氧療及肺部復原在COPD之臨床應用

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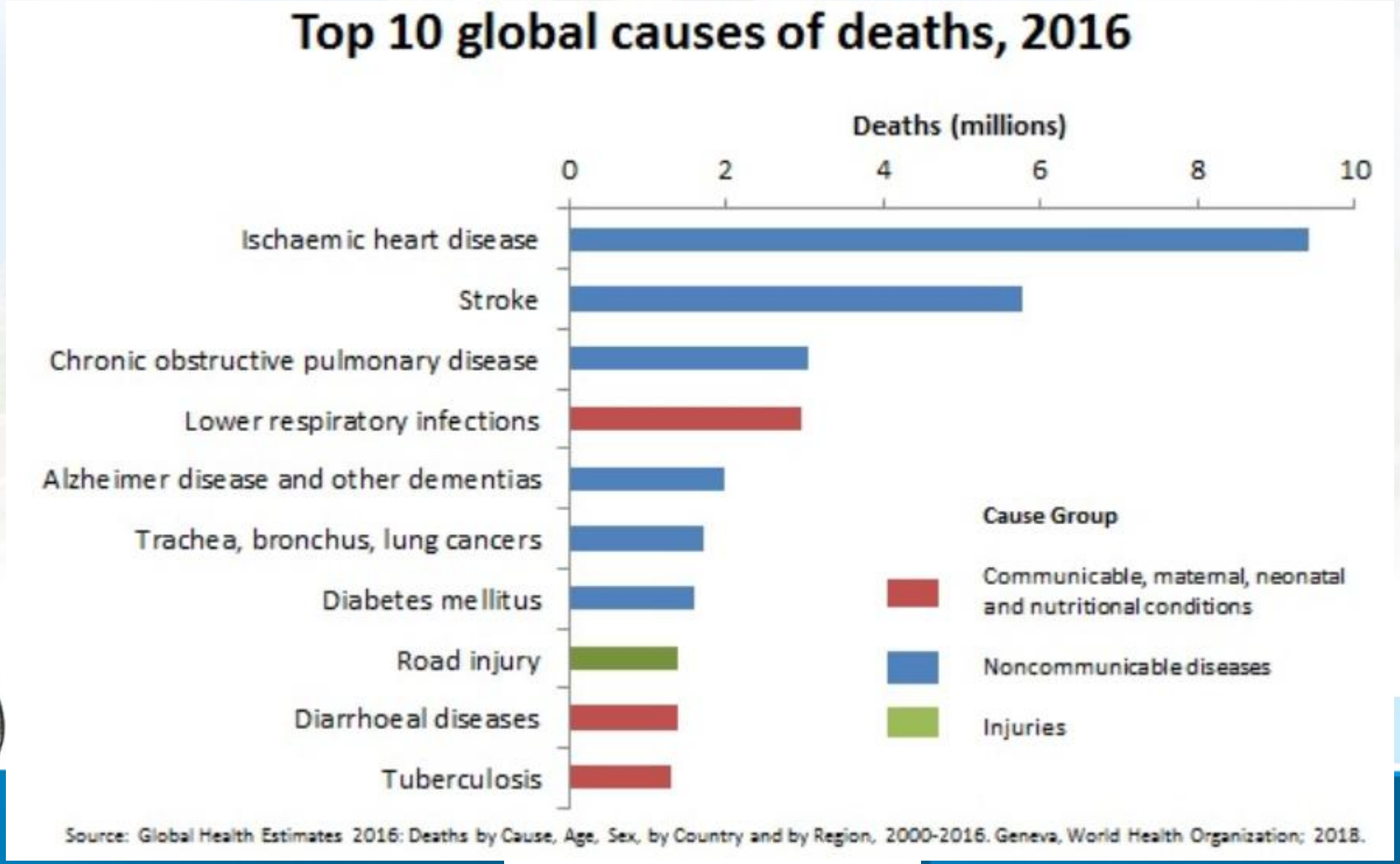
COPD in Taiwan’s Perspective

- COPD is the seventh leading cause of death in Taiwan in 2017 (ave death age. 84)
  - Account for 4.7% >65 age mortality population (higher than HTN 4.1%); >85 age even 6.2% (3,000 people)
  - Potential life-year loss caused by COPD is 9.5 years (benchmark as 70 age)

Country	Moderate/severe COPD cases	Prevalence
1. Australia	558 000	4.7%
2. China	38 160 000	6.5%
3. Hong Kong	139 000	3.5%
4. Indonesia	4 806 000	5.6%
5. Japan	5 014 000	6.1%
6. South Korea	1 467 000	5.9%
7. Malaysia	448 000	4.7%
8. Philippines	1 691 000	6.3%
9. Singapore	64 000	3.5%
10. Taiwan	636 000	5.4%
11. Thailand	1 502 000	5.0%
12. Vietnam	2 068 000	6.7%
Total	56 553 000	6.3%

Regional COPD Working Group. Respirology 2003
107 年國人十大死因

COPD: the third-leading cause of death worldwide



World Health Organization 2017

Clinical presentation

At risk | Symptomatic | Exacerbations | Respiratory failure

Interventions

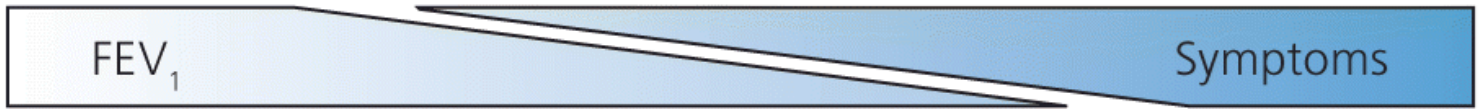
Smoking cessation

Disease management

Pulmonary rehabilitation

Other options

Disease progression

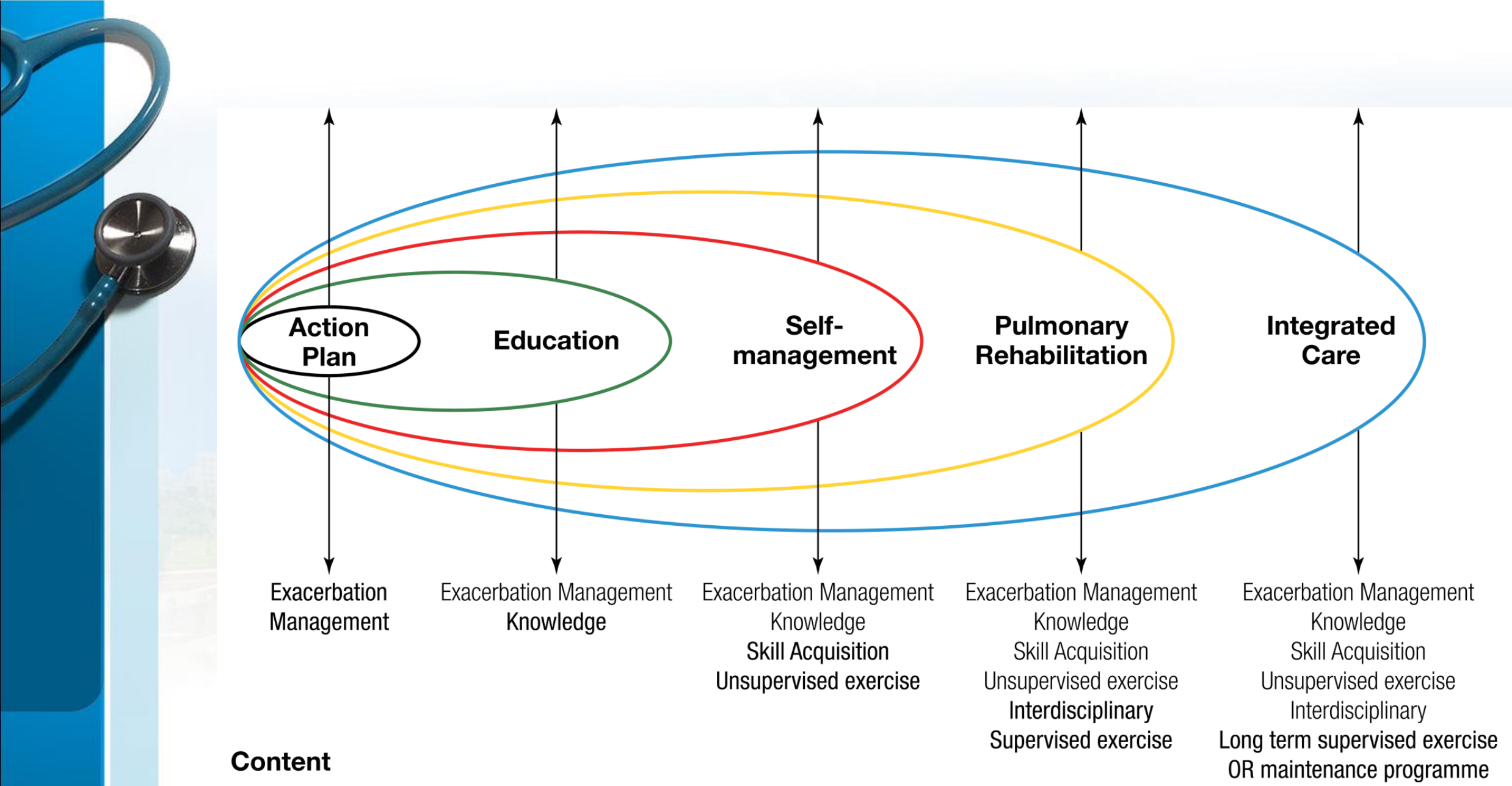


Pulmonary rehabilitation

- Pulmonary rehabilitation is a comprehensive intervention designed to improve the physical and psychological condition of people with chronic respiratory disease and promote the long-term adherence to health-enhancing behaviours

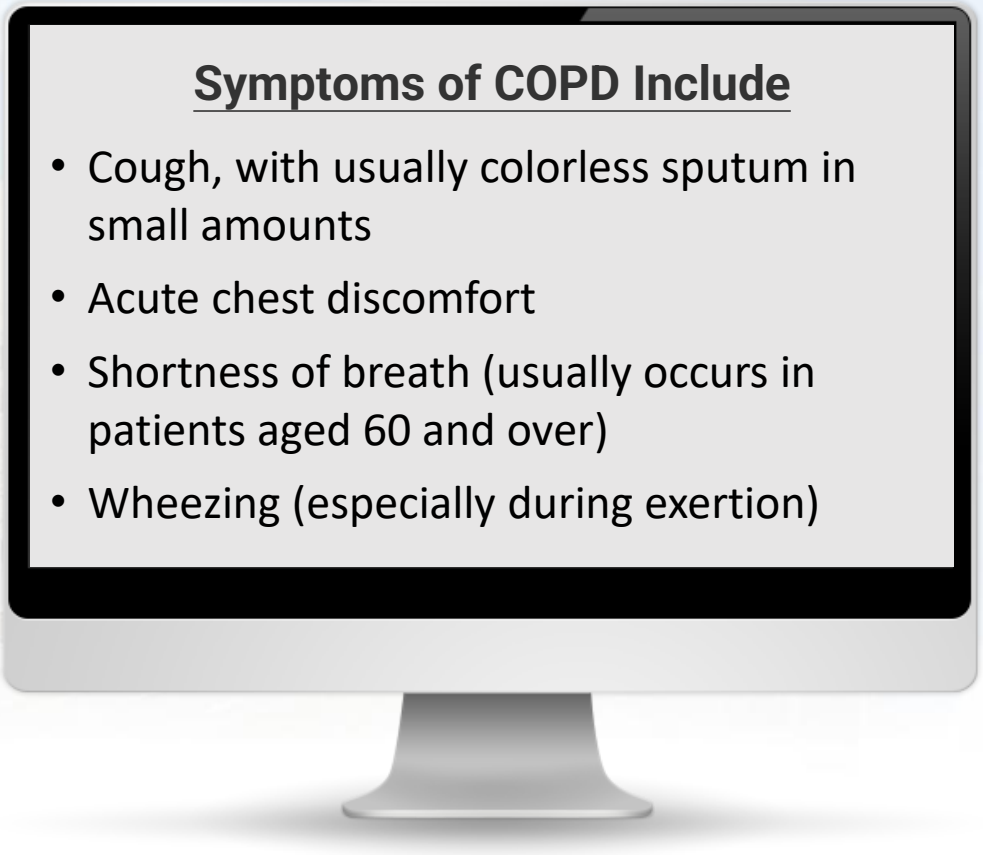
- Are **not limited to, exercise training**, education and behavior change, which are designed to improve the physical and psychological condition of people with chronic respiratory disease and promote the long-term adherence to health-enhancing behaviours

Eur Respir Rev 2014; 23: 55–63


Action Plan
Education
Self-management
Pulmonary Rehabilitation
Integrated Care
Exacerbation Management
Exacerbation Management
Knowledge
Exacerbation Management
Knowledge
Skill Acquisition
Unsupervised exercise
Exacerbation Management
Knowledge
Skill Acquisition
Unsupervised exercise
Interdisciplinary
Supervised exercise
Exacerbation Management
Knowledge
Skill Acquisition
Unsupervised exercise
Interdisciplinary
Long term supervised exercise
OR maintenance programme
Content

Clinical

- Exercise intolerance by dyspnea or fatigue
- *Quality of life* is impaired by symptoms, decreased functional status, and frequency of exacerbations.



COPD治療目標

Reduce symptom & prevent exacerbation is key goal

減低症狀

緩解症狀

改善運動耐受力

改善健康狀態

降低風險

預防疾病進程

預防及治療
急性惡化

降低致死率

Risk factors of COPD AE re-admission

Table 3 Multivariate adjusted risk factors of readmission to hospital for an exacerbation in a cohort of 312 patients with COPD (Cox regression)

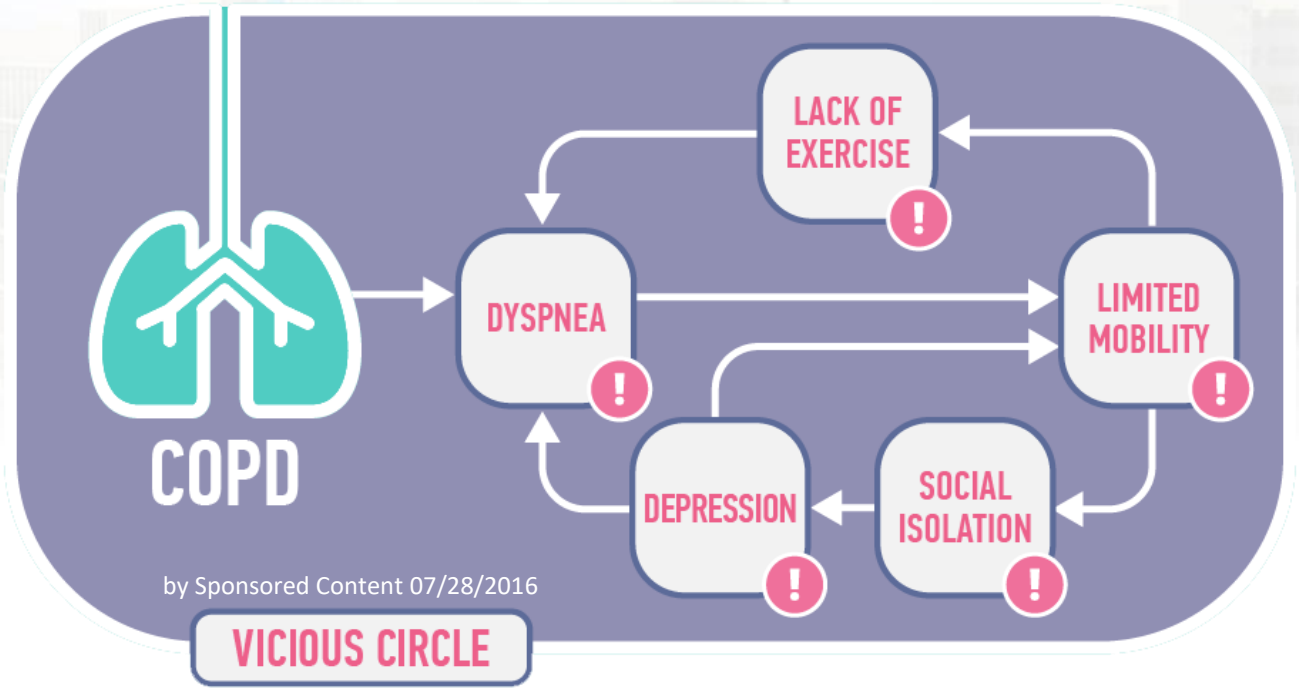
	Adjusted HR (95% CI)	p value
≥3 COPD admissions in the year before recruitment*	1.66 (1.16 to 2.39)	0.006
% predicted FEV_1	0.97 (0.96 to 0.99)	0.001
PO_2 (kPa)	0.88 (0.79 to 0.98)	0.024
Controlled by a:		
General practitioner	1.00	
Pulmonologist	1.66 (0.98 to 2.80)	0.058
Anticholinergics	1.81 (1.11 to 2.94)	0.017
Usual physical activity (in tertiles):		
<79 kcal/day	1.00	
79–232 kcal/day	0.87 (0.60 to 1.27)	0.469
>232 kcal/day	0.54 (0.34 to 0.86)	0.010

HR=hazard ratio; CI=confidence interval; FEV_1=forced expiratory volume in 1 second.
*HR for "COPD admissions as a continuous variable" 1.19 (95% CI 1.10 to 1.30), p=0.000.

Thorax 2003;58:100–105

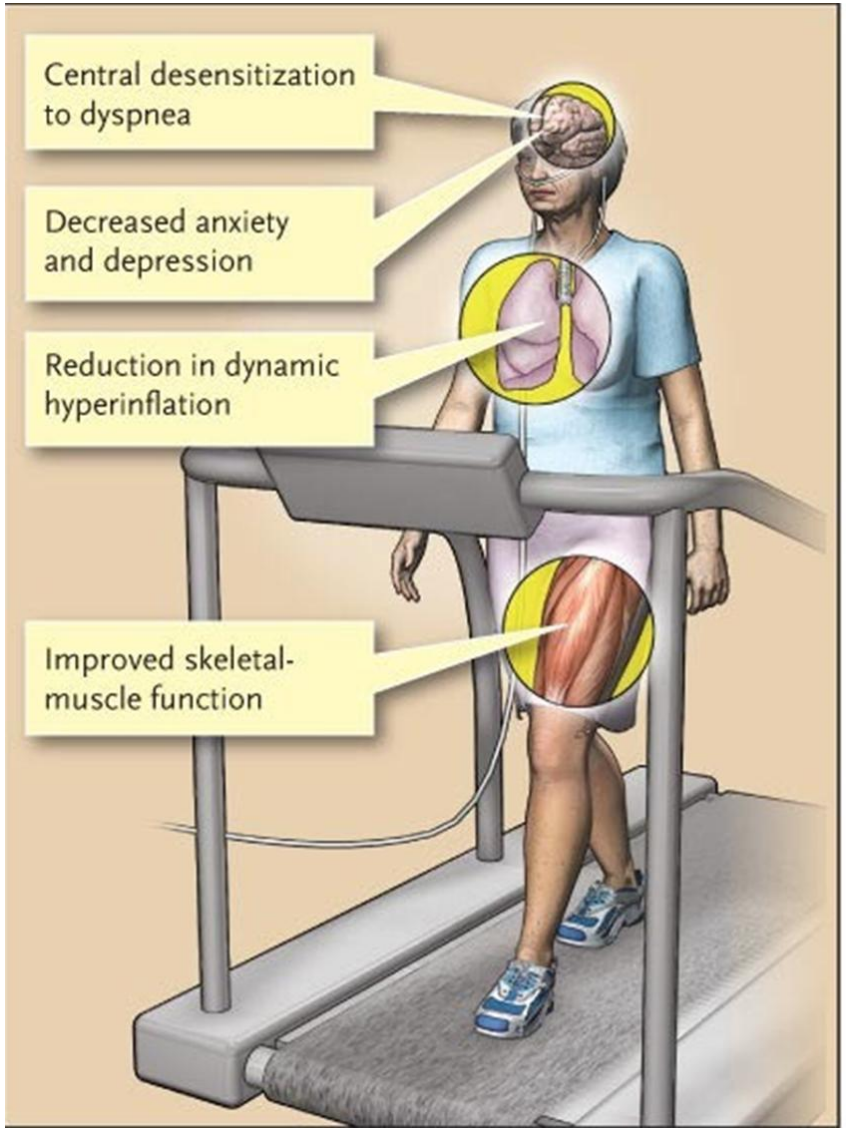
Pathophysiology and Effect of Therapy

- Pulmonary rehabilitation does not improve lung mechanics or gas exchange. (does not improve pulmonary function)
- Higher work rates can be tolerated without appreciable lactic acidosis



Pulmonary rehabilitation benefit

- Increased exercise endurance and capacity
- Improved muscle strength
- Reduced symptom burden, including dyspnea and fatigue
- Enhanced health-related quality of life (health status)
- Reduced depression and anxiety symptoms
- Decreased health care utilization
- Increased self-efficacy for walking
- Increased physical activity and functional status
- Reduction in mortality following discharge for a COPD exacerbation

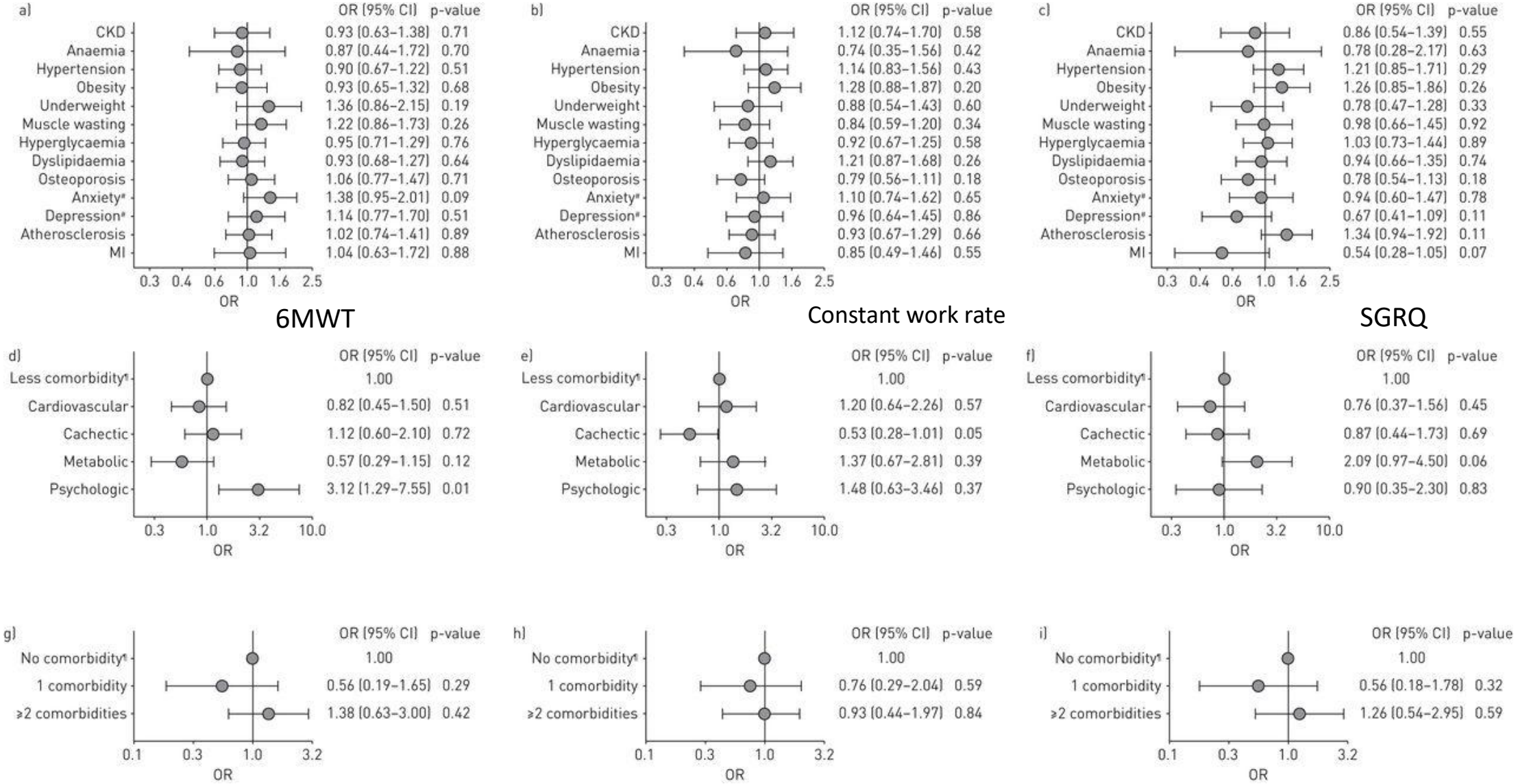


Predictors of Barrier to pulmonary rehabilitation

- Smoking status,
- Live alone (availability of social support)and
- markers of disease severity (FEV1, CRQ, LOT)
- Inconvenience for the patient

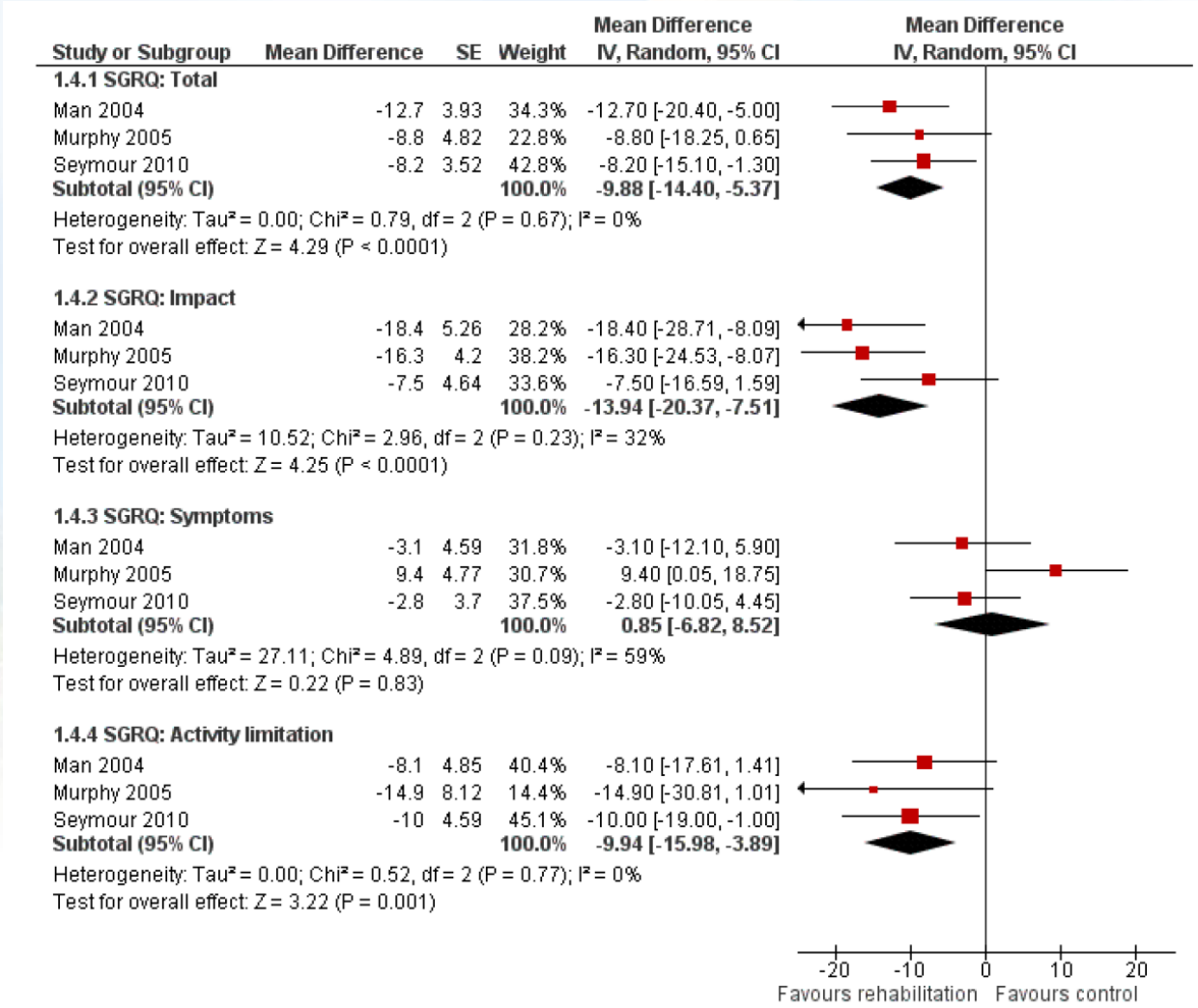
Respir Med. 2013 Mar;107(3):401-7

Predictive role of individual objectively identified comorbidities (a–c), clusters of objectively identified comorbidities (d–f), and the number of objectively identified comorbidities (h–i) on meaningful improvements, after pulmonary rehabilitation,



Rafael Mesquita et al. Eur Respir J 2015;46:545-548

Pulmonary rehabilitation on SGRQ



Cochrane Database Syst Rev. 2011 Oct 5;(10):CD005305

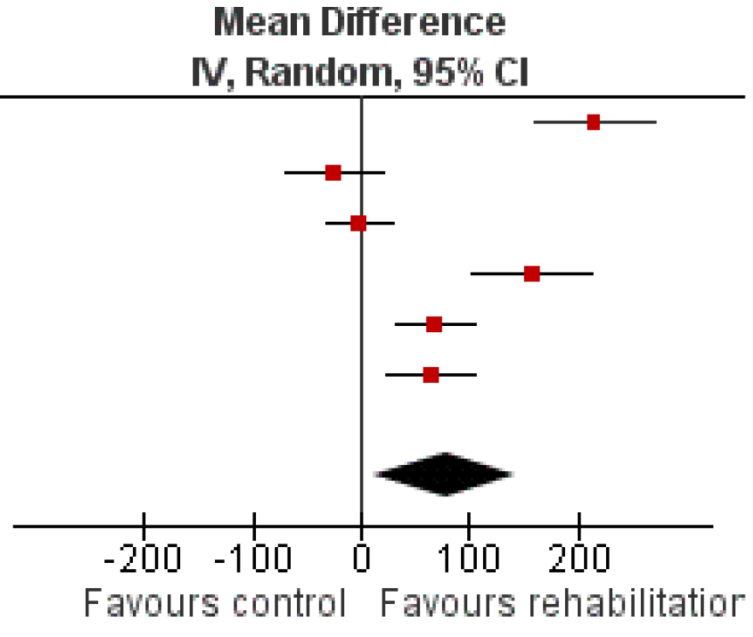
Pulmonary rehabilitation on exercise capacity

6 minute walking test.

Study or Subgroup	Mean Difference	SE	Weight	Mean Difference IV, Random, 95% CI
Behnke 2000	215	28	16.0%	215.00 [160.12, 269.88]
Carr 2009	-25	23	16.6%	-25.00 [-70.08, 20.08]
Eaton 2009	-2	16	17.4%	-2.00 [-33.36, 29.36]
Kirsten 1998	158	28	16.0%	158.00 [103.12, 212.88]
Nava 1998	68	19	17.1%	68.00 [30.76, 105.24]
Troosters 2000	64	21	16.9%	64.00 [22.84, 105.16]
Total (95% CI)			**100.0%**	**77.70 [12.21, 143.20]**

Heterogeneity: $Tau^2 = 6179.55$; $Chi^2 = 71.60$, $df = 5$ ($P < 0.00001$); $I^2 = 93\%$

Test for overall effect: $Z = 2.33$ ($P = 0.02$)



Cochrane Database Syst Rev. 2011 Oct 5;(10):CD005305

Re-admission (PR within 4 wks after discharge)

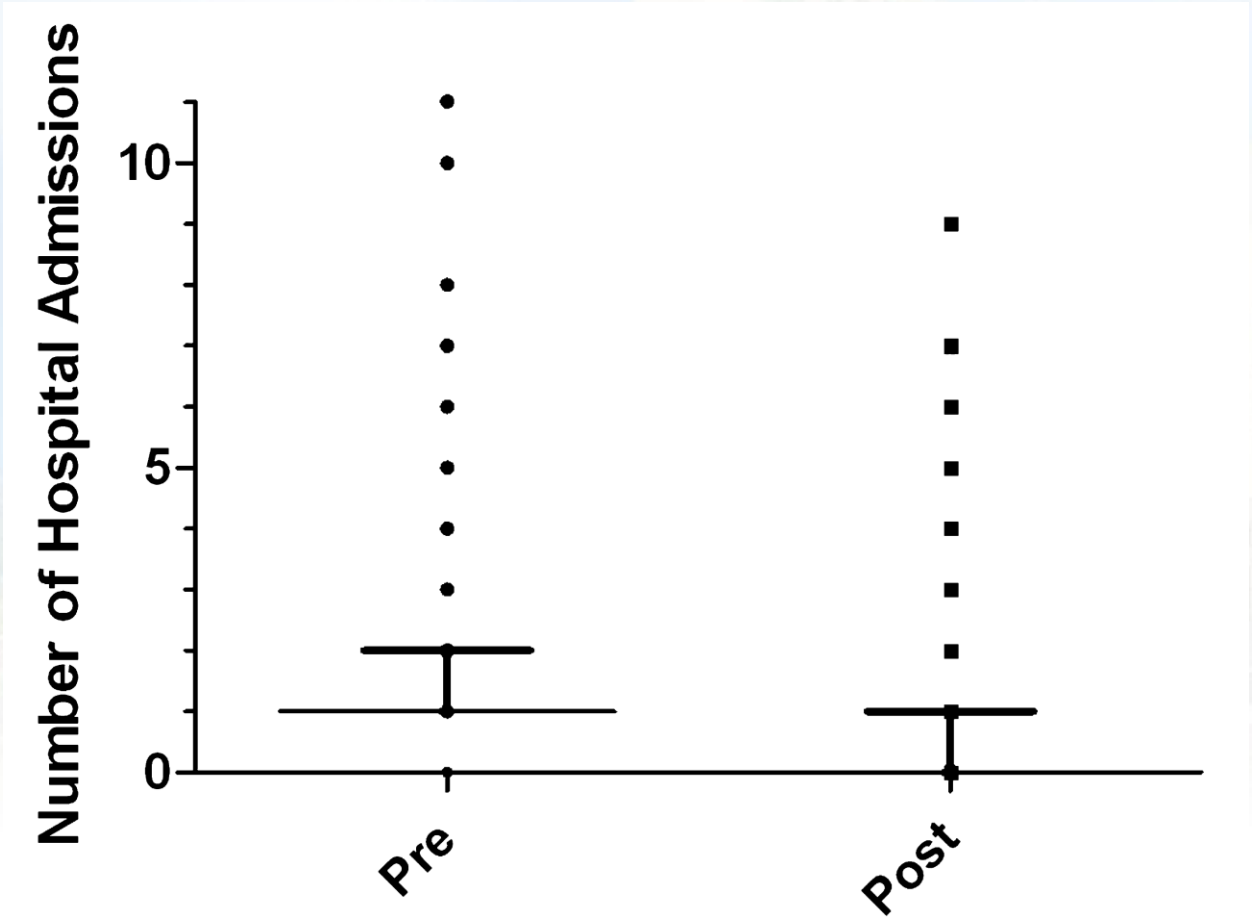
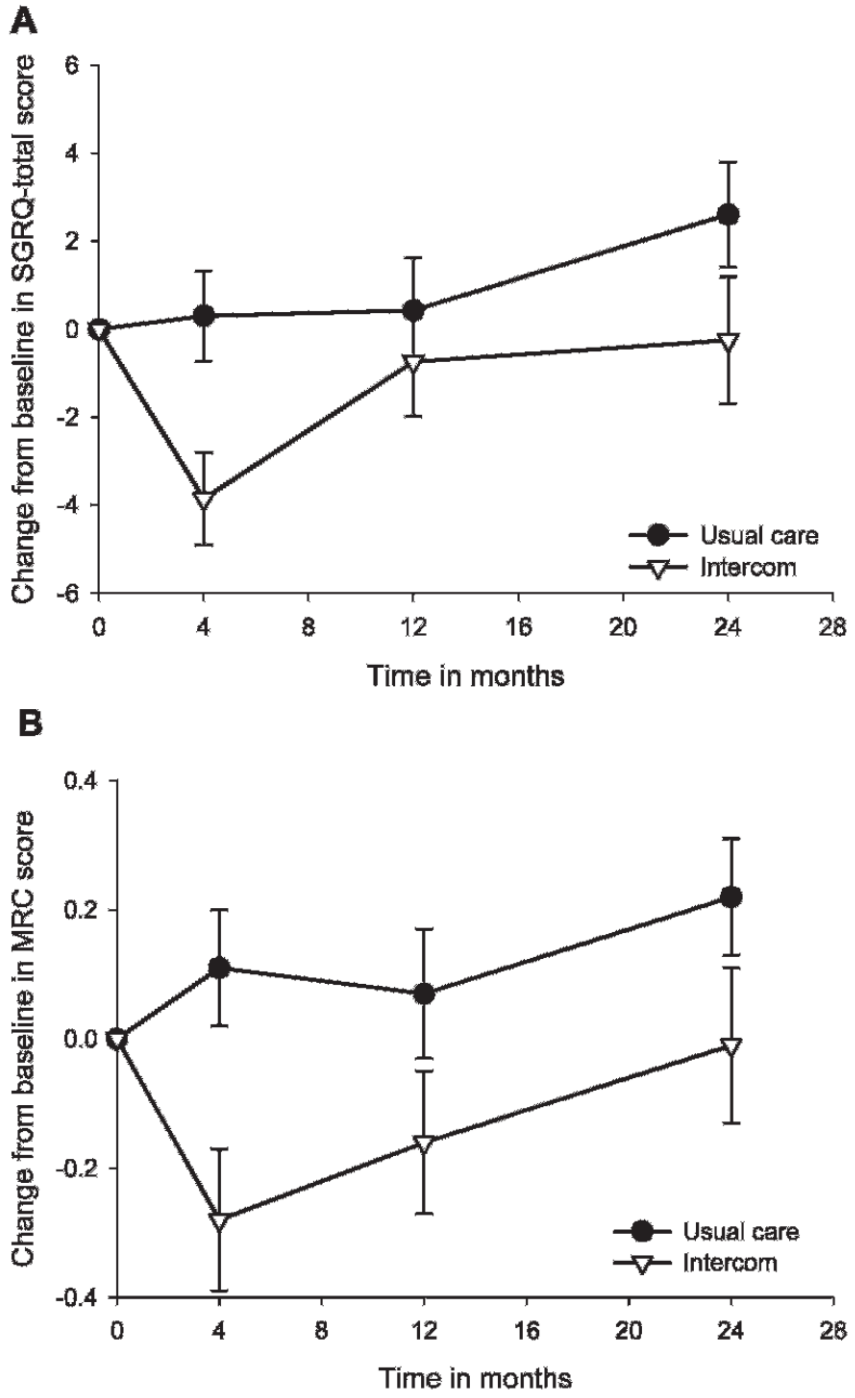


Figure 2 Number of hospital admissions pre- and post-pulmonary rehabilitation.

Respirology (2013) 18, 1063–1068

Stable COPD

- PR improved SGRQ and mMRC



Thorax 2010;65(1):7–13

PR (within 4wks of discharge)

- Improvement of exercise capacity and health status
- Decreased readmission

Table 3 Mean changes for patients who completed the pulmonary rehabilitation

$n = 100$	Mean change (95% CI)
ISWT (metres)	63.40 (51.99 to 75.41)***
ESWT (s)	400.42 (330.49 to 470.34)***
CRQ-SR Dyspnoea	0.65 (0.37 to 0.94)***
CRQ-SR Fatigue	0.94 (0.65 to 1.24)***
CRQ-SR Emotion	0.83 (0.56 to 1.10)***
CRQ-SR Mastery	0.94 (0.63 to 1.26)***

CRQ-SR, Chronic Respiratory Questionnaire Self-Reported; ESWT, Endurance Shuttle Walk Test; ISWT, Incremental Shuttle Walking Test.

***$P < 0.0001$ *$P < 0.001$.

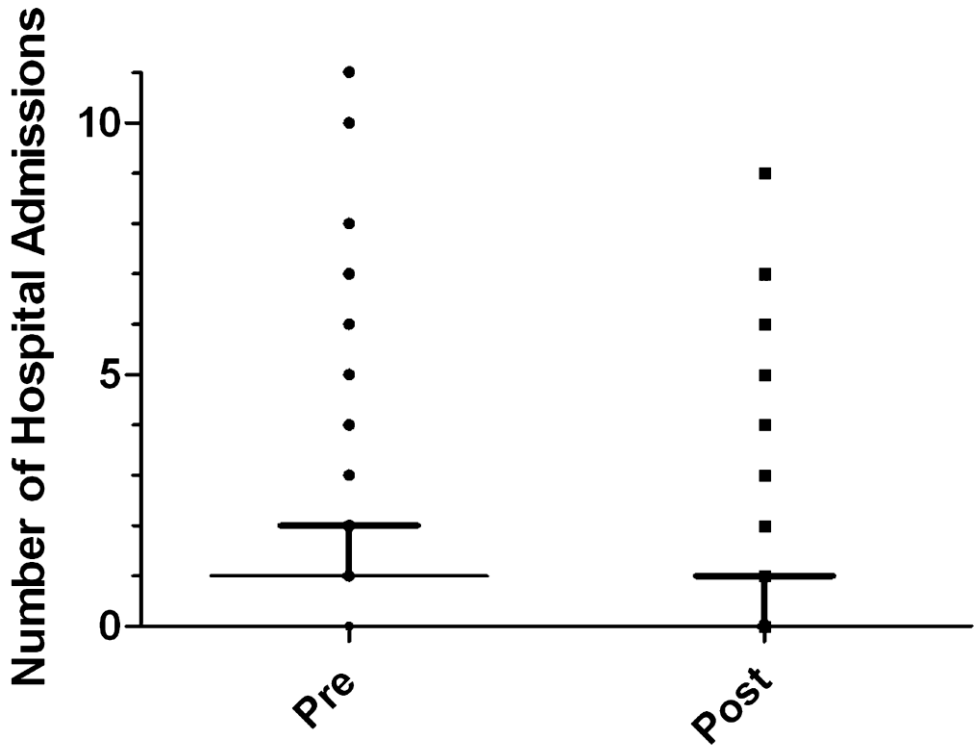


Figure 2 Number of hospital admissions pre- and post-pulmonary rehabilitation.

Respirology (2013) 18, 1063–1068

Acute stage of COPDAE

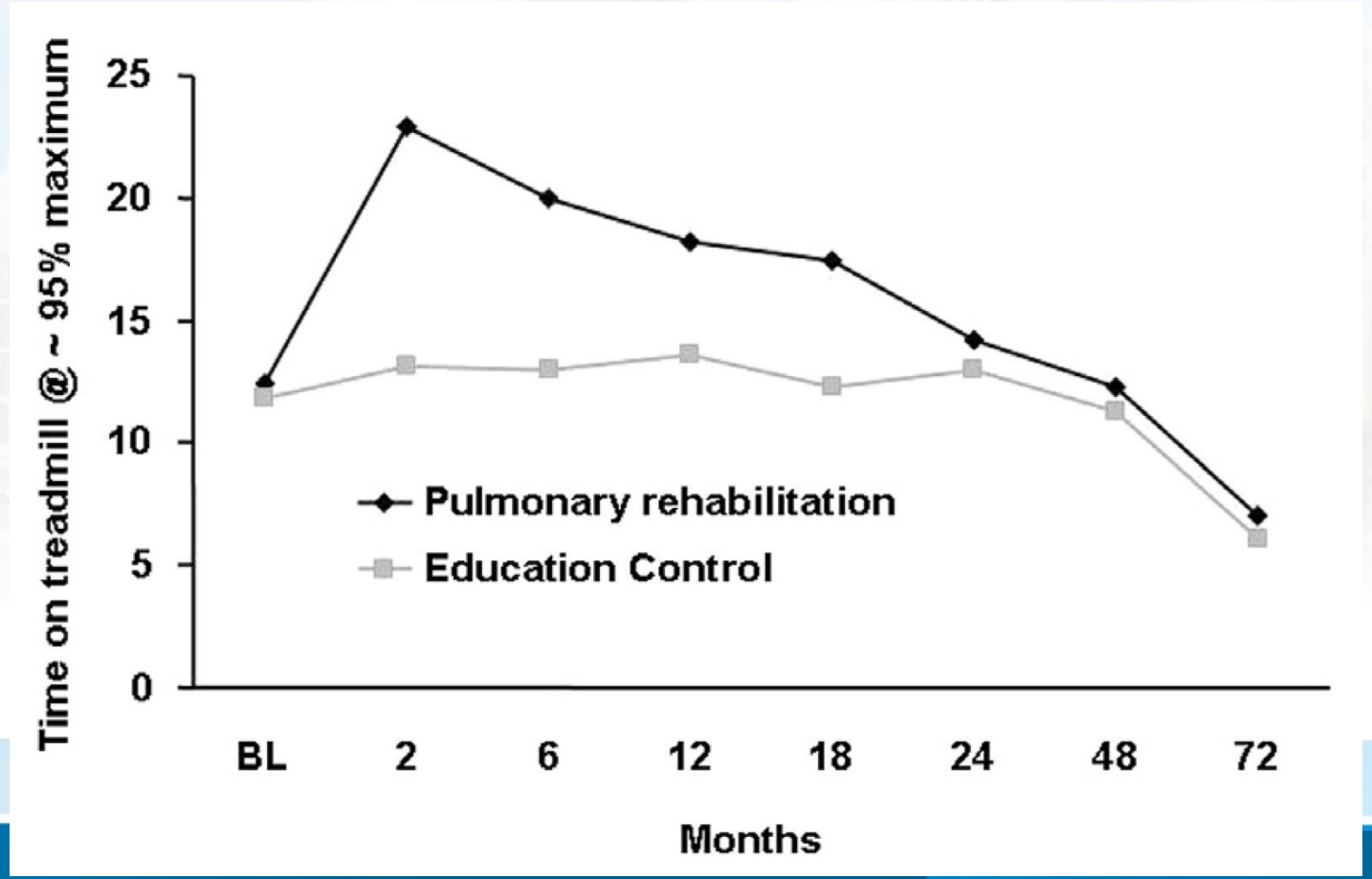
Early PR (less than 48 hrs of admission) decreased re-admission and hospital stays

Table 3 Risk-adjusted treatment effects of early pulmonary rehabilitation on the outcomes

	Risk-adjusted treatment effect[a] (95% confidence interval)	*P*-value
90-day readmission (%)	−2.1 (−3.7, −0.5)	0.009
Barthel index ≥15 at discharge (%)	−0.5 (−2.2, 1.1)	0.504
Length of stay (days)	−9.8 (−10.7, −8.8)	<0.001

Respiratory Research (2017) 18:68

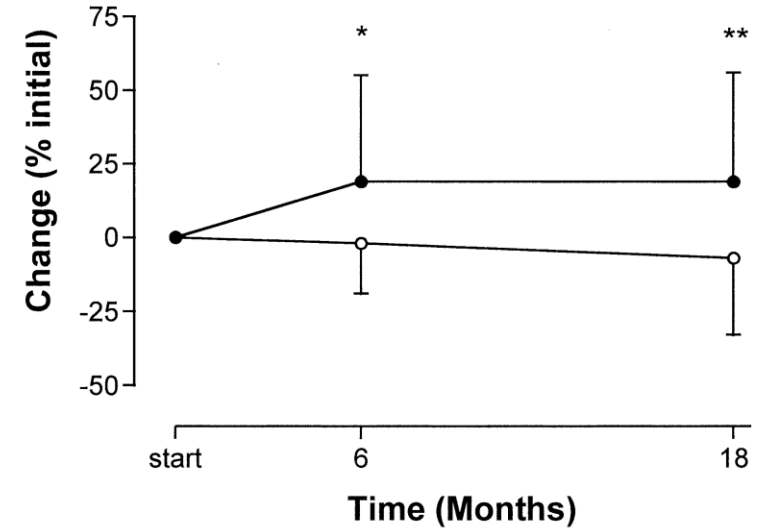
Gradual decline of pulmonary rehabilitation effect



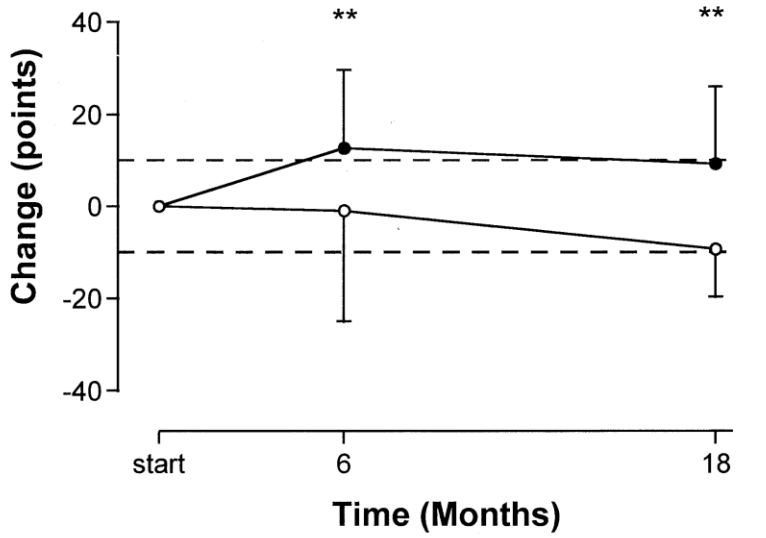
Ann Intern Med 1995;122:823–32.

Gradual decline of pulmonary rehabilitation effect

- 6 months of hospital training program
- Lasting 18 months



6MWT



QoL

Am J Med. 2000;109:207–212.

- Although a key focus of pulmonary rehabilitation is to provide strategies to maintain long-term benefits from the intervention, the most effective approaches to achieve this goal are not currently known.
- Extending the duration of pulmonary rehabilitation seems to prolong its benefits(lifetime would be best), but this may not be feasible in all areas.
  - Intercom by phone
  - Regular booster by hospital centered PR
  - Home plan

Home PR

Better QoL、exercise endurance & respiratory strength

Table 2 Mean and standard deviations of the values obtained on the ISWT, ULIT, and AQ-20

Variables	IG (n = 13)		CG (n = 10)	
	Pre-PR	Post-PR	Pre-PR	Post-PR
ISWT				
ISWT (m)	297.4 ± 98.5	318.2 ± 100.8	275.1 ± 105	272.2 ± 125.6
% ISWT (predicted)	64.2 ± 23.6	63.8 ± 20.5	56.3 ± 27.1	56.6 ± 26.5
HR maximum	113.2 ± 17.9	112.5 ± 15.3	104.8 ± 15.0	99.5 ± 14.9
% HR maximum	74.1 ± 11.5	73.4 ± 10.0	67.6 ± 8.95	64.3 ± 9.7
ULIT				
Load (kg)	1.1 ± 0.5	1.3 ± 0.8	0.8 ± 0.5	0.9 ± 0.5
SpO_2	95 ± 1	95 ± 2	93 ± 3	94 ± 4
AQ-20				
Score (minimum and maximum value)	12 (3–18)	15 (0–18)	10 (4–20)	11 (3–20)
MIP (cmH_2O)	62.1 ± 12.2	76.9 ± 21.5	71.0 ± 15.9	73.1 ± 14.3
% predicted (cmH_2O)	65.1 ± 11.0	74.2 ± 19.3	71.1 ± 16.7	70.2 ± 13.9
MEP (cmH_2O)	86.0 ± 41.9	89.5 ± 40.8	72.5 ± 22.7	75.5 ± 20.3
% predicted (cmH_2O)	77.9 ± 38.8	82.7 ± 38.3	51.6 ± 21.7	53.7 ± 22.9
Incremental load				
Maximum load (cmH_2O)	32.5 ± 16.6	37.5 ± 16.6	26.7 ± 19.0	20.0 ± 16.0
Constant load				
80% of maximum load (cmH_2O)	21.2 ± 12.4	26.2 ± 13.0	21.2 ± 12.4*	16.2 ± 9.1
Sustained time (seconds)	365.6 ± 219.2	314.0 ± 96.0†	208.7 ± 103.9	202.2 ± 81.9

Int J Chron Obstruct Pulmon Dis. 2013;8:537-44

Home PR

Lessen symptoms, improve activity and psychosocial impacts

	Treatment Group (n = 23)			Control Group (n = 18)			*P* Value	
	Initial	3 mo	*P* Value	Initial	3 mo	*P* Value	Initial	3 mo
SGRQ								
Symptoms	55.8 ± 19.0	52.6 ± 21.4	NS	63.2 ± 15.8	62.1 ± 22.0	NS	NS	NS
Activity	74.3 ± 15.0	65.2 ± 17.2	.008	81.5 ± 13.8	81.8 ± 17.0	NS	NS	.004
Impact	46.8 ± 13.6	33.4 ± 12.8	<.001	51.6 ± 15.4	58.0 ± 10.1	.012	NS	<.001
Total	56.3 ± 13.1	46.0 ± 12.0	<.001	62.3 ± 11.6	65.6 ± 10.6	.035	NS	<.001

J Cardiopul Rehab Preve 2014;34:355-359

Table 2 Post hoc analyses comparing baseline, post-PR, 6 months and 12 months variables

	Baseline	Post-PR	6 months	12 months
n	211	195	171	159
6MST	328.9±163	394.7±172.6***	396.5±196.6***	432.6±182.1***
TUG	10.4±5.9	9.2±7.3**	9.6±5.6$^{£}$	9.3±5.4
10TSTS	32.3±19.1	27.1±14.3***	28.1±14.3*	28.6±14
HAD	17.3±7.3	14.5±7.3***	13.2±7.1***,$^{££}$	13.9±7.5***,§
MRF 28	48.5±23.4	39.6±23***	37.3±23.5***	39.5±25***,§
VQ11	33.4±9.1	29.7±9.9***	27.7±9***,$^{££}$	29.4±10.3***,§
VSRQ	32.8±15.5	40.1±16.4***	41.6±15.7***	39.6±16.1***,§

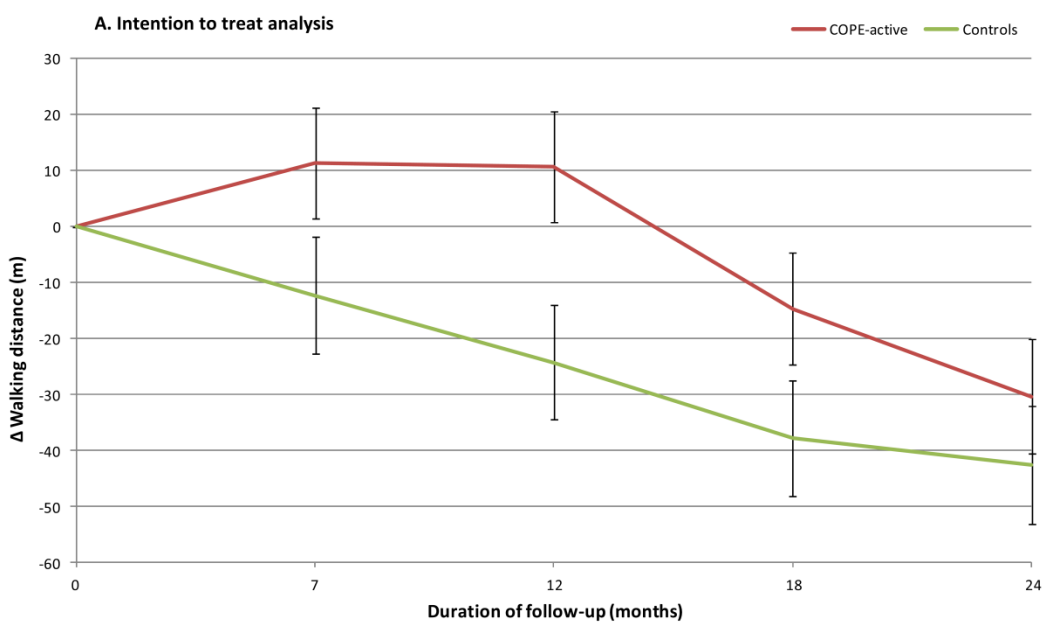
Notes: Data are expressed as mean ± standard deviation. *$P<0.05$, **$P<0.001$, ***$P<0.0001$, statistical comparison with baseline values; $^{£}P<0.05$ and $^{££}P<0.01$, statistical comparison with post-PR values; $^{§}P<0.05$, statistical comparison with 6 months values. Data are presented as mean ± standard.

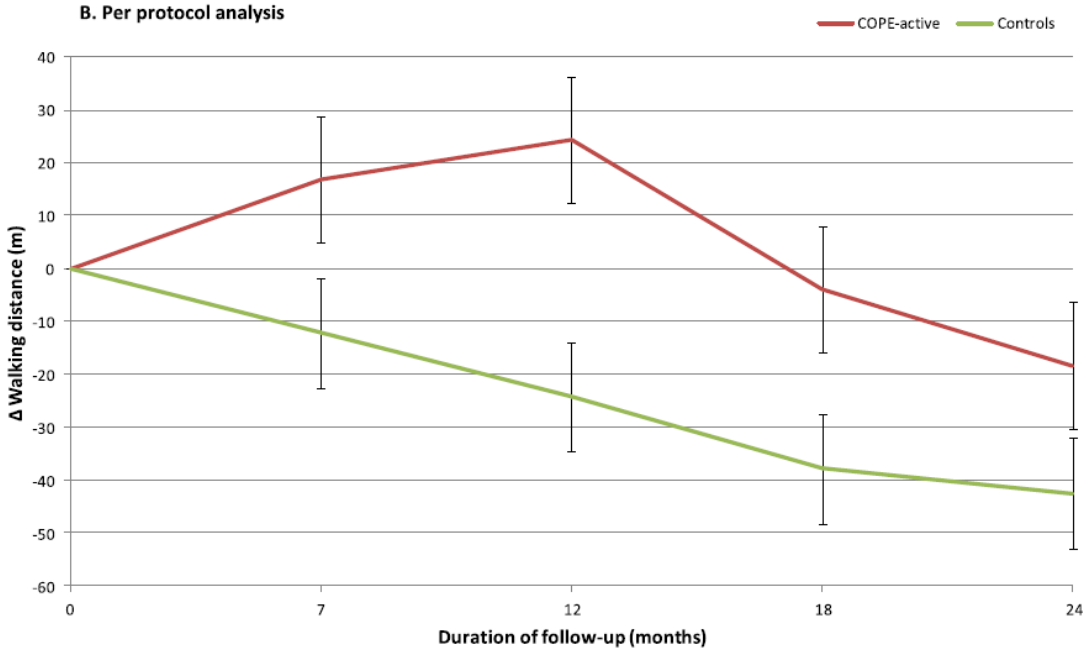
Abbreviations: PR, pulmonary rehabilitation; 6MST, 6-minute stepper test (number of steps); TUG, Timed Up and Go; 10TSTS, ten times sit-to-stand test; HAD, Hospital Anxiety and Depression questionnaire; MRF 28, Maugeri Respiratory Failure 28; VSRQ, Visual Simplified Respiratory Questionnaire.

- Home based PR is effective to improve exercise performance and QoL, which lasted 12 months

Int J Chron Obstruct Pulmon Dis. 2015;10:2037-44

Home rehabilitation 2 yr F/U





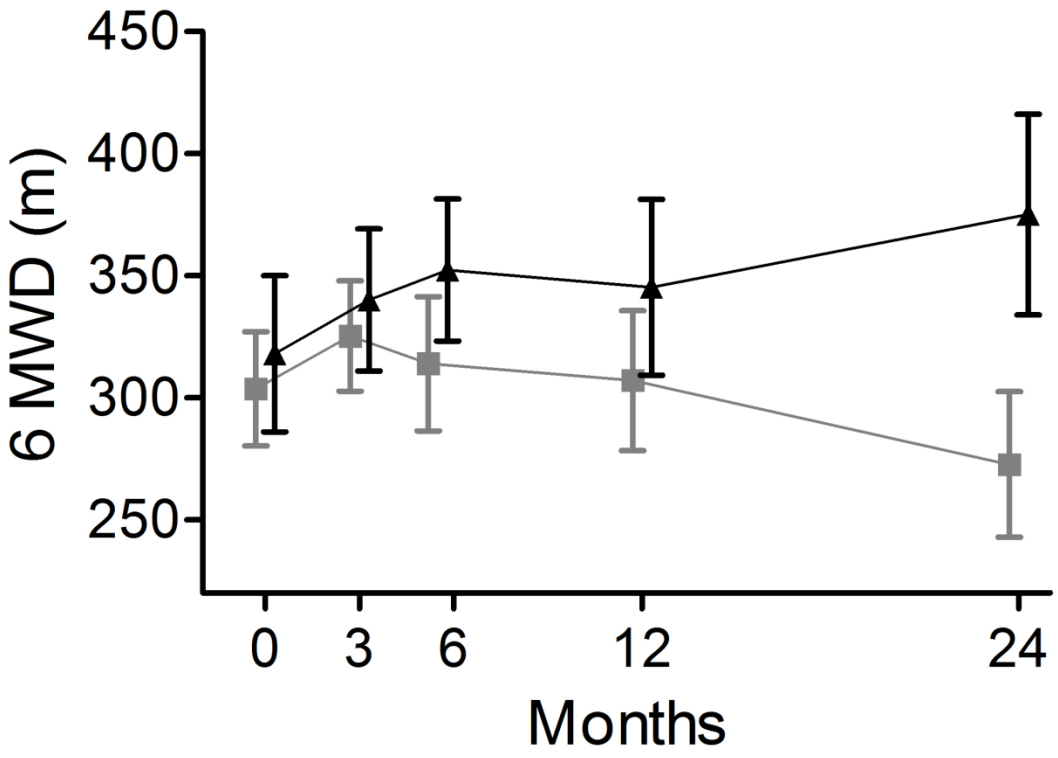
Respir Med. 2014 Oct;108(10):1481-90

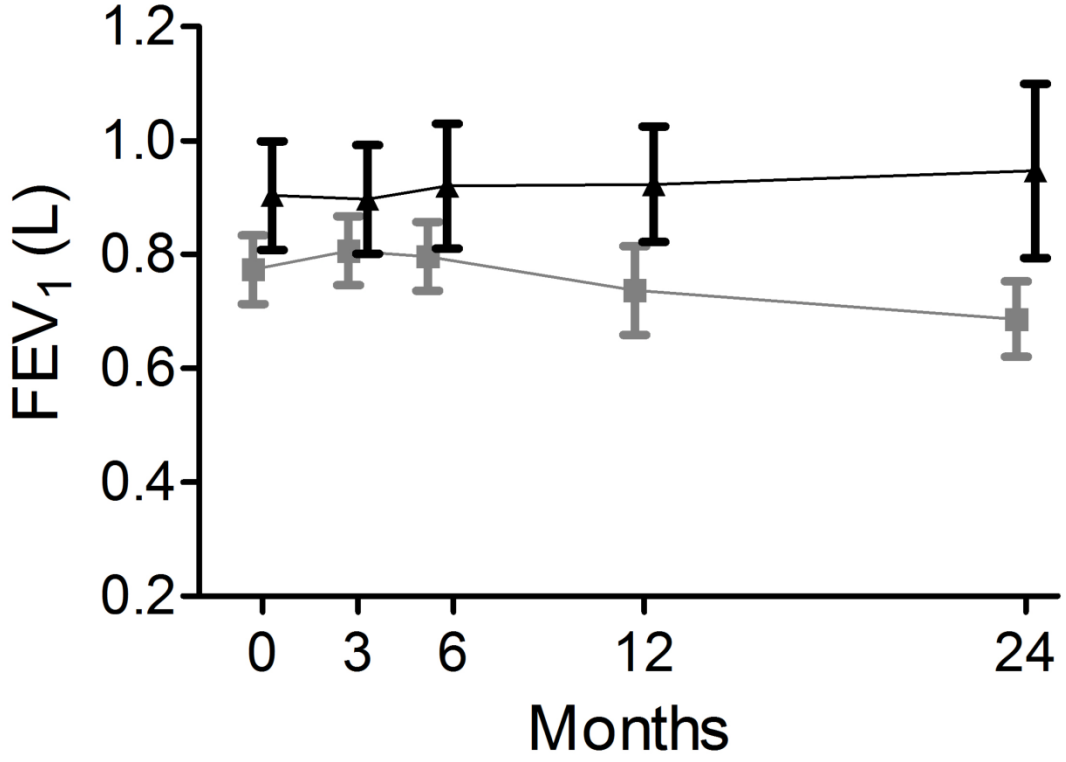
Table 1
An overview of possible locations for rehabilitation programs

Type Program	Location	Typical Duration	Multidiscipline	Suitable Patients
Inpatient	Dedicated rehabilitation center	4 wk	++++	Complex patients with limited mobility or poor social support After ICU
Outpatient	Dedicated rehabilitation center	6 wk to 6 mo	+++	Complex patients with sufficient social support After exacerbation
	Second-line hospital	6–12 wk	++	Less complex patient
Community based	Fitness center, gym	8–12 wk or maintenance	+/–	Patients who need exercise only
	Nursing home	Maintenance exercise	+	Institutionalized patients
Primary care based	Physiotherapy practice	8–12 wk	+/–	Mobile patients who need exercise only and/or respiratory physiotherapy (mucus problems)
Home based	With physiotherapy supervision	12 wk	–	Less mobile patients who need exercise only and/or respiratory physiotherapy (mucus problems)
	Without supervision	NA	–	Patients who need only physical activity and mild exercises with proper self-management
Home based and telemonitored	—	Maintenance or primary	++ (educ.)	Patients who need mostly exercise and can manage technology

Clin Chest Med 35 (2014) 303–311

NIPPV + R vs. R alone





Respir Res. 2011 Aug 23;12:112.

常見的運動復健及職能復健

Respiratory muscle exercise

Breathing re-training exercise

- ↑Muscle strength, awareness, and coordination
- Ex: diaphragmatic breathing

Pursed-lip breathing

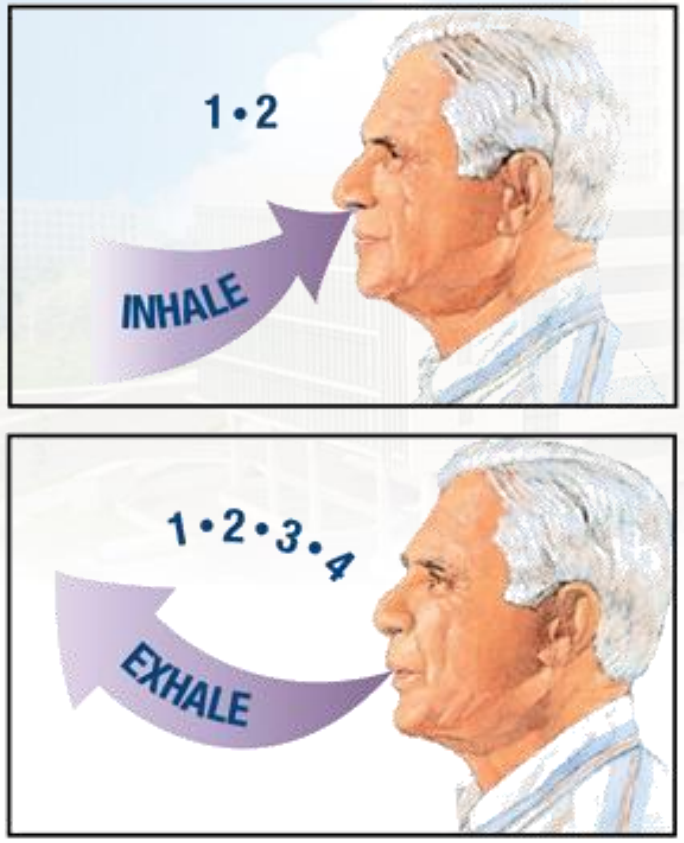
- ↑Alveolar ventilation, tidal volume
- ↓RP
- ↑SpO_2

Aerobic exercise

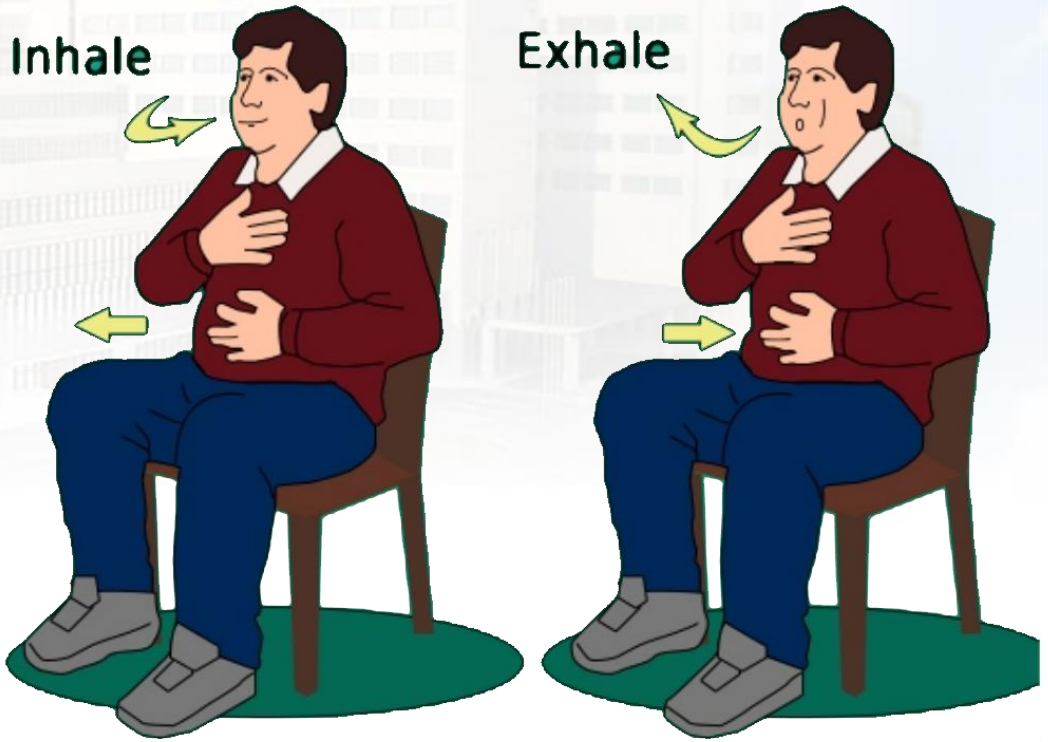
- UE or/and LE
- ↑Respiratory muscle endurance/strength

Inpatient pulmonary rehabilitation

Pursed-lip breathing



Breathing re-training exercise
abdominal breathing

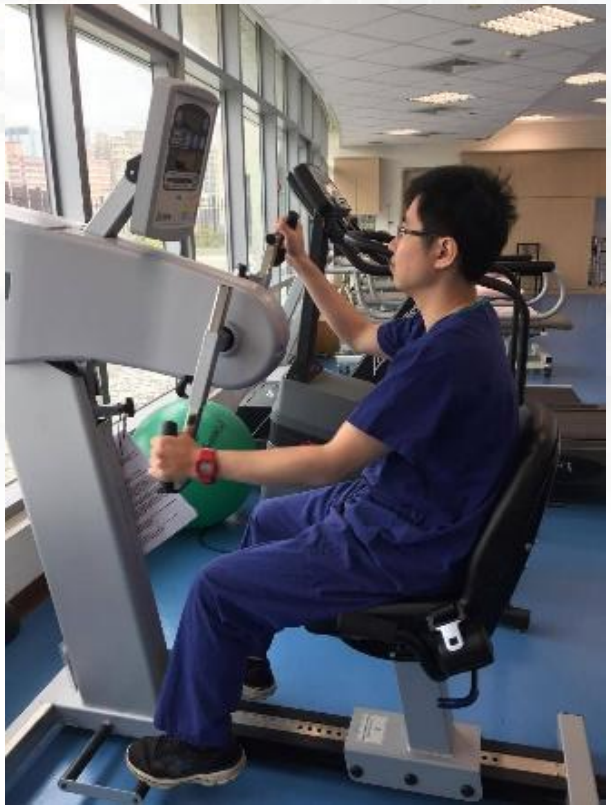


Inpatient pulmonary rehabilitation

- ROM exercise
  - UE/LE
  - 10-15 times/set, 3 sets/ day
  - Maintain the flexibility of muscle and range of motion
- Functional activity
  - Sitting, standing, ambulation…

Outpatient pulmonary rehabilitation

- Aerobic exercise
  一邊監控心跳和血氧濃度，一邊做有氧耐力運動



Resistance-Exercise Component

1. Improved **leg strength** aids in activities of daily living
2. Lessen the risk of falls
3. Upper-arm muscles also serve as auxiliary muscles of respiration
4. Respiratory-muscle training was once common, but functional capacity usually does not improve

Adverse Effects

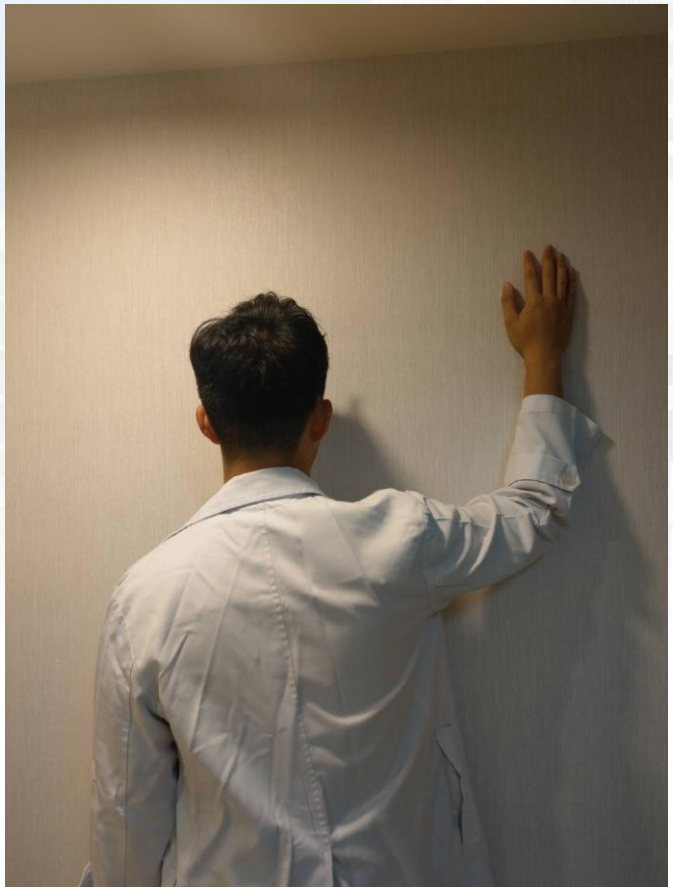
- Rare, risk is reduced by supervise
- Musculoskeletal injury
- Exercise-induced bronchospasm: use of bronchodilators before or during exercise
- Cardiovascular event: myocardial ischemia or infarction, arrhythmia, sudden cardiac death
  - Evaluation for MI before exercise

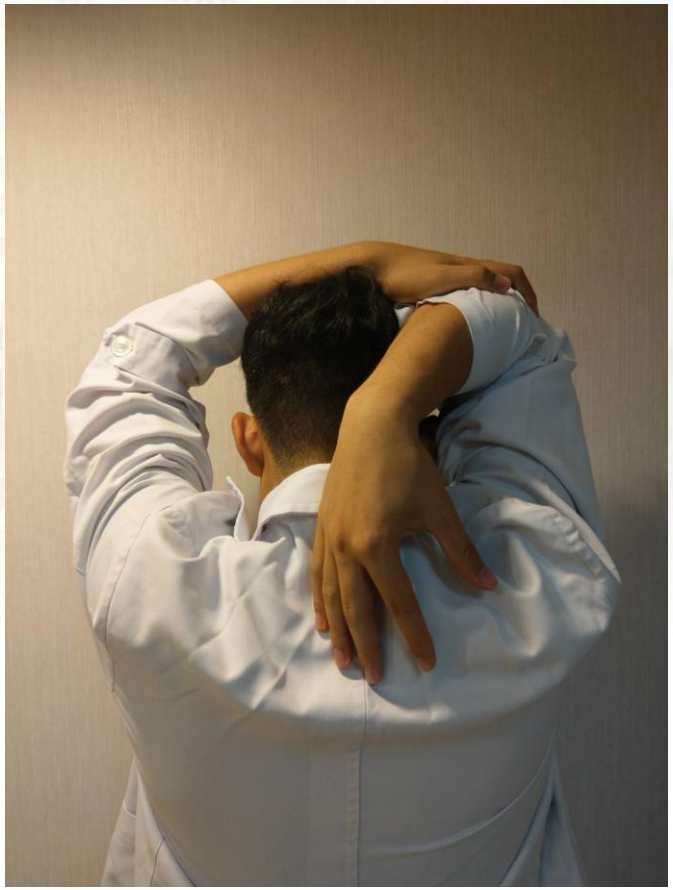
Contraindication

- Unable to walk/bicycle (orthopedic or neurologic disorders)
- Unstable cardiac disease
- Cognitive or psychiatric problem with poor cooperating with the treatment

Outpatient pulmonary rehabilitation

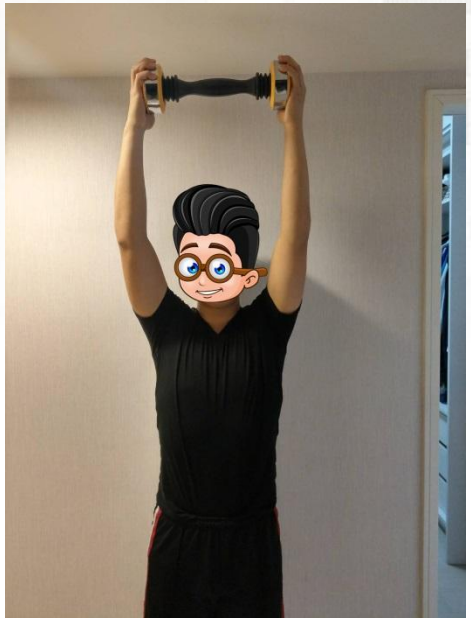
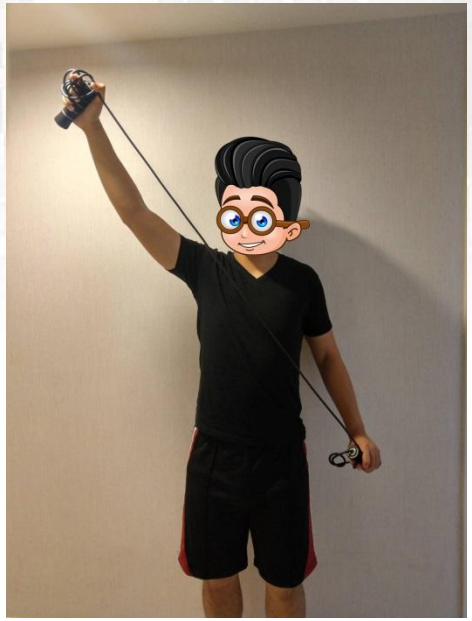
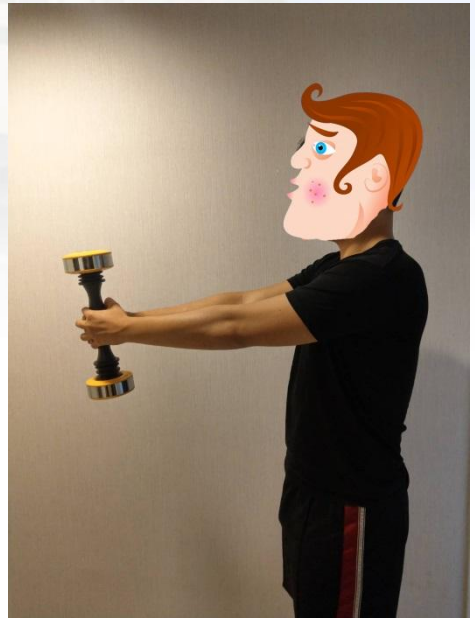
- Stretch exercise





Outpatient pulmonary rehabilitation

- Resistance exercise
  - 大肌肉群(肩、臂、胸、臀、腿)
  - 重複8-12次
  - 用力時吐氣，放鬆時吸氣

PR After Hospital Discharge

- PR initiated early (within 3 weeks)
  - Improves exercise tolerance, symptoms, and QOL
  - Reduces subsequent health care use
- A 2011 Cochrane review: PR after a hospitalization for COPD exacerbation reduces 42% of readmissions over 25 weeks

Components of a Respiratory Rehabilitation Program

- Education
- Respiration physiotherapy
- Muscle training
  - Lower extremity muscles
  - Upper extremity muscles
  - Respiratory muscles
- Psychosocial support
- Nutritional support
- Occupational therapy

Cardiopulmonary Exercise Testing (CPET)

ACSM美國運動醫學會– Exercise prescription for PR

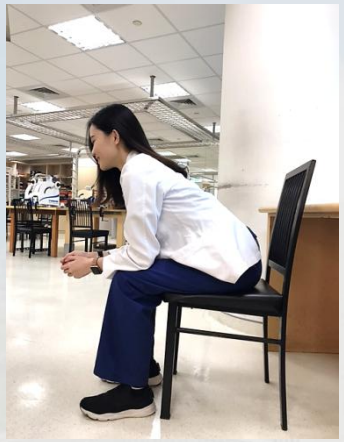
Component	Cardiorespiratory endurance training
Activity	Dynamic exercise of large muscles
Mode	Overground or treadmill walking
	Stationary leg cycling or outdoor bicycling
	Stair climbing
Frequency	3-5 days /wk
Duration	20-60 min per session
Intensity	50-85% heart rate reserve
	65-90% max heart rate

Frequency and Duration

- Most research involve PR within 1-3 visits per week
- There are no consensus on the optional duration of PR
  - A minimum of 8 weeks is required to achieve a substantial effect on exercise performance and QOL
  - Improvement in functional exercise capacity seems to plateau within 12 weeks

以適當的身體姿勢減低喘及不適

坐下姿勢



雙肘靠在膝蓋上，保持背部直立放鬆。

上半身趴在胸部高度的桌子上，墊個枕頭上讓自己更舒服一點

站立姿勢

雙手扶在大腿上，保持背部直立放鬆。背靠牆會更舒服一點。

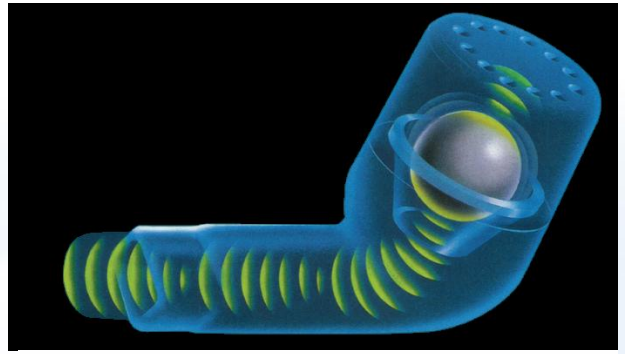
上半身趴在胸部高度的平面上，或是雙手撐桌。

節省體力原則

- 預先排定您的活動順序，不要重複來回走動消耗體力，並計畫休息時間。
- 根據自己的能力安排日常活動時間表，避免將費力的活動全擠在一起進行。費力的活動安排在早晨精神體力良好時進行。
- 避免過度消耗體力的動作及姿勢，盡可能坐著工作，動作時需配合呼吸。
- 工作節奏必須要適中，避免不必要的擔心、焦慮和挫折，焦慮和挫折非常容易產生疲勞。
- 必要時考慮使用輔助工具、簡化流程或環境改善。
- 如有明顯生活功能受損，許多日常生活工作無法進行時，建議應在復健科進行節能訓練的職能治療。

壓力管理: 避免焦慮造成喘及活動力減損

Chest physiotherapy



GRADE 建議等級	臨床建議內容
1B	利用呼吸咳痰技巧可以改善支氣管擴張症或囊性纖維化病人痰液清除，促進痰液清除能力。
1B	支氣管擴張症或囊性纖維化病人執行胸腔物理治療對痰液的排除成效皆優於不使用胸腔物理治療或自發性咳嗽方式。
1B	支氣管擴張症或囊性纖維化病人執行姿位引流配合震顫、背部扣擊及呼吸咳痰技巧，操作方便不需器材，是臨床上較適合的選擇。
1C	姿位引流能顯著改善支氣管擴張症病人咳痰困難度、增進肺瀰散量及增加六分鐘走路距離。
2C	高頻胸腔振動可幫助痰液清除，進而可能進一步改善肺功能及生活品質，對於痰液較多之肺阻塞、支氣管擴張症的效果較為顯著。
2C	震動吐氣末正壓裝置對肺阻塞及支氣管擴張症，可幫助痰液清除，進而可能進一步改善肺功能及生活品質。若合併吸入性支氣管擴張劑使用，可增加支氣管擴張的效果

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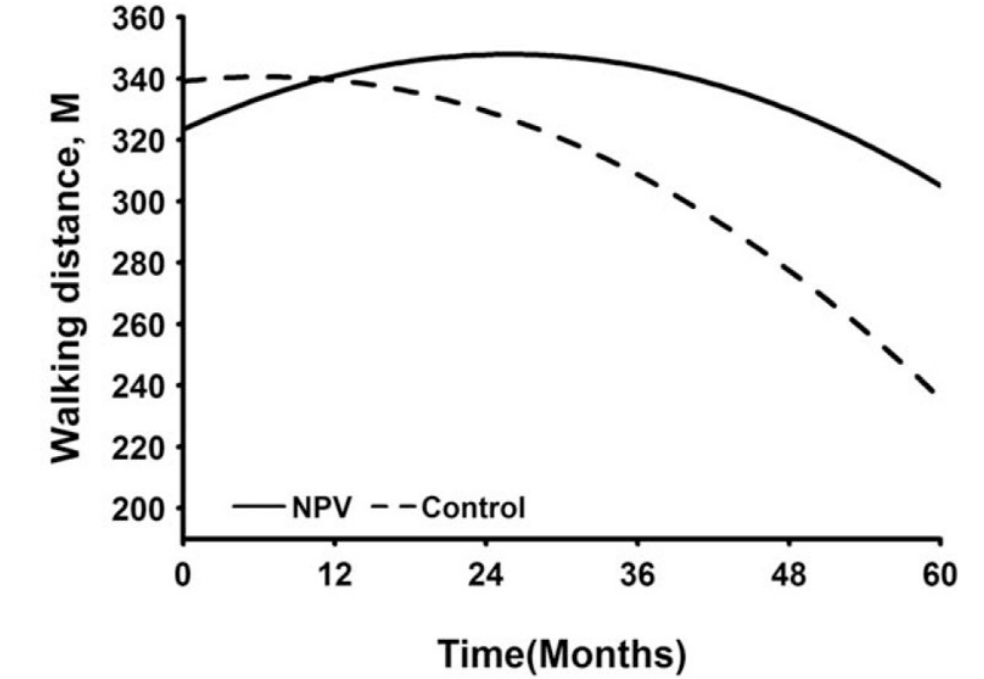
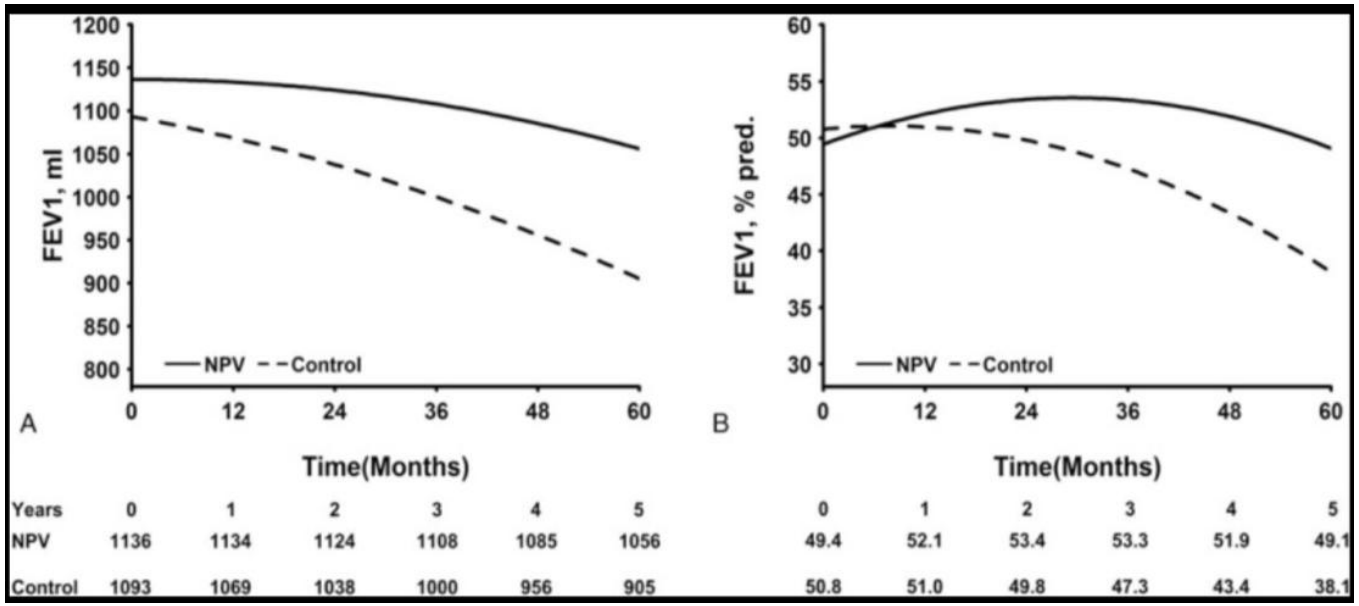
Negative Pressure ventilation

Negative pressure ventilation in COPD



Years	0	1	2	3	4	5
NPV	323.4	340.9	347.7	344.1	329.8	305.1
Control	339.1	339.5	329.4	308.7	277.5	235.7



Years	0	1	2	3	4	5
NPV	1136	1134	1124	1108	1085	1056
Control	1093	1069	1038	1000	956	905

Years	0	1	2	3	4	5
NPV	49.4	52.1	53.4	53.3	51.9	49.1
Control	50.8	51.0	49.8	47.3	43.4	38.1

Medicine (Baltimore). 2016 Oct;95(41):e5119

Negative pressure ventilation in COPD

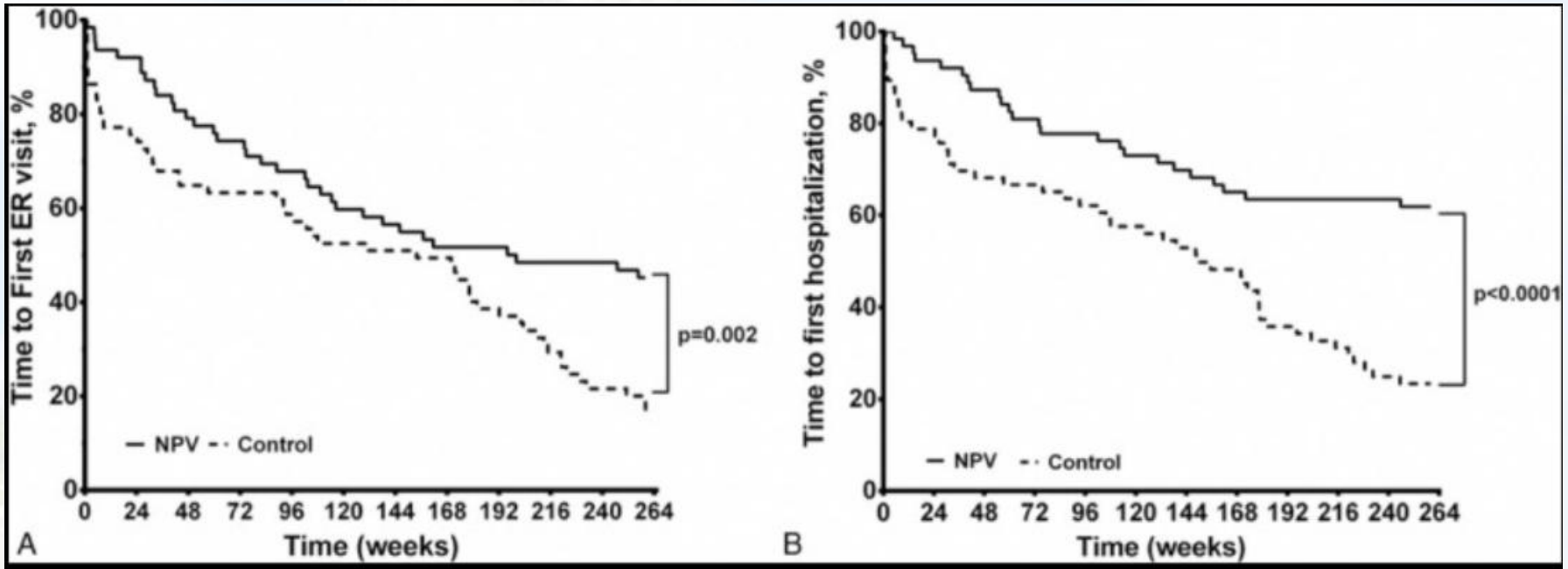


Figure 4 The Kaplan–Meier plots for the time to a first severe exacerbation (A) and hospitalization (B). The solid line represents the negative pressure ventilation group and dashed line is shown the control group. Significance is indicated by using the log-rank test.

Medicine (Baltimore). 2016 Oct;95(41):e5119

氧氣治療

The relationship between cognitive function and arterial partial pressure O_2 in patients with COPD

A meta-analysis

Medicine (Baltimore). 2018 Jan;97(4):e9599

Xia-Hong Wen, PhD[a], Yan Li, MD[a], Dong Han, MD[a], Li Sun, MD[a,*], Ping-Xiao Ren, MD[a], Dan Ren, MD[b]

Abstract

Background: The high incidence of cognition disorders in chronic obstructive pulmonary disease (COPD) patients represents a main focus in public health field recently. Thus, we tried to explore relationship between cognitive function and arterial partial pressure O_2 (PaO_2) in patients with COPD as assessed by Mini-mental State Examination (MMSE) and/or Montreal Cognitive Assessment (MoCA).

Materials and methods: Medical and scientific literature databases, such as Web of Science, PubMed, Cochrane Library, China National Knowledge Infrastructure, and Wanfang Database, were searched independently by 2 reviewers until February 2016. Correlation coefficient (r or r_s) values were obtained from each study, and 95% confidence intervals (CIs) were calculated using STATA12.0 software.

Results: A total of 2049 studies were produced, and 9 of which were analyzed (714 participants) in the meta-analysis. The pooled r observed medium relationship for all selected studies ($r=0.405$, 95% CI 0.31–0.55), and notable heterogeneity was also tested between studies ($\chi^2=17.72$, $P=.023$; $I^2=54.9\%$). After the sensitivity and subgroup analysis, the heterogeneity significantly decreased. Subgroup analysis showed that MMSE score was stronger correlation between PaO_2 and cognitive function than MoCA score in the COPD patients. Begg test did not indicate potential risk of publication bias.

Conclusions: There was a negative correlation between cognitive function and anoxia in patients with COPD, so it may be extremely essential to predict and improve the status of hypoxia in COPD patients.

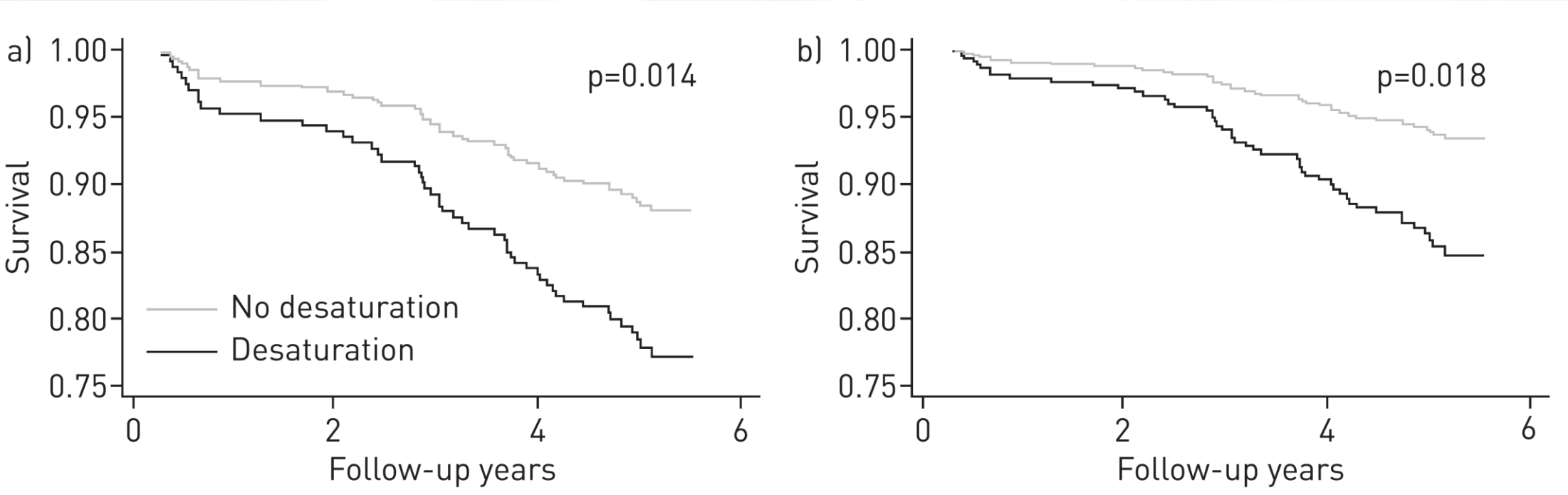
	γ with Cognition	95% CI
PaO2	0.405	0.31-0.55
All COPD	0.508	0.36-0.77
Stable COPD	0.31	0.23-0.42
AE COPD	0.39	0.12-0.71

Oxygen desaturation in 6-min walk test is a risk factor for adverse outcomes in COPD

	Total	No desaturation	Desaturation	p-value[#]
Subjects	370	284	86	
Pre-6MWT S_{pO_2}	94±2.6	95±2.4	93±2.7	<0.001
Post-6MWT S_{pO_2}	91±5.6	94±2.7	83±5.5	<0.001
Pre-6MWT pulse	86±15	84±14.5	90±14.6	<0.01
Post-6MWT pulse	110±18	107±16.5	118±1.6	<0.001
Post-6MWT pulse/age-expected maximal pulse ratio	0.7±0.1	0.68±0.1	0.76±0.1	<0.001
6MWD m	432±103.5	440.7±98.8	406.0±114.7	<0.01

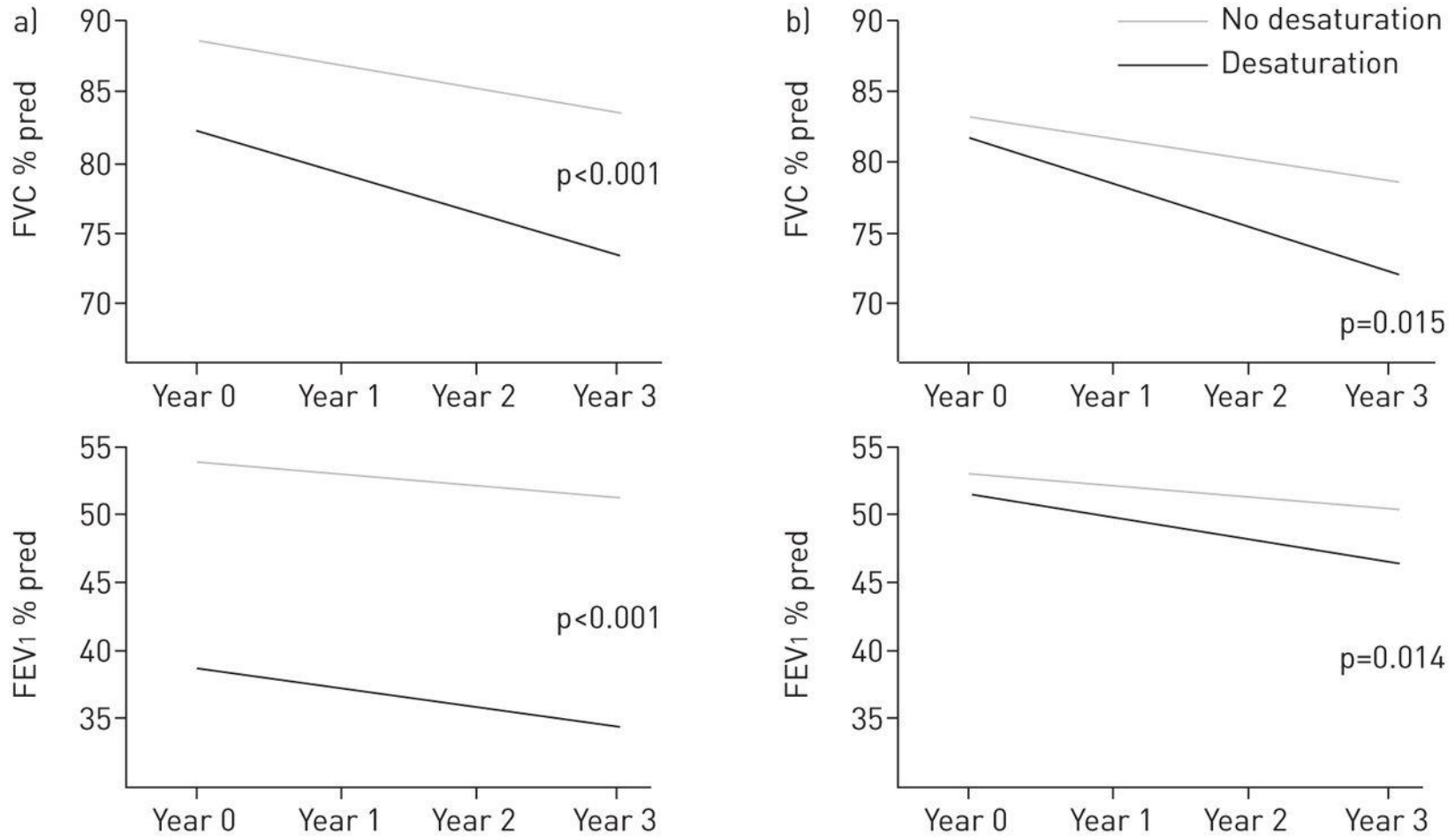
Eur Respir J. 2016 Jul;48(1):82-91

Oxygen desaturation in 6-min walk test is a risk factor for adverse outcomes in COPD



Eur Respir J. 2016 Jul;48(1):82-91

The estimated decline in lung function in chronic obstructive pulmonary disease patients over 3 years by desaturation during the 6-min walk test based on the coefficients from generalised estimating equation analyses. a) Unadjusted; b) after adjustments for...



Marie Waatevik et al. Eur Respir J 2016;48:82-91

1981 年 MRC study 顯示對於嚴重低血氧的肺阻塞病人，長期氧氣治療（每天大於 15 小時）比沒有氧氣治療，可以顯著改善死亡率

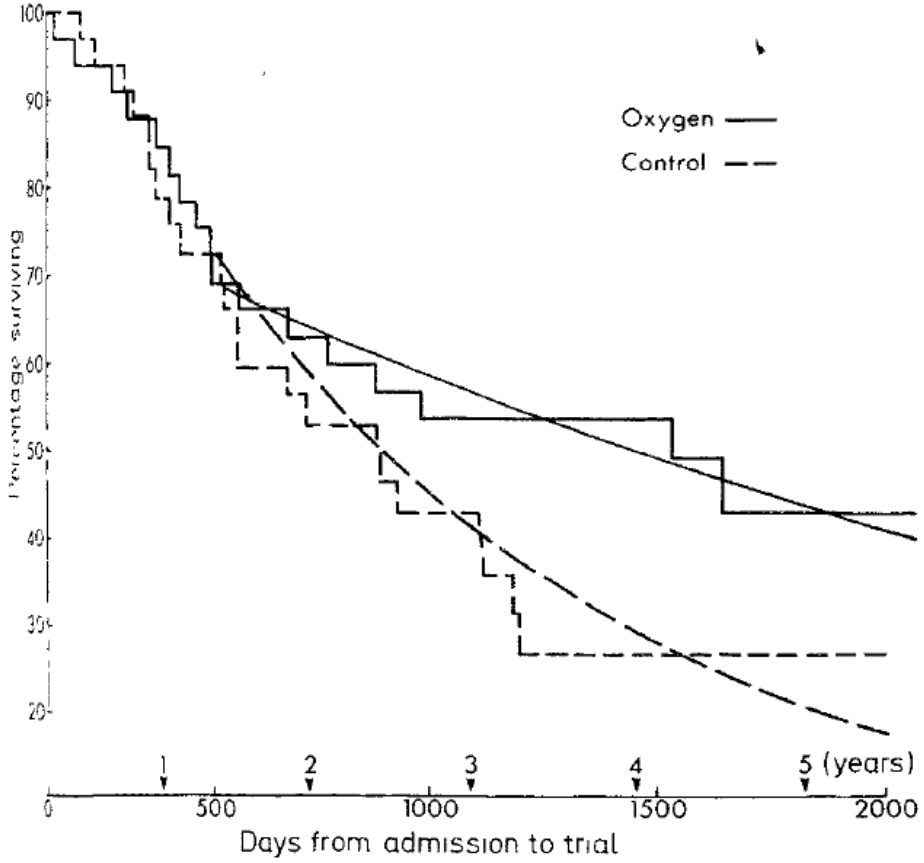


Fig. 1—Mortality in male patients.

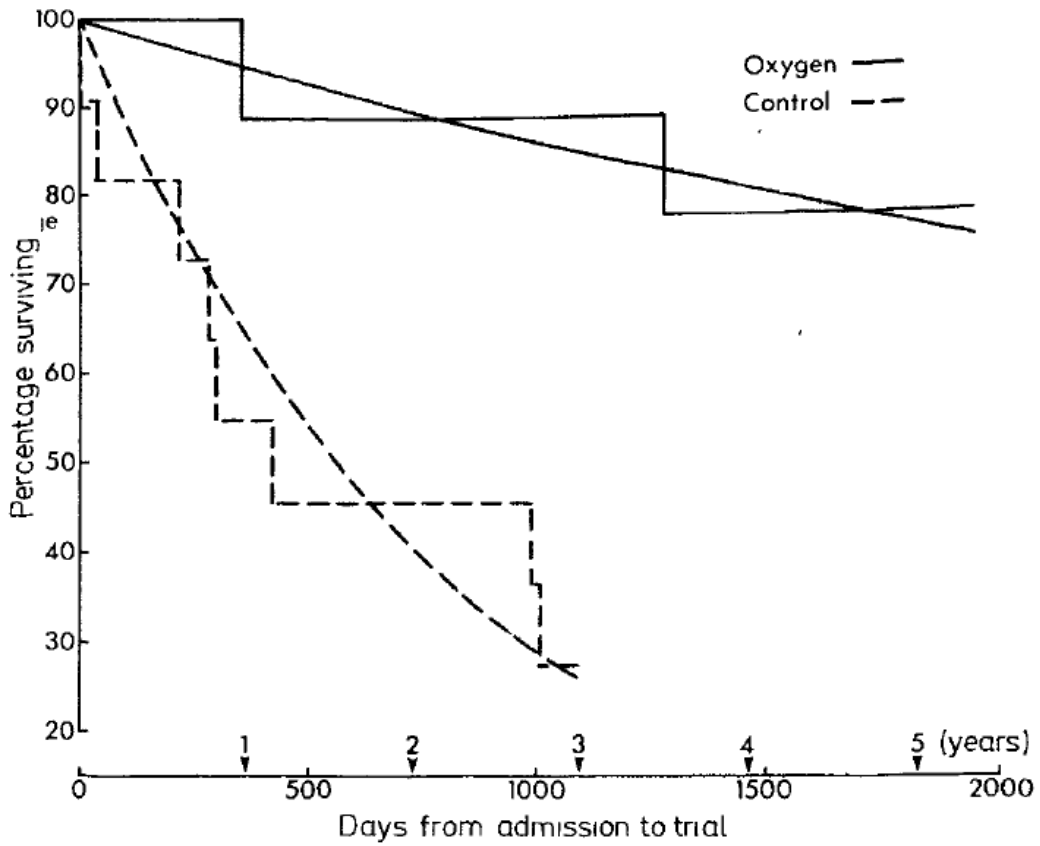
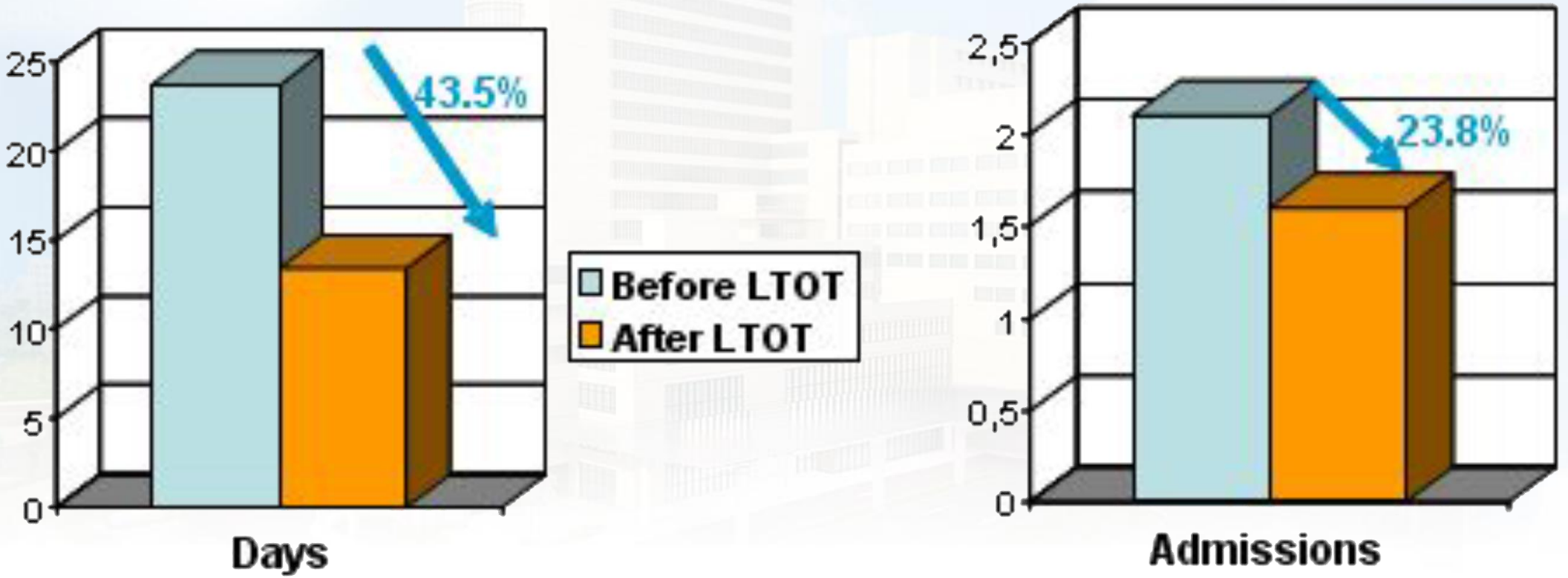


Fig. 2—Mortality in female patients.

Lancet. 1981;1(8222):681–6.

長期氧療降低 COPD惡化及重住院率



* Ringbaek JJ, et al.,Does long-term oxygen therapy reduce hospitalisation in hypoxaemic chronic obstructive pulmonary disease?" European Respiratory Journal 2002, 20; 1: 38–42

** Garcia-Aymerich J. Patients hospitalized for COPD have a high prevalence of modifiable risk factors for exacerbation (EFRAM study) European Respiratory Journal 2000;16, 6,1037–1042,.

Continuous or Nocturnal Oxygen Therapy in Hypoxemic Chronic Obstructive Lung Disease: A Clinical Trial

*NOCTURNAL OXYGEN THERAPY TRIAL GROUP**

1980 年夜間氧氣治療研究（Nocturnal Oxygen Therapy Trial study, NOTT study）也顯示此類肺阻塞病人連續氧氣治療比夜間氧氣治療可以顯著改善死亡率。

FULL TEXT

MORE

Abstract

At six centers, 203 patients with hypoxemic chronic obstructive lung disease were randomly allocated to either continuous oxygen (O_2) therapy or 12-hour nocturnal O_2 therapy and followed for at least 12 months (mean, 19.3 months). The two groups were initially well matched in terms of physiological and neuropsychological function. Compliance with each oxygen regimen was good. Overall mortality in the nocturnal O_2 therapy group was 1.94 times that in the continuous O_2 therapy group ($P = 0.01$). This trend was striking in patients with carbon dioxide retention and also present in patients with relatively poor lung function, low mean nocturnal oxygen saturation, more severe brain dysfunction, and prominent mood disturbances. Continuous O_2 therapy also appeared to benefit patients with low mean pulmonary artery pressure and pulmonary vascular resistance and those with relatively well-preserved exercise capacity. We conclude that in hypoxemic chronic obstructive lung disease, continuous O_2 therapy is associated with a lower mortality than is nocturnal O_2 therapy. The reason for this difference is not clear.

長期氧氣治療對於肺阻塞併**中度低血氧**病人（ PaO2：56-65 mmHg）對於存活率並沒有助益

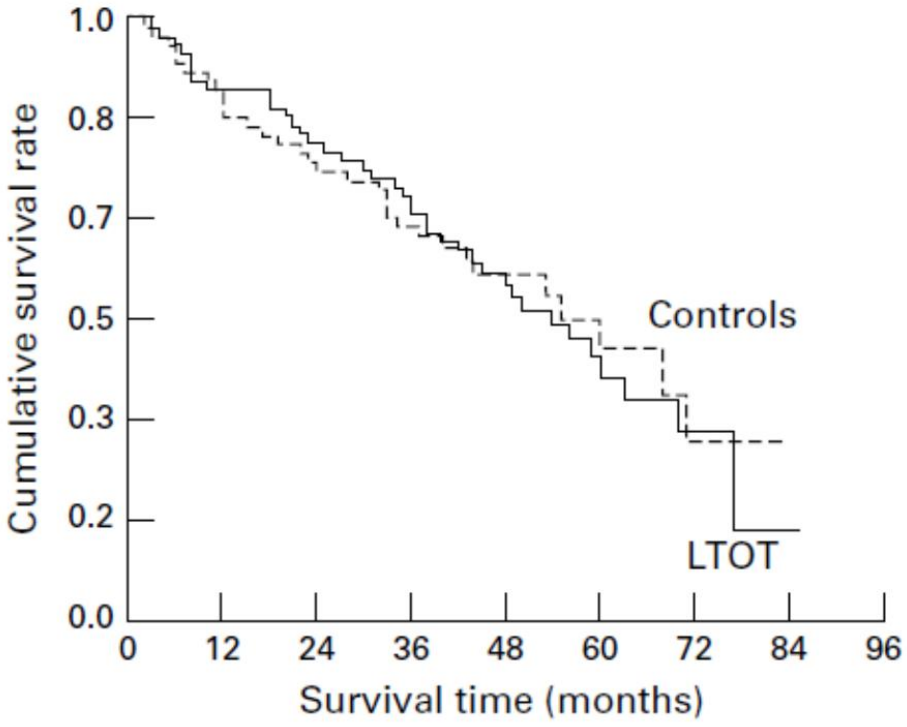


Figure 1 Cumulative survival rate in LTOT group and controls. Difference between groups is not statistically significant ($p = 0.892$).

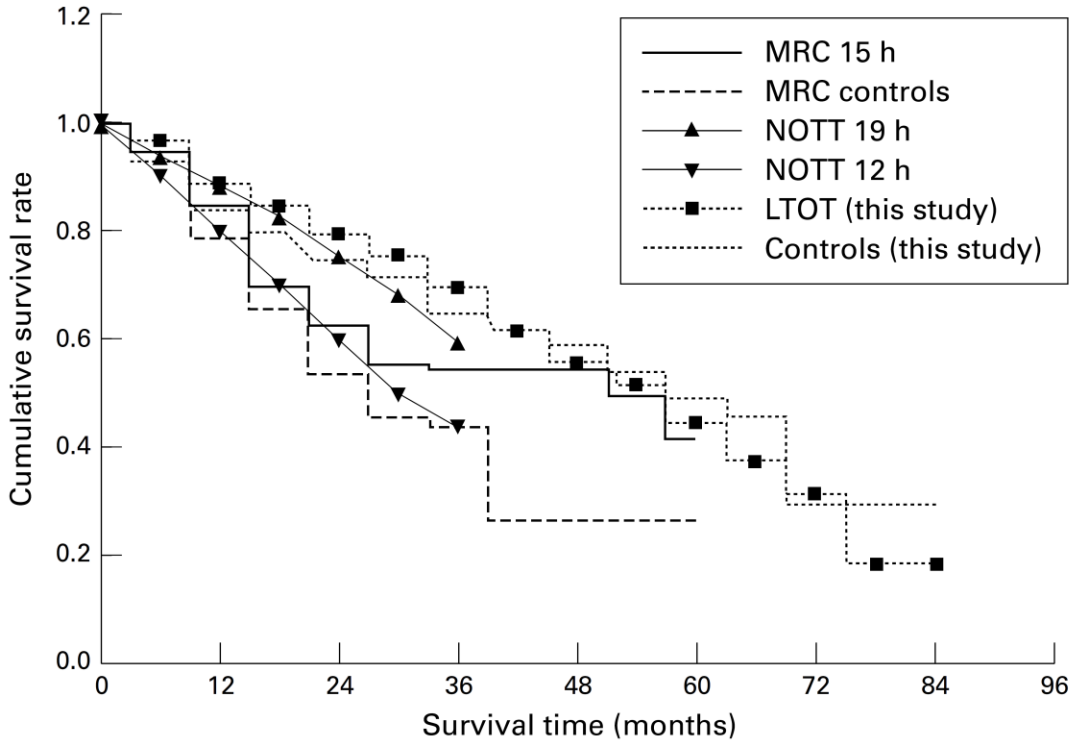


Figure 2 Cumulative survival rate in the LTOT group and control patients compared with the survival of patients in the MRC and NOTT studies.

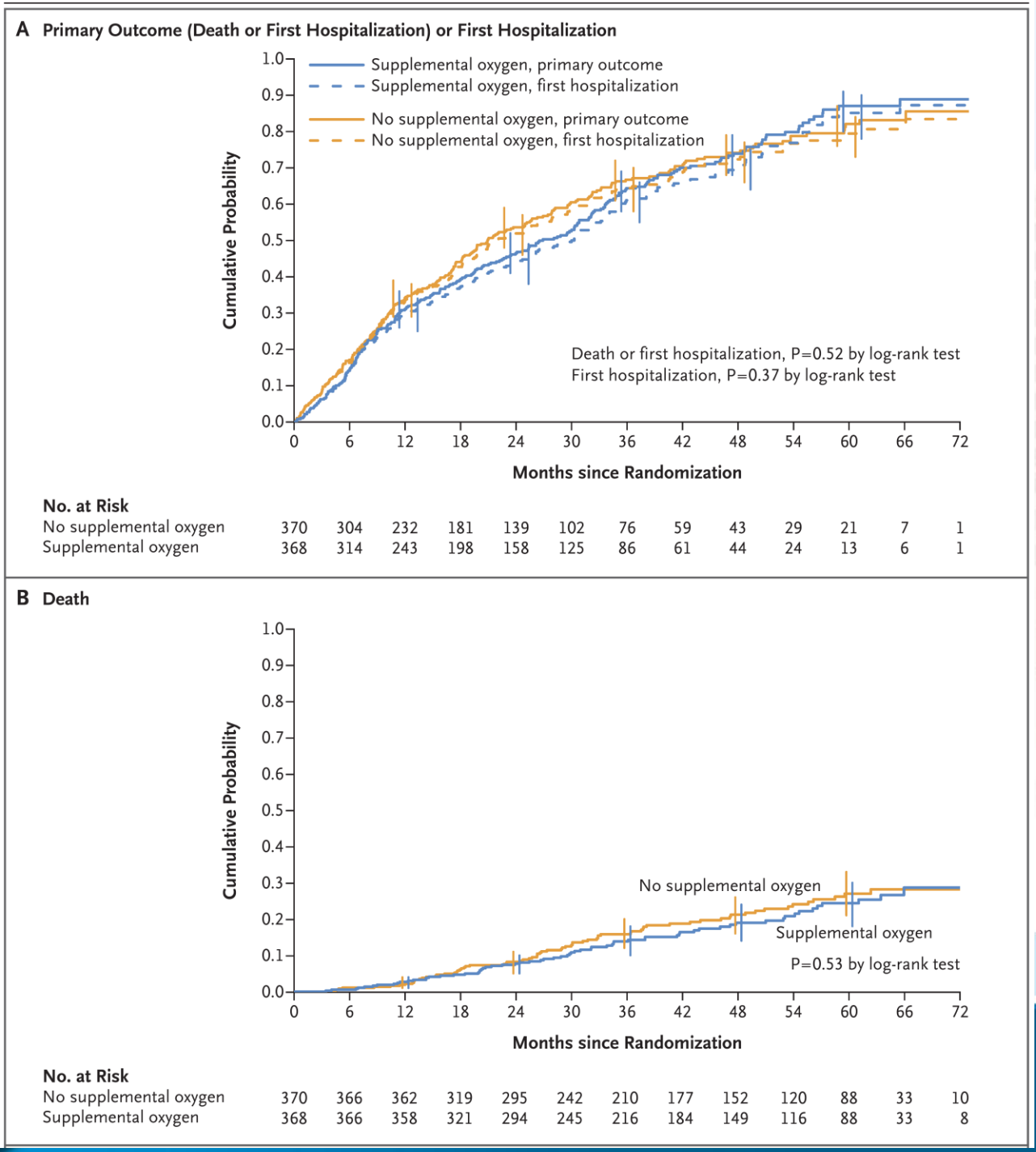
Thorax 1997;52:674–9

A Randomized Trial of Long-Term Oxygen for COPD with Moderate Desaturation

- Resting: SpO2:89-93%
- exercise-induced desaturation (6MWT, Spo2 ≥80% for ≥5 minutes and <90% for ≥10 seconds)

Characteristic	No Supplemental Oxygen (N=370)	Supplemental Oxygen (N=368)
Spo_2 at rest while breathing ambient air — %		
All patients	93.5±1.9	93.3±2.1
Resting only	92.3±0.8	92.4±0.9
Exercise only	95.2±1.2	95.4±1.4
Resting and exercise	91.9±1.2	91.7±1.1

N Engl J Med. 2016 ;375(17):1617-1627



No difference of first hospitalization and death

Limitations
Not really severe
Physician selection bias

N Engl J Med. 2016 ;375(17):1617-1627

長期氧氣治療的適應症

1. 休息時 $PaO_2 \leq 55$ mmHg 或 $SaO_2 \leq 88\%$
2. 休息時 PaO_2 介於 56-59 mmHg 或 SaO_2 介於 88-90%，合併有肺高壓、心臟衰竭合併肢體水腫、紅血球過多症（血比容大於 55%）。

Community Physician-Guided Long-Term Domiciliary Oxygen Therapy Combined With Conventional Therapy in Stage IV COPD Patients

Table 2 Effects of oxygen therapy on COPD patients' blood gas analyses and pulmonary function under conventional therapy

	LTDOT Group (n = 28)		Control Group (n = 26)	
Index	Before Treatment	After Treatment	Before Treatment	After Treatment
PaO_2 (mm Hg)	52.32 ± 2.45	61.23 ± 6.12*	52.48 ± 2.37	51.76 ± 5.21
$PaCO_2$ (mm Hg)	45.26 ± 4.81	44.16 ± 5.03	45.12 ± 5.08	46.05 ± 4.25
FEV_1%	42.2 ± 8.1	47.3 ± 5.56*	41.8 ± 4.7	40.00 ± 3.08
FEV_1/FVC	54.23 ± 4.8	57.48 ± 5.43*	54.08 ± 4.7	54.63 ± 5.0

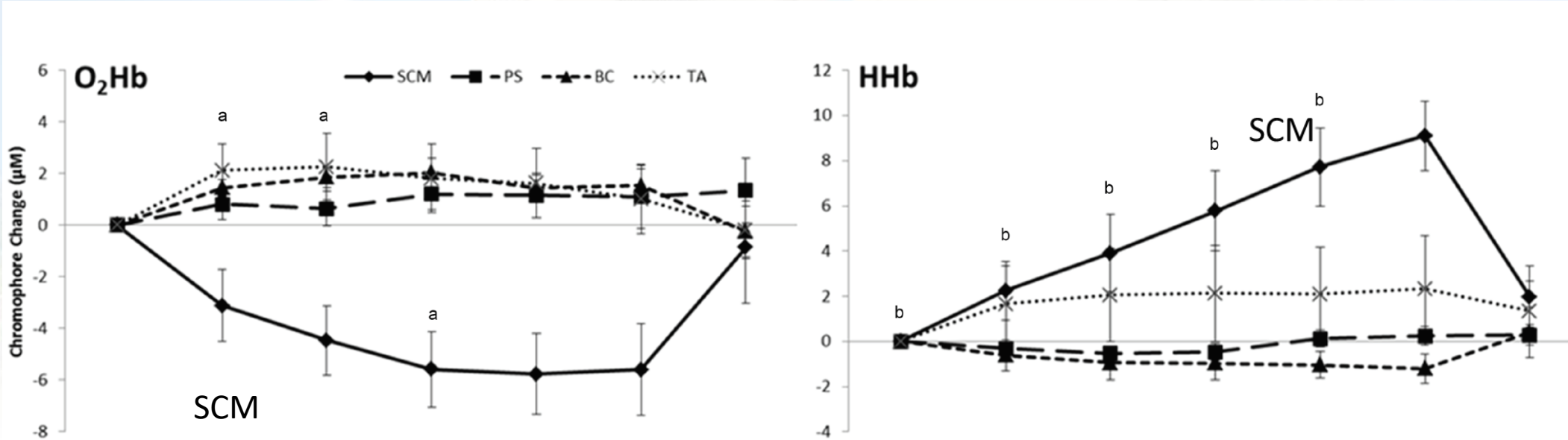
Table 4 Evaluation of the medical economics for COPD patients in both groups

	LTDOT Group (n = 28)		Control Group (n = 26)	
Index	Before Treatment	After Treatment	Before Treatment	After Treatment
Hospitalizations in the acute exacerbation stage	2.89 ± 1.18	1.71 ± 0.76*	2.85 ± 1.02	2.87 ± 1.3
Costs of emergency medical services (10,000 RMB/year)	1.39 ± 0.34	1.02 ± 0.21*	1.36 ± 0.32	1.35 ± 0.35
Hospitalization costs (10,000 RMB/year)	4.94 ± 2.09	3.74 ± 1.67*	4.85 ± 2.36	4.91 ± 2.30

Note. LTDOT = long-term domiciliary oxygen therapy; COPD = chronic obstructive pulmonary disease. *$p < .05$ compared with the control group.

Rehabil Nurs. 2017;42:268-273.

Recruitment and Deoxygenation of Respiratory and Skeletal Muscles During Incremental Loading in Stable COPD Patients



J Cardiopulm Rehabil Prev. 2016;36:279-87

Oxygen enhances the effect of rehabilitation

Baseline characteristics of the study population (n=16)

Characteristic	Mean ± SD
Age, years	65.9±6.6
FEV_1, % predicted	41.5±13.8
VO_2/kg, % predicted	48.8±16.7
Oxygen saturation on resting oximetry, %	97.1±1.9
Lowest oxygen saturation on ambulation, %	92.9±2.7

FEV_1 Forced expiratory volume in 1 s; VO_2 Maximal oxygen uptake

Exercise duration pre- and postrehabilitation, with and without oxygen (n=16)

	Exercise duration, s (mean ± SD)
Postrehabilitation (with oxygen)	409.4±205.3
Postrehabilitation (without oxygen)	256.3±158.4
Prerehabilitation (with oxygen)	303.5±145.0
Prerehabilitation (without oxygen)	228.1±156.8

Can Respir J. 2010;17(1):e14-9

Oxygen supplement in normoxemic patients with PR

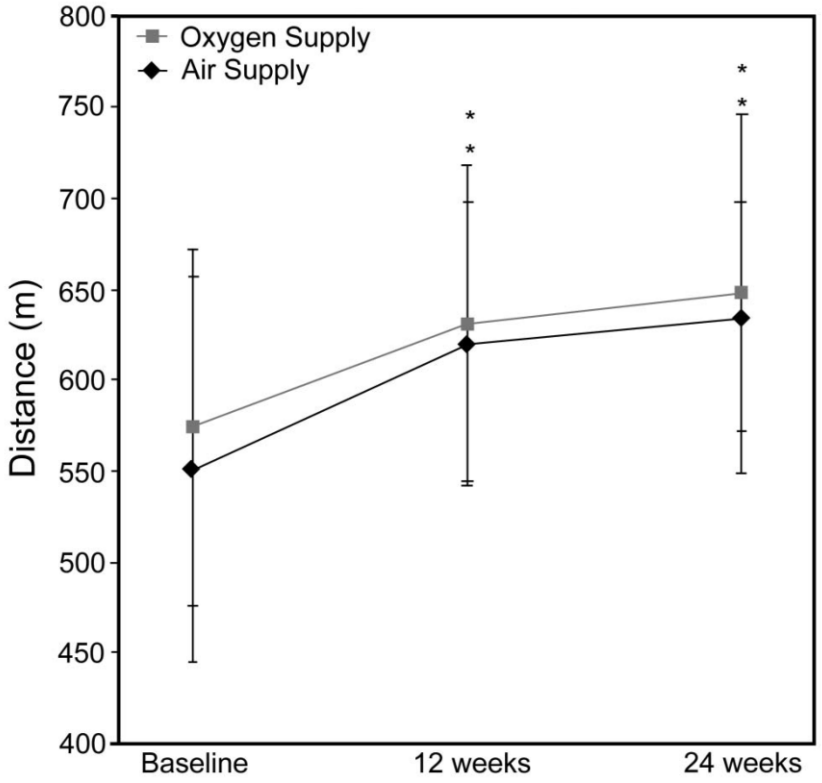


Fig. 2. The 6-min walk distance before (baseline) and after 12 and 24 weeks of training. Data are shown as mean ± SD. * Significant difference from baseline.

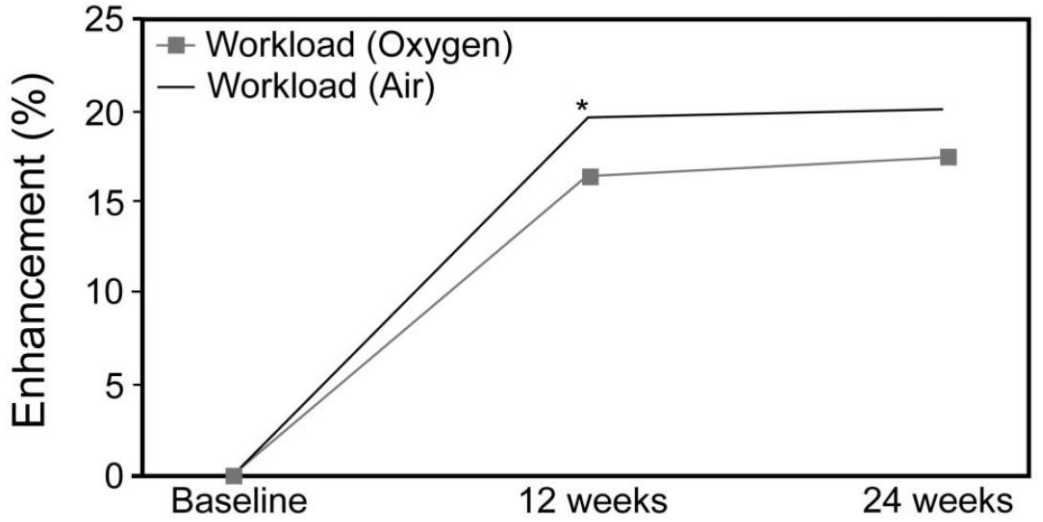


Fig. 3. Percent changes in peak work load after 12 and 24 weeks of training. * Significant difference from baseline. $P = .03$ (oxygen) and .03 (air).

Respir care 2015;60:540-8

行走中氧氣輔助治療Ambulatory Oxygen Therapy (AOT)

- AOT只應執行在 病患已經符合LTOT治療條件並且需要外出活動時 (Grade A)

  AOT assessment should only be offered to patients already on LTOT if they are mobile outdoors

- AOT可應用於病患在運動訓練/肺部復原課程時(需有一正式評估攜帶式氧氣可改善其運動耐受程度) (Grade B)

  AOT should be offered to patients for ise during exercise in a pulmonary rehabilitation programme or during an exercise programme following a formal assessment demonstrating improvement in exercise endurance

行走中氧氣輔助治療Ambulatory Oxygen Therapy (AOT)

- AOT之於病人之潛在性助益 hypothetical benefits：
  - 增加氧氣運送量(至組織) Increased oxygen transport
  - 使肌肉在運動時獲得更多的氧氣 Allowing greater utilisation of oxygen by exercising muscles
  - 使吸氣肌疲乏延遲發生 Delayed onset of inspiratory muscle fatigue
  - 減少呼吸困難 Reduction in symptoms of dyspnoea
  - 改善右心室功能 Improved right ventricular function

More longer use of home based oxygen: better physical activity in daily life

Table 3. Correlation between PADL and clinical and functional variables.

Variable	Correlation coefficient *r*	*p* Value
LTOT (h/day)	− 0.50	0.01
FSS (points)	− 0.36	0.03
MRC (points)	− 0.24	0.14
LCADL (points)	− 0.41	0.01
TUG (s)	− 0.33	0.07
6MST (no. of steps)	0.48	<0.01
STST (no. of repetitions)	0.53	<0.01

LTOT, long-term oxygen therapy; FSS, fatigue severity scale; MRC, Medical Research Council; LCADL, London Chest Activity of Daily Living; TUG, timed up and go; 6MST, 6-Minute step test; STST, sit to stand test.

COPD. 2018 May 25:1-6.

Summary of evidence for long-term oxygen use in in specific circumstances in COPD.

Resting hypoxemia	Resting PaO_2 ≤55 mmHg or SaO_2 ≤88% OR Resting PaO_2 between 56-59 mmHg (or SaO_2 ≤88%) with evidence of either pulmonary hypertension, cor pulmonale or polycythemia (hematocrit >55%)
Moderate hypoxemia	Resting PaO_2 ranging between 56 and 69 mmHg
Nocturnal desaturation	Spending ≥30% sleep time with SaO_2 < 90% without evidence of associated sleep apnea OR A fall in SaO_2 below 90% for 5 minutes or more with a nadir SaO_2 below 85% during sleep
Exercise-induced desaturation	SaO_2 ≤ 88% during exercise OR A fall in SaO_2 ≥ 4% during exercise

Moderate hypoxemia	Current evidence does not support the use of LTOT in COPD patients with moderate desaturation
Nocturnal desaturation	The benefit of LTOT for clinically relevant outcomes remains unclear due to the paucity of data
Exercise-induced desaturation	Oxygen administration causes less breathlessness and improves exercise capacity during exercise however the effectiveness of long term use of ambulatory oxygen on exercise capacity and mortality is not evident
Pulmonary rehabilitation and exercise training	There is insufficient evidence to confirm the benefits of supplemental oxygen during exercise training but oxygen administration may reduce breathlessness and improve exercise tolerance
Relief of dyspnea for palliation	Current evidence does not support the use of LTOT for the relief of dyspnea in non-hypoxemic COPD patients

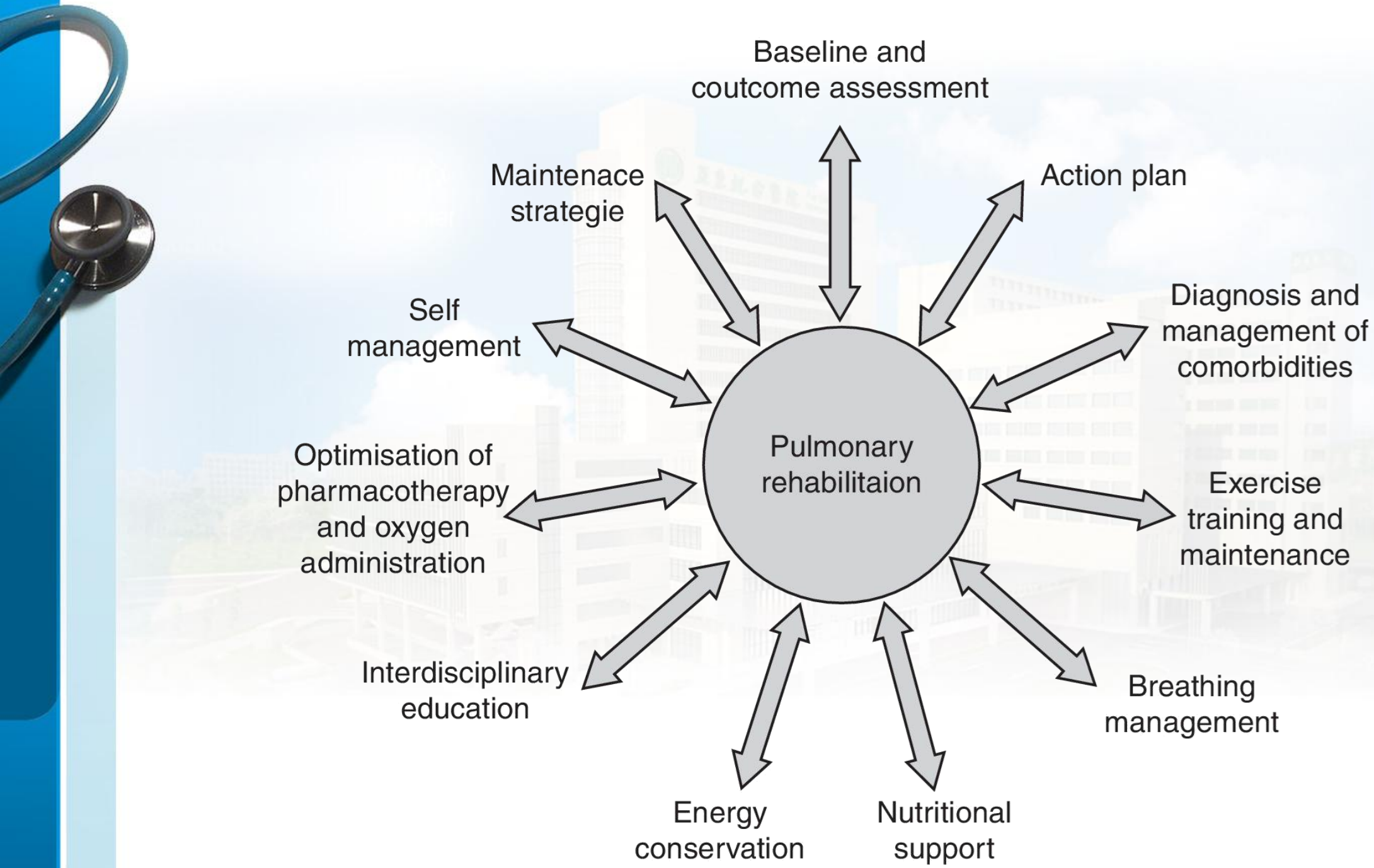
COPD. 2017;14:351-66

LTOT病患之後續追蹤

- 居家氧氣訪視與評估的附加價值：
  - 辨識和糾正病患用氧觀念與使用之錯誤 (氧氣設備、潮濕瓶、氧氣管路長度、用氧方式等) Identifying and correcting problems(Granados et al. 1997; Godoy et al., 2012)
  - 降低再發作率 Decrease exacerbation rates (Rizzi et al., 2009)
  - **顯著減少醫療成本 (儘管居家訪視本身有其支出，但大幅降低醫療院所資源之使用)** Significantly decreased costs in the homecare follow-up group (a reduction in use of hospital resources, despite the cost of running the service itself) (Farrero et al. 2001)

Conclusion

	Recommend/strength
A program of exercise training of the ambulation muscles is a mandatory component of pulmonary rehabilitationFor COPD	1A
Pulmonary rehabilitation improves dyspnea in patients with COPD	1A
Pulmonary rehabilitation improves health-related quality of life in patients with COPD	1A
Pulmonary rehabilitation reduces the number of hospital days and other measures of health-care utilization in patients with COPD	2B
There are psychosocial benefits from comprehensive pulmonary rehabilitation programs in patients with COPD	2B
Six to 12 weeks of pulmonary rehabilitation produces benefits in several outcomes, but these benefits decline gradually over 12–18 months	1A
Longer (12 weeks) pulmonary rehabilitation programs produce greater sustained benefits than do shorter programs	2C
Maintenance strategies following pulmonary rehabilitation have a modest effect on long-term outcomes	2C
In patients without exercise-induced hypoxemia, supplemental oxygen during a high-intensity exercise program may improve gains in exercise endurance	2C
Use supplemental oxygen rehabilitation exercise training in patients with severe exercise-induced hypoxemia	1C


Baseline and coutcome assessment
Maintenace strategie
Action plan
Self management
Diagnosis and management of comorbidities
Pulmonary rehabilitaion
Optimisation of pharmacotherapy and oxygen administration
Exercise training and maintenance
Interdisciplinary education
Breathing management
Energy conservation
Nutritional support

肺部復健/氧氣治療

居家住院、救人無數、必備良方

Thank You