeks†	Exercise SpO ₂ = 78% Decompensated heart failure: stomach protective drug = beta-adrenergic blocker!		Patient information on medication not checked by PT → pharmacy records or drug packing material

*Reassessment at 8 weeks due to unattained goals (walk ≤ 6 min); †Serious adverse event during exercise happened at 9 weeks; ‡ Emerging problems during PT due to failures in the communication and the clinical decision-making process.

PT: Physical Therapist; VAS: Visual Analogue Scale; min: minute; MRC: Medical Research Council Dyspnea scale; COPD: Chronic Obstructive Pulmonary Disease; GOLD IV: very severe COPD; FEV₁/FVC: Forced Expiratory Ratio; FEV₁: % Forced Expiratory Volume in one second of predicted; SpO₂: Transcutaneous Oxygen saturation

Table 1: Collected data and assessment data of case 1.

pink-coloured vitamin pill, “MB” believed she used a white-coloured stomach protector. The physical therapy intervention consisted of exercise training twice a week (interval training for eight weeks until she managed to walk/cycle for more than ten consecutive minutes on a treadmill or ergometer) in combination with strength training (lower and upper extremities) and counseling.

Nine weeks after the start of the COPD training programme, “MB” started endurance treadmill/cycle training, while the PT monitored heart rate and SpO₂. Taking into account an intensity of 70% of the patient’s predicted heart rate, “MB” was encouraged to raise her pace (as her heart rate was around 90 beats per minute, i.e. 60% of her predicted heart rate). After 20 minutes signs of cyanosis appeared in “MB’s” hands and spread directly to her lips and angina was present. When the PT measured SpO₂, a rapid drop until 78% forced the PT to stop the patient immediately for safety reasons.

Analysis of case 1

The PT adequately noticed that the index disease shifted from a-specific low back pain to COPD (the first hypothesis was not viable anymore and some steps in the hypothesis-oriented algorithm for clinicians (HOAC) were redone, Figure 1) [11]. However, if the PT had followed the complete HOAC, the PT would not only have addressed the patient’s goal (a-specific low back pain and related limitation in activities), but would also have searched for non-reported complaints by the patient and related viable goals [11]. The PT could then have taken the limitation in exercise capacity due to COPD into account and monitor more symptoms from the beginning (also dyspnea and SpO₂). Moreover, the PT missed that the dyspnea, which presented acutely during the treadmill exercise could also have been caused by comorbidity. “MB” had stable COPD in combination with hypotension, depression and decompensated heart failure (the white-coloured drug was actually a beta-adrenergic blocker). Therefore, limited increase in heart rate and acute presentation of increased dyspnea on exertion was present (best measured with the modified Borg scale (0-10) in this case). The PT could have known these responses if the medication regimen had been checked from a more reliable source. This case illustrated that GP’s and physicians should provide a PT with information on all coexisting diseases and related medication, when they refer a patient to a PT for only one complaint/disease. The PT could have collected the data more thoroughly

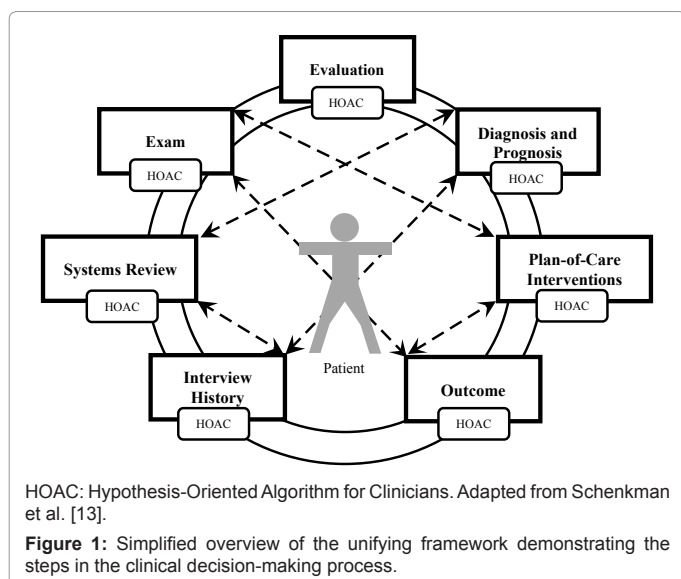
by asking the patient’s permission for a complete drug overview from the GP or pharmacist. Another option was to ask the patient to bring all packing material of used drugs. In patients with circulatory problems, saturation may decline in a late stage of the exercise. In this case the PT was not supposed to take heart rate as an indicator for exercise intensity. The physical therapy intensity should have been individually tailored based on the results of a maximal cardiopulmonary exercise test (CPET) with gas analysis under monitoring of electrocardiography (ECG), SpO₂ and blood pressure. Unfortunately, this test was never executed in the hospital, whereas enough indicators for the necessity of a CPET were present, like angina and desaturation < 90% [12]. A (minor) alternative method to tailor exercise intensity on the treadmill could have been using 70% of the walking speed during the six-minute walk test and controlling dyspnea and fatigue with the Borg scale.

Case 2

“MK” is a 65-year-old retired woman diagnosed with COPD GOLD I in combination with asthma (diagnosed in 2005). Although she was treated by a PT for her COPD, after a thorough interview/history-taking and systems review (HOAC, Figure 1) [13], the PT was aware of all other comorbidities (and medication) she had when she started with physical therapy (Table 2). “MK” participated in a graded exercise programme to reduce dyspnea, improve mucus clearance, reach increased exercise capacity and improved physical activity in daily life. The programme consisted of endurance training on a treadmill (starting with an intensity of 60% of the walking speed during the six-minute walk test) and cycle-ergometry (starting with an intensity of 60% of maximum wattage based on the results of a CPET), peripheral muscle training of upper and lower extremities (starting with an intensity of 60% of maximal voluntary contraction), relaxation therapy, breathing exercises and lifestyle advises (stimulating exercise and following the diet by her dietician). After 12 weeks, re-evaluation showed that she had not lost weight and her dyspnea remained (Table 2). “MK” experienced three severe COPD exacerbations in one year. State-of-the-art treatment was a 10-day dose of Prednisolone and this helped to reduce the infection. However, she gained weight as a result of the Prednisolone. The PT noticed “MK’s” absence from the therapy several times a year. It appeared that “MK” fell a lot as a result of hypoglycaemia, caused by intentionally eating less food in order to lose weight. The PT referred her to her dietician. The PT measured blood pressure and blood glucose level at the start of every training session, but “MK” often experienced hypoglycaemia or hyperglycaemia leading to many interruptions during the training programme. According to the internal medicine physician, her Diabetes remained unstable due to the combination of COPD and Diabetes Mellitus type 2 (DM II). Another problem during physical activity was her reduced work capacity and experienced pain resulting from osteoarthritis of her right knee. Total knee replacement, which was indicated by the severity of the osteoarthritis, was contraindicated due to “MK’s” reduced peripheral blood flow (DM II) and pulmonary capacity (COPD) precluding anaesthesia. Therefore, the PT advised her to start swimming as a regular sport activity. However, after a few weeks “MK” was too afraid to continue, because of the risk of a hypoglycaemia during swimming. In the same year, an additional comorbidity appeared. “MK” showed depression and suicidal thoughts, increased by the disappointment that she could not undergo surgery for her right knee (Table 2). She visited a psychologist.

Analysis of case 2

According to the guidelines, the physical therapy programme



Assessment in time	Interview/history-taking	Related PT goals	Emerging problems during PT†
0 weeks	COPD GOLD I (2005) - FEV ₁ /FVC = 0.69 - FEV ₁ = 86% of predicted - Dyspnea, MRC = 4/5 - Walking ≤ 10 min - Never smoked - Physical activity, 3x/week → not anymore Diabetes type 2 (1998) - No-proliferative retinopathy, lase eye-surgery in 2004 and 2011 - Sensory neuropathy in both feet Obesity, BMI = 42.3 kg/m ² (2008) Hypercholesterolemia (2008) Severe osteoarthritis right knee, Kellgren-Lawrence score=grade 4 (2008) Multiple falls per year	Reduce dyspnea, MRC < 4. Improve mucus clearance. Improve exercise capacity and physical activity in daily life, walk > 30 min.	COPD exacerbations → prednisolone → weight gain → less eating → hypoglycaemia → multiple falls. Combination COPD & DM → instable DM → interruptions in training programme and physical activity in daily life. Physical activity ↑ → osteoarthritis ↑ → work capacity ↓ and pain ↑ in knee. Total knee replacement ↔ contraindicated by COPD & DM → depression.
12 weeks*	Dyspnea due to COPD, MRC = 4/5 3 COPD exacerbations/year Walking ≤ 15 min No weight loss, BMI = 42.3 > kg/m ² Depression		

*Reassessment at 12 weeks; †Emerging problems during PT due to complex system interrelationships.

COPD: Chronic Obstructive Pulmonary Disease; GOLD I: Mild COPD; FEV₁/FVC: Forced Expiratory Ratio; FEV₁: % Forced Expiratory Volume in one second of predicted; MRC: Medical Research Council Dyspnea scale; BMI: Body Mass Index; DM: Diabetes Mellitus

Table 2: Collected data and assessment data of case 2.

would suite a patient with COPD. However, the number, type and severity of comorbidities that this patient suffered from made the training programme very complex. Even in this case—where the patient was directly referred to PT as part of pulmonary rehabilitation and thorough history, assessment and evaluation revealed all present comorbidities—complex system interrelationships make it difficult for PTs to achieve the treatment goals. All comorbidities might have been responsible for the programme’s reduced effectiveness. This case demonstrated that not only are patients with severe airflow limitation susceptible to comorbidities, but also patients with mild airflow limitation are susceptible to comorbidities [14]. The training programme had to be adjusted to the physical and mental state of the patient every week. Cognitive therapy in an earlier stage was probably useful, seen her kinesiophobia in relations to her multimorbidity and inadequate interpretations of body signals. However, she refused to admit to her need for psychological help until she was informed about the contraindications for a total knee replacement. In line with the HOAC [11], adjustments could be carried out at different steps in the clinical decision-making process: checking implementation of tactics (e.g. eating and medication intake before training), appropriateness of tactics used (e.g. reduction of intensity because increasing to 80% of maximal voluntary contraction was not possible), type of exercises (more cycling than walking), duration of a session (more resting and counseling were necessary concerning physical activity in daily life, eating and depressive feelings), plan strategy (e.g. interval instead of endurance training) or adjusting viable goals (e.g. cycling three times 10 minutes instead of 30 consecutive minutes in daily life) [11]. The patient could only continue with the physical therapy programme, because the PT assessed and continued to monitor blood pressure, glucose level, reduced muscle capacity and pain in the right knee, and three-monthly questionnaires addressing depression and social inhibition, apart from the standard COPD outcomes like oxygen saturation, dyspnea, fatigue and functional capacity. Moreover, multidisciplinary evaluations with the GP, dietician, psychologist, internal medicine physician and pulmonologist were necessary.

Weighing comorbidity in clinical reasoning

Once a PT knows all coexisting diseases and medication use of a patient, not often will this information be transformed into a useful

overview. Researchers have developed indexes to standardise the weight or value of comorbid conditions. A review in 2003 concluded that the Charlson index, the Cumulative Illness Rating Scale (CIRS), the Index of Coexisting Disease (ICED) and the Kaplan Index are valid a reliable methods to measure comorbidity or multimorbidity [15]. Although researchers have validated such lists, no one index is as yet recognised as a standard. The DO-IT task force (a group of researchers from four different universities in the Netherlands emerging from the project Designing Optimal Interventions for physical Therapy, DO-IT) reached consensus on the use of the CIRS for physical therapy research and clinical practice, based on literature [15-18]. The CIRS registers co-occurrence of multiple chronic or acute diseases and medical conditions within one person in 13 categories and weights its severity (from 0 to 4). For the case examples in this article a CIRS score of 7 (case 1: cardiac=2; vascular=1; and respiratory=4) and a score of 10 (case 2: respiratory=2; ear/nose/throat/eye=1; musculoskeletal/skin=3; psychiatric=2; and endocrine=2) could be assigned.

Discussion

Physical therapy, advices and clinimetric methods may contradict in patients with COPD and comorbidity (e.g. state-of-the-art therapy for COPD includes promotion of physical activity, but might not be possible if the patient suffers from severe osteoarthritis of the knee) [10]. Both cases illustrated the importance of careful consideration of the impact of co-morbidities on the process of clinical reasoning in physical therapy in patients with COPD as the index disease. In the case examples of this article, three steps in the clinical decision-making-process can be recognised where a PT should be increasingly aware regarding comorbidities of patients with COPD [13].

First, thorough identification of all coexisting diseases during physical therapy interview/history-taking and systems review is crucial in clinical reasoning (Figure 1). Additionally, PTs should recognise and explain to the patient that there might be other non-reported complaints, which can lead to viable treatment goals. For PTs it is a delicate task to acquire all information of all comorbid conditions of a patient and stay informed, as it is an on-going process. A PT should not always solely trust patients’ knowledge of diseases and related medication, as case one clearly demonstrated. Physical

therapists are advised to collect additional thorough information from the referring physician and pharmacy records. The CIRS may be of help in categorising the multi-morbid conditions and grading the severity. On the other hand, physicians should be aware that only referring a COPD patient to physical therapy is insufficient and additional information on comorbidities, like medication use, severity, complications and any other cues that may hamper clinical reasoning is necessary. Comparably, guidelines on acute lower respiratory tract infections recommend restrictive use of antibiotics and therefore GPs need to know the patients' relevant comorbid conditions [19]. A tool to evaluate the patients' comorbidities, like the CIRS, should be part of a request form from a referring physician, similar to other standardised tools to evaluate the patients' health (e.g. lung functions, MRC or the Clinical COPD Questionnaire) [20]. Importantly, a PT does not only have to be familiar with the name of drug treatments used by the patient for comorbidities, but needs to know whether the drug components influence the relation between physical activity and exercise physiology (heart rate response, glycaemic response or peripheral blood flow). In most COPD patients (all with desaturation > 4% during exercise) a CPET is needed for safety issues, but is also useful for establishing the limiting factors of the patient (pulmonary, cardiovascular, diffusion, peripheral or mental factors) [21]. In the case of absence of a CPET, a PT is advised to request such a test from the referring physician [21]. Even better would be to make a CPET part of the usual-care policy in COPD patients who are referred for an exercise training intervention, because of the major benefits regarding safety considerations in PT practices and effectiveness of the training programme (i.e. determination exercise intensity).

Second, monitoring outcomes of the index disease and outcomes of comorbidities (exam, evaluation and outcome) are a crucial step in treating chronic conditions in a physical therapy practice (Figure 1). In every training session, depending on the comorbidities extensive monitoring of the patient is needed (such as measuring pain and impairments in activities due to osteoarthritis of the hip or knee, measuring blood pressure in hypertensive patients or glucose level in patients with DM). Moreover, one should be alert to hidden comorbidities, as important comorbidities in COPD patients can be easily overlooked because their symptoms are also associated with COPD (e.g. heart failure and lung cancer (dyspnea and weight loss) or depression (fatigue and reduced physical activity)) [2]. Physical therapists can play a key role in recognizing comorbid symptoms in patients, as they observe patients for long periods during exercise training. It is important that a PT refers a patient back to the GP when a comorbid condition is suspected. Good monitoring of comorbidity is a prerequisite for successful physical therapy in COPD. Not only has physical therapy proven to be effective in improving health related quality of life, improving exercise capacity and reducing the risk of mortality in COPD patients [22] and in COPD patients with comorbidities [23], physical therapy (in term of increasing physical activity) may also play a role in reducing the risk of comorbidity [2].

Third, monitoring may reveal the need for adjustments of the plan-of-care and interventions (Figure 1) due to comorbidities regarding the FITT factors (Frequency, Intensity, Time and Type of training). Current guidelines for PTs treating COPD, for example, do not stress very clearly how to handle a COPD patient with DM II or how to treat a patient with COPD, cardiac failure, osteoarthritis and depression [24]. These guidelines largely depend on scientific evidence for treatments and lifestyle advice. However, the underlying scientific studies are mostly executed in homogenous study populations, as comorbidity is treated as an exclusion or correction factor due to methodological

difficulties [25]. Therefore, not a disease but the individual patient needs to be the starting point in physical therapy, as no other patient has the exact same comorbidities and the same drug and other medical treatments.

Generally speaking, current literature suggests that the importance of comorbidities should not alter COPD treatment and vice versa; comorbidities should be treated as if the patient did not have COPD [2]. From a physical therapists' perspective, this recommendation is insufficient and it is often not possible to execute, as is the case with disease-specific guidelines. Dealing with comorbidity needs a patient-centred rather than a disease-oriented approach [10]. For physical therapy this means a qualitative improvement in skills and knowledge (PTs need to combine different medical areas in order to meet comorbidity knowledge requirements). In patients where the index disease is related to the comorbidity, with or without a mutual risk factor, disease-specific guidelines can be used to direct management [10], as long as all applicable guidelines are laid side by side. In patients with coexisting chronic morbidity without any known causal relation to the index disease, problems with disease-specific guidelines emerge, especially in aging-related diseases when comorbidity is linked to frailty [26]. In general, the PT curriculum in the Netherlands does not yet underscore the need for a more advanced understanding of complex system interrelationships regarding multiple-morbidities. The curriculum can place more emphasis on the possible effects of comorbidities on exercise physiology and related pharmacotherapy. In the future, guidelines for PTs, where physical therapy treatment and monitoring of outcomes of COPD is guided on the basis of the coexistence of different comorbidities therapy, may be desirable. Therefore, research is needed where comorbidity is not seen as an exclusion or correction factor but as a variable of interest.

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