BTS Guideline on Pulmonary Rehabilitation in adults

Web appendix 1: Clinical Questions

- **Do patients with COPD who continue to smoke get similar benefit and have similar completion rates from pulmonary rehabilitation compared with ex-smokers? Should they be referred?**
- **Do patients with COPD with chronic respiratory failure get similar benefit from pulmonary rehabilitation compared with those who do not have chronic respiratory failure and is it safe? Should they be referred?**
- **Do patients with COPD with co-existent cardiovascular disease get similar benefit from pulmonary rehabilitation compared with those who do not have cardiovascular disease and is it safe? Should they be referred?**
- **Do patients with COPD with co-existent anxiety and depression get similar benefit from pulmonary rehabilitation compared with those who are not anxious or depressed? Should they be referred?**
- **Do patients with COPD who are MRC grade 2 breathless get similar benefit from pulmonary rehabilitation compared with those with greater breathlessness? Should they be referred?**
- **Do patients with COPD who are MRC grade 5 breathless get similar benefit from pulmonary rehabilitation compared with those with MRC grade 3-4? Should they be referred?**
- **Role of pharmacological agents at referral to pulmonary rehabilitation.**
- **Is once weekly supervised pulmonary rehabilitation as effective at improving exercise performance and health status in patients with chronic respiratory disease when compared with a twice (or thrice) weekly supervised programme?**

- **Are pulmonary rehabilitation programmes that are less than 6 weeks in duration equally effective at improving exercise performance and health status in patients with chronic respiratory disease when compared with programmes that are longer or equal to 6 weeks in duration?**
- **Are rolling programmes of pulmonary rehabilitation equally effective as stand-alone programmes for patients with chronic respiratory disease?**
- **Are Pulmonary rehabilitation programmes that include resistance training and aerobic training more effective at improving exercise performance in patients with chronic respiratory disease when compared with aerobic training alone.**
- **Are Pulmonary rehabilitation programmes that include interval training more effective at improving exercise performance in patients with chronic respiratory disease when compared with continuous aerobic training?**
- **Do pulmonary rehabilitation programmes that include personal goal setting achieve greater improvements in functioning when compared with programmes that do not include personal goal setting?**
- **In patients with COPD does face to face twice-weekly supervision of pulmonary rehabilitation lead to greater improvements in walk test distance and dyspnoea scores than supervision provided by internet support /manual etc ?**
- **Does Pulmonary Rehabilitation within one month of discharge improve outcomes in COPD patients hospitalised for acute exacerbations of COPD compared with usual care?**
- **What is the completion rate of Pulmonary Rehabilitation within one month of hospital discharge in unselected patients compared with elective pulmonary rehabilitation?**

- **Does a cognitive-behavioural component delivered before commencing rehabilitation improve compliance (adherence / completion) of pulmonary rehabilitation?**
- **What is the impact of a pulmonary rehabilitation programme on the exercise, physical activity, muscle strength, health status, psychological state, and nutritional status of participants compared with usual care without pulmonary rehabilitation?**
- **What is the impact of a pulmonary rehabilitation programme on survival of participants compared with usual care without pulmonary rehabilitation?**
- **In patients with COPD does inspiratory muscle training plus pulmonary rehabilitation lead to greater improvements in exercise tolerance and dyspnoea scores than pulmonary rehabilitation alone?**
- **In patients with COPD does therapy with hormones / drug / nutricicals plus pulmonary rehabilitation lead to greater improvements in walk test distance and dyspnoea scores than pulmonary rehabilitation alone?**
- **In patients with COPD does non-invasive ventilation (NIV) DURING exercise of pulmonary rehabilitation lead to greater improvements in walk test distance and dyspnoea scores than pulmonary rehabilitation alone in those with type II respiratory failure?**
- **In patients with COPD does neuromuscular electrical stimulation (NMES) plus pulmonary rehabilitation lead to greater improvements in walk test distance and dyspnoea scores than pulmonary rehabilitation alone?**
- **In patients with COPD and exercise desaturation does the acute administration of medical gases DURING the exercise component of pulmonary rehabilitation lead to**

greater improvements in walk test distance and dyspnoea scores than pulmonary rehabilitation in room air?

- **Should pulmonary rehabilitation be repeated? If so, when?**
- **Should maintenance "exercise" be offered following their first pulmonary rehabilitation**
- **Does pulmonary rehabilitation lead to improvement in exercise capacity, health status, breathlessness in adult patients with non-CF bronchiectasis compared with patients with non-CF bronchiectasis that do not undergo rehabilitation?**
- **Does pulmonary rehabilitation lead to improvement in exercise capacity, health status, breathlessness in adult patients with interstitial lung disease compared with patients with interstitial lung disease that do not undergo rehabilitation?**
- **Does pulmonary rehabilitation lead to improvement in exercise capacity, health status, breathlessness in adult patients with asthma compared with patients with asthma that do not undergo rehabilitation?**

b) Web appendix: Literature Search details

Sources to be searched for the guidelines;

Cochrane Database of Systematic Reviews (CDSR)
Database of Abstracts of Reviews of Effects (DARE)
MEDLINE
EMBASE

Dates searched: 1980 onwards
All study types
English language only

Four search strategies used- COPD, bronchiectasis, restrictive lung disease, and asthma.

1.COPD search

Cochrane Library (includes CDSR and DARE)
http://www.thecochranelibrary.com
Searched online 05/08/11

#1 MeSH descriptor Pulmonary Disease, Chronic Obstructive explode all trees 1669
#2 (COPD or "chronic obstructive pulmonary disease" or "pulmonary disease, chronic obstructive"):ti,ab 6357
#3 ("chronic obstructive airway* disease" or "chronic airflow limitation"):ti,ab 132
#4 ("chronic obstructive lung disease" or "lung disease, chronic obstructive"):ti,ab 786
#5 (#1 OR #2 OR #3 OR #4) 7042
#6 (pulmonary near/3 rehabilitat*):ti,ab 453
#7 (#5 AND #6) 365
#8 MeSH descriptor Pulmonary Disease, Chronic Obstructive, this term only with qualifier: RH 235
#9 (#7 OR #8) 481
#10 (#7 OR #8), from 1980 to 2011 30
Of 30 results 9 were from Cochrane Database of Systematic Reviews (CDSR) and 21 from Database of Reviews of Effects (DARE).

MEDLINE
Searched 05/08/11 via OVID interface
Ovid MEDLINE(R) <1948 to July Week 4 2011>

1 exp Pulmonary Disease, Chronic Obstructive/ (16419)
2 (COPD or "chronic obstructive pulmonary disease" or "pulmonary disease, chronic obstructive").ti,ab. (25628)
3 ("chronic obstructive airway$ disease" or "chronic airflow limitation").ti,ab. (915)

4 ("chronic obstructive lung disease" or "lung disease, chronic obstructive").ti,ab. (2494)
5 1 or 2 or 3 or 4 (31618)
6 (pulmonary adj3 rehabilitat$).ti,ab. (1507)
7 5 and 6 (1023)
8 *Pulmonary Disease, Chronic Obstructive/rh [Rehabilitation] (735)
9 7 or 8 (1343)
10 limit 9 to (english language and yr="1980 - 2011") (1127)

EMBASE

Searched 05/08/11 via OVID interface
Embase <1980 to 2011 Week 30>

1 exp chronic obstructive lung disease/ (51618)
2 (COPD or "chronic obstructive pulmonary disease" or "pulmonary disease, chronic obstructive").ti,ab. (32905)
3 ("chronic obstructive airway$ disease" or "chronic airflow limitation").ti,ab. (1116)
4 ("chronic obstructive lung disease" or "lung disease, chronic obstructive").ti,ab. (2956)
5 1 or 2 or 3 or 4 (57587)
6 (pulmonary adj3 rehabilitat$).ti,ab. (2037)
7 5 and 6 (1508)
8 *chronic obstructive lung disease/rh [Rehabilitation] (1886)
9 7 or 8 (2581)
10 limit 9 to (english language and yr="1980 - 2011") (1931)

Results

Database	**Results**	**After deduplication**	**Custom 4 field**
Cochrane Database of Systematic Reviews	9	9	main search Cochrane Database of Systematic Reviews 05/08/11
Database of Abstracts of Reviews of Effects	21	21	main search DARE (non-Cochrane systematic reviews) 05/08/11
MEDLINE	1343	1085	main search Medline 05/08/11
EMBASE	1931	972	main search Embase 05/08/11

Total	**3304**	**2087**	

2087 results saved to Endnote X3 library bts pulmonary rehab.enl

2. Bronchiectasis search

Cochrane Library (includes CDSR and DARE)
http://www.thecochranelibrary.com
Searched online 11/08/11

#1 (pulmonary near/3 rehabilitat*):ti,ab 453
#2 MeSH descriptor Bronchiectasis explode all trees 124
#3 bronchiectasis:ti,ab 240
#4 "kartagener syndrome":ti,ab 0
#5 (#2 OR #3 OR #4) 275
#6 (#1 AND #5), from 1980 to 2011 7
Of 7 results in entire Cochrane Library 1 was from Cochrane Database of Systematic Reviews (CDSR) and none from Database of Reviews of Effects (DARE).

MEDLINE
Searched 11/08/11 via OVID interface
Ovid MEDLINE(R) <1948 to August Week 1 2011>

1 (pulmonary adj3 rehabilitat$).ti,ab. (1510)
2 exp Bronchiectasis/ (6778)
3 bronchiectasis.ti,ab. (5128)
4 "kartagener syndrome".ti,ab. (170)
5 2 or 3 or 4 (8706)
6 1 and 5 (17)
7 limit 6 to (english language and yr="1980 - 2011") (13)

EMBASE
Searched 11/08/11 via OVID interface
Embase <1980 to 2011 Week 31>

1 (pulmonary adj3 rehabilitat$).ti,ab. (2039)
2 exp Bronchiectasis/ (10031)
3 bronchiectasis.ti,ab. (6097)
4 "kartagener syndrome".ti,ab. (198)
5 2 or 3 or 4 (11405)
6 1 and 5 (37)
7 limit 6 to (english language and yr="1980 - 2011") (30)

Results

Database	Results	After deduplication	Custom 4 field
Cochrane Database of Systematic Reviews	1	1	Q9 bronchiectasis CDSR 12/08/11
Database of Abstracts of Reviews of Effects	0	0	
MEDLINE	13	12	Q9 bronchiectasis medline 12/08/11
EMBASE	30	16	Q9 bronchiectasis embase 12/08/11
Total	**44**	**29**	

29 results saved to Endnote X3 library bts pulmonary rehab.enl were not deduplicated against the results of the COPD, restrictive lung disease or asthma searches.

3. Restrictive lung disease search

Cochrane Library (includes CDSR and DARE)
http://www.thecochranelibrary.com
Searched online 11/08/11

#1 (pulmonary near/3 rehabilitat*):ti,ab 453
#2 MeSH descriptor Idiopathic Interstitial Pneumonias explode all trees 13
#3 "idiopathic pulmonary fibrosis":ti,ab 127
#4 "Idiopathic interstitial pneumonia":ti,ab 7
#5 MeSH descriptor Sarcoidosis explode all trees 105
#6 sarcoidosis:ti,ab 168
#7 MeSH descriptor Pulmonary Eosinophilia explode all trees 23
#8 "Eosinophilic pneumonia":ti,ab 1
#9 MeSH descriptor Lymphangioleiomyomatosis explode all trees 4
#10 lymphangioleiomyomatos*:ti,ab 4
#11 MeSH descriptor Histiocytosis, Langerhans-Cell explode all trees 10
#12 "pulmonary Langerhans cell histiocytosis":ti,ab 1
#13 MeSH descriptor Pulmonary Alveolar Proteinosis explode all trees 2

#14 "pulmonary alveolar proteinosis":ti,ab 3
#15 (#2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11 OR #12 OR #13 OR #14) 350
#16 (#1 AND #15), from 1980 to 2011 7
Of 7 results in entire Cochrane Library none were from Cochrane Database of Systematic Reviews (CDSR) or from Database of Reviews of Effects (DARE).

MEDLINE
Searched 11/08/11 via OVID interface
Ovid MEDLINE(R) <1948 to August Week 1 2011>

1 (pulmonary adj3 rehabilitat$).ti,ab. (1510)
2 exp Idiopathic Interstitial Pneumonias/ (1240)
3 "idiopathic pulmonary fibros$".ti,ab. (2749)
4 "Idiopathic interstitial pneumonia$".ti,ab. (617)
5 exp Sarcoidosis/ (19537)
6 sarcoidosis.ti,ab. (16735)
7 exp Pulmonary Eosinophilia/ (2141)
8 "Eosinophilic pneumonia$".ti,ab. (796)
9 exp Lymphangioleiomyomatosis/ (712)
10 lymphangioleiomyomatos$.ti,ab. (832)
11 exp Histiocytosis, Langerhans-Cell/ (6349)
12 "pulmonary Langerhans$ cell histiocytos$".ti,ab. (159)
13 exp Pulmonary Alveolar Proteinosis/ (1181)
14 "pulmonary alveolar proteinos$".ti,ab. (921)
15 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 (35891)
16 1 and 15 (16)
17 limit 16 to (english language and yr="1980 - 2011") (11)

EMBASE
Searched 11/08/11 via OVID interface
Embase <1980 to 2011 Week 31>

1 (pulmonary adj3 rehabilitat$).ti,ab. (2039)
2 exp interstitial pneumonia/ (7074)
3 "idiopathic pulmonary fibros$".ti,ab. (3350)
4 "Idiopathic interstitial pneumonia$".ti,ab. (768)
5 exp Sarcoidosis/ (22878)
6 sarcoidosis.ti,ab. (18865)
7 exp Loeffler pneumonia/ (2462)
8 "Eosinophilic pneumonia$".ti,ab. (977)
9 exp lymphangioleiomyomatosis/ (1022)

10 lymphangioleiomyomatos$.ti,ab. (980)
11 exp histiocytosis X/ (4354)
12 "pulmonary Langerhans$ cell histiocytos$".ti,ab. (195)
13 exp lung alveolus proteinosis/ (1503)
14 "pulmonary alveolar proteinos$".ti,ab. (998)
15 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 (44441)
16 1 and 15 (24)
17 limit 16 to (english language and yr="1980 - 2011") (18)

Results

Database	**Results**	**After deduplication**	**Custom 4 field**
Cochrane Database of Systematic Reviews	0	0	
Database of Abstracts of Reviews of Effects	0	0	
MEDLINE	11	11	Q9 restrictive lung disease medline 12/08/11
EMBASE	18	8	Q9 restrictive lung disease embase 12/08/11
Total	**29**	**19**	

19 results saved to Endnote X3 library bts pulmonary rehab.enl were not deduplicated against the results of the COPD, bronchiectasis or asthma searches.

4. Asthma search

Cochrane Library (includes CDSR and DARE)
http://www.thecochranelibrary.com
Searched online 11/08/11

#1 (pulmonary near/3 rehabilitat*):ti,ab 453
#2 MeSH descriptor Asthma explode all trees 8569
#3 asthma*:ti,ab 17864

#4 (#2 OR #3) 18448
#5 (#1 AND #4), from 1980 to 2011 14
Of 14 results in entire Cochrane Library none were from Cochrane Database of Systematic Reviews (CDSR) and 1 was from Database of Reviews of Effects (DARE).

MEDLINE
Searched 11/08/11 via OVID interface
Ovid MEDLINE(R) <1948 to August Week 1 2011>

1 (pulmonary adj3 rehabilitat$).ti,ab. (1510)
2 exp Asthma/ (96007)
3 asthma$.ti,ab. (101127)
4 2 or 3 (118985)
5 1 and 4 (73)
6 limit 5 to (english language and yr="1980 - 2011") (49)

EMBASE
Searched 11/08/11 via OVID interface
Embase <1980 to 2011 Week 31>

1 (pulmonary adj3 rehabilitat$).ti,ab. (2039)
2 exp Asthma/ (147677)
3 asthma$.ti,ab. (124740)
4 2 or 3 (165715)
5 1 and 4 (122)
6 limit 5 to (english language and yr="1980 - 2011") (89)

Results

Database	**Results**	**After deduplication**	**Custom 4 field**
Cochrane Database of Systematic Reviews	0	0	
Database of Abstracts of Reviews of Effects	1	1	Q9 asthma DARE 12/08/11
MEDLINE	49	47	Q9 asthma medline 12/08/11
EMBASE	89	44	Q9 asthma embase

			12/08/11
Total	**139**	**92**	

92 results saved to Endnote X3 library bts pulmonary rehab.enl were not deduplicated against the results of the COPD, bronchiectasis or restrictive lung disease searches.

BTS Guideline on Pulmonary Rehabilitation in adults

Web appendix 3: Evidence tables

The evidence tables can be found as an online appendix at the British Thoracic Society website. See separate document. Abbreviations for the evidence tables are listed in web appendix 4.

Title: The British Thoracic Society Guideline on Pulmonary Rehabilitation in Adults

Short Title: BTS Pulmonary Rehabilitation Guideline

Web Appendix 3 - EVIDENCE TABLES

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iii) Web appendix: Evidence tables

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Ambrosino N, Foglio K, Balzano G, *et. al*; Tiotropium Multicentric Italian Study Group. Int J Chron Obstruct Pulmon Dis. 2008; 3(4):771-80.	RCT	1-	234	234 (196 male) patients with COPD – FEV1 1.1(0.4)L; 41(13)% predicted randomised to tiotropium or placebo before pulmonary rehabilitation. 87 tiotropium and 90 placebo patients completed study	Tiotropium All subjects had 8 week outpatient pulmonary rehabilitation (3 exercise sessions/week).	Placebo	12 weeks after pulmonary rehabilitation	Comparison of group response tiotropium vs. placebo. Outcome measures exercise capacity (6MWT), dyspnoea (TDI) and HRQOL (SGRQ)	Both groups improved 6MWD after pulmonary rehabilitation (27m tiotropium vs. 33m placebo) but no difference between the groups at end of pulmonary rehabilitation or 12 weeks post-pulmonary rehabilitation. Both groups improved TDI after pulmonary rehabilitation (3.6 tiotropium vs. 2.3 placebo) with larger increase in tiotropium ($p<0.001$). both groups improved SGRQ after pulmonary rehabilitation (-8.1 tiotropium vs. -6.1 placebo) maintained after 12 week follow-up but no difference between groups at either time point	Boehringer Ingelheim and Pfizer Pharmaceuticals (Italy)
Comments: Patients with COPD improve walking distance, dyspnoea and HRQOL with pulmonary rehabilitation. Tiotropium enhances improvement in breathlessness but not walking distance or HRQOL. The randomisation process is unclear (and exact "1:1" raises concern). There is no mention of allocation concealment or blinding methods. The difference in medication use at trial entry meant far more of the placebo arm had medication stopped (ICS/anticholinergics). An ITT analysis is reported in the methods but not undertaken – analysis is neither ITT nor per-protocol and numbers vary by analysis.										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Arnold R, Ranchor AV, Koëter GH, *et*	Cohort	2-	39	COPD, age 40-80, FEV1<70%, no	Pulmonary rehabilitation	Pre and post	mean duration 20	Rand 36 health survey, Cantril's	Improvements in overall quality of	Not stated

***al.* Changes in personal control as a predictor of quality of life after pulmonary rehabilitation. Patient Education and Counselling. 2006; 61: 99–108.**				psychiatric illness in previous year			weeks	ladder, Mastery scale of Pearlin and Schooler, Self-efficacy scale of Sullivan et al	life and self-efficacy. No change in mastery, symptoms of COPD	
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Baldi S, Aquilani R, Pinna GD, *et al.* Fat-free mass change after nutritional rehabilitation in weight losing COPD: role of insulin, C-reactive protein and tissue hypoxia. Int J Chron Obstruct Pulmon Dis. 2010; 5: 29-39.	RCT	1-	28 subjects; Intervention group; 14 (13 analysed) Control group; 14 (13 analysed)	COPD diagnosis, >5% weight loss in previous 6 months, clinically stable	4 grams of essential amino acid (EAA) solution x 2 / day with an initial 4 week inpatient and then 8 week outpatient pulmonary rehabilitation programme.	4 week inpatient and then 8 week outpatient pulmonary rehabilitation programme	12 weeks.	Body weight, FFM Change in FFM in contrast to fasting insulin plasma levels, (CRP) and oxygen extraction tension.	Body weight; EAA group average increase of 3.8kg +/- 2.6kg (p 0.0002) and –0.1kg +/- 1.1kg (p 0.81) in Control group. FFM; EAA group average increase of 1.5kg +/- 2.6kg (p 0.05) and –0.1kg +/- 2.3kg in Control group (p 0.94). In EAA group FFM significantly related to fasting insulin (r2 = 0.68, p <0.0005), CRP (r2 = 0.46, p <0.01) and oxygen extraction tension (r2 = 0.46, p <0.01).	Not stated
Comments: No details of randomising process. No details of compliance regarding home based pulmonary rehabilitation programme. Results not ITT.										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Bernard S, Whittom F, Leblanc P, *et al*. Aerobic and strength training in patients with COPD. Am J Resp Crit Care	RT Reviewed in O'Shea systematic review	1+	45 (36 completed)	Mod – severe COPD	12 week Combination of aerobic training and strength training X 3 sessions per week.	12 week aerobic training alone	12 weeks	Peripheral muscle strength and composition, 6MWD, HRQOL	Small non-significant trend towards improvement in walking distance. Sig increase in muscle strength.	Supported in part by the Fonds de la Recherche en Santé du Québec and by la Fondation J. D. Bégin, Université

Med. 1999; 159(3): 896 – 901.									No improvement in HRQOL	Laval.

Comments: No concealment of treatment allocation

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Berry MJ, Rejeski WJ, Miller ME, *et al*. A lifestyle activity intervention in patients with chronic obstructive pulmonary disease. Respiratory Medicine. 2010; 104: 829-839.	RCT (single blinded)	1-	176 randomised: intervention group= 87 control group= 89.	FEV1/FVC ≤70%, FEV1 ≥20% pred. Reported difficulty in performing at least one of several daily activities (listed in paper) due to dyspnoea. Number of exclusions including severe CV disease, no active treatment for cancer, not participated in a pulmonary rehabilitation or exercise programme in the previous 3 months	Lifestyle activity programme (LAP).	Traditional exercise treatment (TET)	12 months	**Primary outcome**; Moderate physical activity (kcals / week). **Secondary outcomes**; Physical function (6 MWT, stair climb time, Short physical performance battery (SPPB), Self-reported disability, Health related QOL (CRDQ, CESD, SF-36). Exercise capacity via VO2 peak and total time during graded exercise test on treadmill.	No significant 'between group' differences seen at 12 month follow up.	Supported grants HL 53755, AG 21332 and M01 RR07122 from the National Institutes of Health

Comments: Well written although appears to have lost power. Single blinded. Results not ITT. Study patients pre assessed prior to randomisation to select most motivated to complete self-monitoring over 12 months.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Berry MJ, Adair NE, Sevensky KS *et al*. Inspiratory Muscle Training and Whole Body Reconditioning in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 1996; 153:1812-6	RCT	1+	25 total: 8 IMT & GER, 9 GER, 8 flexibility exercise and sham IMT	Mild to moderate COPD by usual definitions	GER: individualised strength and aerobic exercise plan thrice weekly over 12 weeks; IMT: threshold trainer at increasing % to 80% PImax	Flexibility exercises, breathing exercises, IMT at 15% Pimax	End of intervention	Pimax; CPEX outcomes; 12 MWT; dyspnoea score	12 MWT increases of 400 ft in both active arms. No change in dyspnoea scores or CPEX parameters.	Charity

Comments: 2 drop-outs from this small study, similar baseline characteristics. Blinding described but not randomisation process. Analyses strategy appropriate.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Borg-Silva A,	RCT	1-	16 patients (10 male);	Stable COPD,	2g oral L-	Saline solution	6 weeks	Nutritional status,	Blood lactate,	L-carnitine partly

Baldissera V, Sampaio LMM, *et al*. L-Carnitine as an ergogenic aid for patients with chronic obstructive pulmonary disease submitted to whole-body and respiratory muscle training programs. Brazilian Journal of Medical and Biological Research. 2006; 39: 465-474.			8 in intervention group 8 in control group.	FEV1 <50% / FVC <70% predicted and clinical history consistent with COPD	carnitine daily	"similar in colour, shape and taste" to L-carnitine. (Dose not specified).		exercise tolerance on a treadmill and 6MWD, blood lactate, heart rate, blood pressure, respiratory muscle strength.	blood pressure, oxygen saturation, heart rate at identical exercise levels lower in intervention group post training (p <0.05) Increases in PImax sig greater in intervention group v control (40+/- 14 vs. 14 +/- 5 cm H2O p<0.05). Increases in 6MWD sig improved in intervention group v control (87 +/- 30 vs. 34 +/- 29m p<0.05). Blood lactate concentration was sig lower in intervention group v control (1.6 +/- 0.7 vs. 2.3 +/- 0.7 Mm/L, p<0.05)	supplied by Sinto-farma as a donation and additional Sintofarma L-carnitine supplies funded by FAPESP (No. 00/00311-6)

Comments: Randomising process poorly detailed, study workers not blinded, risk of recall bias when using diet history recall. Anthropometric measurements (Tricep skin fold (TSF) and mid-arm circumference (MAC)) carried out although not stated if same worker completed all measurements.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Borghi-Silva A, Mendes RG, Toledo AC, *et al*. Adjuncts to physical training of patients with severe COPD: Oxygen or noninvasive ventilation? Respiratory Care. 2010; 55(7):885-94.	RCT	1-	28 randomised; 24 completed	GOLD 3 or 4 COPD	Supplemental oxygen via NS to keep SpO2>90% plus pulmonary rehabilitation for 6 weeks	Bi-level pressure support NIV (at maximum pressures tolerated) plus pulmonary rehabilitation for 6 weeks	End of pulmonary rehabilitation	6MWT; SGRQ; CPEX; knee extension power /endurance	74m additional increase (mean) in 6MWT; no difference in leg power, SGRQ, or VO2max.	Not stated

Comments: The study was small and not blinded.

Bibliographic	Study	Ev lev	Number patients	Patient	Intervention	Comparison	Length of	Outcome measures	Effect size	Source of funding

citation	type			characteristics			follow up			
Broekhuizen R, Wouters EFM, Creutzberg EC, *et al*. Polyunsaturated fatty acids improve exercise capacity in chronic obstructive pulmonary disease. Thorax. 2005; 60: 376-382.	RCT double blinded	1-	Total; 102 Intervention; 51 (38 completed) Placebo; 51(42 completed)	Clinically stable GOLD stage II-IV	Polyunsaturated fatty acids PUFA's; Dose 9 g / day (containing 1.04g EPA & DHA)	Placebo; 9g daily containing 80% palm oil and 20% sunflower oil, iso-calorific as PUFA intervention arm	8 weeks	Body composition, Functional capacity; (Lung function, Incremental cycle ergometry test, submaximal cycle test, isokinetic quadriceps strength) Inflammatory markers; CRP, (IL)-6, TNF.	Comparison of intervention vs. placebo; Peak load of incremental exercise test increased in PUFA group more than placebo; (mean diff +9.7W, p=0.009). PUFA group; Greater duration of constant work rate (mean diff +4.3 minutes, p 0.023)	Supported by Numico Research BV

Comments: No details of randomisation process. High drop-out rate of 25% in intervention group. Results not ITT.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Broekhuizen R, Creutzberg EC, Weling-Scheepers CA *et al*. Optimizing oral nutritional drink supplementation in patients with chronic obstructive pulmonary disease. British Journal of Nutrition. 2005; 93: 965-971.	Non-RCT	2-	39 subjects (group A; n=19 Group B; n=20)	Stable COPD, admitted consecutively to inpatient pulmonary rehabilitation unit and requiring nutritional support + at least one of following: BMI equal to or below 21 kg/m2 FFMI equal to or below 16 (men)/ 15 (women) kg/m2 BMI equal to or below 25 kg/m2 & weight loss equal to or over 5% in 1 month or equal to or above 10% in 6 months prior to admission to pulmonary	Group A; x 3 125 ml cartons Respifor supplement drinks daily (2380kJ, 20% energy from protein, 60% from carbohydrate, 20% from fat)	X 3 200 ml cartons supplement drinks daily (3350 kJ, 22.3% energy from protein, 59.7% from carbohydrate, 18% from fat)	8 weeks	Body composition (weight, FFM, fat mass (FM)) Lung function (FEV1) Exercise capacity (incremental bicycle ergometry test) Health status (SGRQ)	Between group results; Group A gained more weight than group B (3.3kg vs. 2.0 kg respectively; p 0.019)	Nutritional supplements provided by Numico Research BV

					rehabilitation centre.					

Comments: Study carried out between years 1995-97 (group B), 2000-2002 (Group A) not detailed if hospital menu changed across this time period. Body composition obtained via bioelectrical impedance indicating a possible source of bias (no details of protocol used to minimise bias during measurements). No indication if trial was blinded. Study does not indicate amount of supplements consumed/ not consumed over 8 weeks.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Brooks D, Krip B, Mangovski-Alzamora S, Goldstein RS. The effect of post rehabilitation programmes among individuals with chronic obstructive pulmonary disease. Eur Resp J. 2002; 20(1):20-9.	RCT	1-	Total 109 patients, 50 in intervention group and 59 in control group. Completers = 18 in intervention group and 23 in control group	Severe stable COPD <40%. Completion of pulmonary rehab programme Non-Smoker 49-85 years Exclusions – co morbidities impacting on exercise tolerance or cognitive functioning, non-compliance, non English speaking, NIV, living too far away.	Enhanced 12 m follow up, patients attended 2 hour monthly support sessions, supervised exercise and group discussion. Between these sessions patients had phone call from physiotherapist to discuss programme adherence and any concerns.	Conventional follow up had therapist contact every 3 months for 12 months where they were asked standardized questions re their illness and hospitalizations. Individuals encouraged to continue or resume exercise programmes and identify concerns to therapist	3,6,9 ,and 12 months	6MWD CRDQ SGRQ	No difference between either group after 1 year. Walking distances improved in study group at 6 months but went back to the same after 12 months.	Not stated

Comments: The authors conclude that all patients who completed a pulmonary rehabilitation programme had deteriorated by 12 months in terms of exercise tolerance and HRQOL. Poor post programme compliance appeared to be a factor which was not improved by an enhanced contact with Health Care Professionals. As there is no agreed definition of pulmonary rehabilitation maintenance, we need to establish the dose response of maintenance. Monthly group sessions in this study had limited effectiveness. Large drop out in both groups after 6 months. Conventional group received monthly visits at home.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Cambach W, Chadwick-Straver RV, Wagenaar RC, *et al*. The effects of a community-based pulmonary rehabilitation programme on exercise tolerance and quality of life: a randomised control trial. Eur Resp J. 1997;	RCT cross over study	1 -	99 patients from 8 practices. 43 of the 66 who completed were asthmatic	Pulmonary rehabilitation conducted in local physiotherapy practices in Netherlands.	Pulmonary rehabilitation including drug treatment	Drug treatment alone.	3 & 6 months	Incremental cycle ergometer test; submaximal cycle ergometer test; 6MWT; CRDQ	6MWD in asthma group alone: Pulmonary rehabilitation-Control (n=18) change in 6MWD at 3 months 63 (89)m Control – pulmonary rehabilitation n= 17 8 (63)m	National Health Insurance Council. Glaxo provided peak flow meters

10:104-113.

Comments: Small numbers of asthma patients entered into study. Of 99 patients with asthma and COPD 66 completed. Patients were seen in small groups of 3 or 4 which may not be that representative of UK programmes and the rehabilitation was delivered for 90 minutes over a 3 month period, again not reflective of UK programmes. COPD patients in the pulmonary rehabilitation – Control arm showed little benefit compared with COPD patients in the control- pulmonary rehabilitation arm suggesting there may be problems with the programme itself, however differences for the asthma group were substantive in benefit of rehab. Randomisation was carried out within individual practices using block randomisation and sealed envelopes leading to possible randomisation bias due to localities. Diagnosis as to whether COPD or asthma made a posteriori. No power calculation.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Carone M, Patessio A, Ambrosino N, *et al.* Efficacy of pulmonary rehabilitation in chronic respiratory failure (CRF) due to chronic obstructive pulmonary disease (COPD) : The Maugeri Study. Resp Med. 2007; 101 (12):2447-2453.	Cohort	3	1130	855 male and 192 female patients with COPD. 720 did not have CRF and 327 had CRF (defined as a PaO_2<8kPa, $PaCO_2$>6kPa or both). Mean FEV1 47% in non-CRF group and 39% in CRF.	All subjects	Subjects completed "tailored" inpatient pulmonary rehabilitation exercising 5 x/week	NA	Comparison of group response based on presence or absence of chronic respiratory failure. Outcome measures exercise capacity (6MWD), breathlessness (MRC score and TDI) and quality of life (SGRQ)	No significant difference in main outcomes when CRF and non-CRF patients are compared. 6MWD improvement 48(4) m CRF vs. 48(3) m non-CRF. MRC improvement 0.85(0.06) CRF vs. 0.73(0.03) non-CRF. TDI improvement 9.7(0.15) CRF vs. 3.8(0.1) non-CRF. SGRQ improvement 8.3(1.5) CRF vs. 10.1(0.6) non-CRF	Italian Ministry of Health

Comments: COPD patients with CRF gained similar benefits from a not clearly defined pulmonary rehabilitation programme compared with patients without CRF

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Carr S J, Hill K, Brooks D, Goldstein RS. Pulmonary rehabilitation after acute exacerbation of chronic obstructive pulmonary disease in patients who previously completed a pulmonary rehabilitation	RCT	1-	33 (28 completed)	COPD patients who had undergone pulmonary rehabilitation. Followed-up and randomised if exacerbation occurred.	3 week pulmonary rehab course	Usual care	7 weeks post second pulmonary rehabilitation course	CRDQ; 6MWT	No difference in per protocol analysis. Exclusion of those with further exacerbation suggested small improvement in dyspnoea (no change in 6MWD).	Not stated

program. J Cardiopulm Rehab Prev. 2009; 29(5):318-24.
Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Casaburi R, Kukafka D, Cooper CB. *et al*. Improvement in exercise tolerance with the combination of tiotropium and pulmonary rehabilitation in patients with COPD. Chest. 2005; 127 (3): 809-817.	RCT	1-	126	Patients with COPD – 57% male, FEV1 0.88(0.36) L; 34(12) % predicted – randomised to pulmonary rehabilitation with or without tiotropium. 47 tiotropium and 44 control subjects completed study	All subjects	8 week outpatient pulmonary rehabilitation with 3 supervised exercise sessions/week. Randomised to tiotropium or placebo which was taken 5 weeks before, during and 12 weeks after pulmonary rehabilitation	12 weeks	Comparison of group response based on taking tiotropium or placebo. Outcome measures endurance exercise time (minutes) on self-limited constant load treadmill test set to 80% of peak achieved on incremental treadmill test, dyspnoea (TDI) and HRQOL (SGRQ)	Tiotropium patients endurance exercise time increased 5.35 minutes greater than placebo at end of pulmonary rehabilitation and 6.6 minutes greater than placebo at 12 weeks post-pulmonary rehabilitation (both $p<0.05$). TDI scores not significantly different at end of pulmonary rehabilitation but 1.67 greater improvement with tiotropium compared with placebo at 12 weeks post-pulmonary rehabilitation ($p<0.05$). SGRQ score 4 point greater improvement tiotropium vs. placebo at end of pulmonary rehabilitation and 12 weeks post-	Boehringer Ingelheim and Pfizer Pharmaceuticals

									pulmonary rehabilitation but not significantly different	

Comments: The addition of tiotropium to other bronchodilator therapy before, during and after pulmonary rehabilitation leads to greater improvement in exercise capacity after pulmonary rehabilitation and greater improvement in exercise capacity and dyspnoea 12 weeks post-pulmonary rehabilitation. Randomisation, allocation concealment, and blinding are not adequately reported. One caution (acknowledged by the authors) is that they use parametric statistics for skewed censored data – the one analysis they include using a non-parametric approach reduced the number of significant findings. However, the results are consistent across measures and the effect size is large.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Casaburi R, Bhasin S, Cosentino L, *et al*. Effects of Testosterone and Resistance Training in Men with Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med. 2004; 170 (8):870-8.	RCT	1+	53 (all men) (47 completed) (11 testosterone + training, 12 testosterone alone 12 placebo + training, 12 placebo alone	Age 55 to 80 years, FEV1 of 60% predicted or less, and FEV1 to vital capacity ratio of 60% or less. serum testosterone was 400 ng/dl or less. Exclusion criteria significant cardiovascular or orthopaedic impairments, body weight of less than 75% or more than 130% of ideal, symptomatic benign prostatic hypertrophy, prostate cancer history, serum prostate specific antigen of more than 4 µg/L, or haemoglobin of more than 16 g/dl.	Strength training and/or testosterone supplementation (100mg IM)	Resistance training, Resistance training + testosterone, placebo, Testosterone	10 weeks	Strength, muscle mass, exercise endurance, blood markers, lung function	Lean body mass; Testosterone alone increased 2.2kg (p=<0.001) Testosterone + training increased 3.3kg (p=<0.001) Maximum leg press strength; Testosterone alone increase 17.2%, Placebo + training increase 17.4%, Testosterone + training 26.8% (p=<0.001)	California Tobacco-Related Disease Research Programme, grant number 6RT-036, the resources of the General Clinical Research Centre, grant M01-RR00425 of the National Center for Research Resources, and the BioTechnology General Corporation (Iselin, NJ)

Comments: Men only

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Cindy Ng LW, Mackney J, Jenkins S, Hill K. Does	Systematic review and	2++	Randomised trials n=201, Single arm intervention n=266.	COPD, Original paper in English, Minimum 4	Exercise training	N/A	6 weeks to 6 months	Physical activity in absolute values (e.g. steps, activity count)	Statistically significant, but clinically small	None

exercise training change physical activity in people with COPD? A systematic review and meta-analysis. Chronic Respiratory Disease. 2012; 9:17-26.	meta-analysis (cohort studies, case-control studies)			weeks exercise therapy, used physical activity monitor.					increase in physical activity (Effect size 0.12)	
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Clark CJ, Cochrane L, Mackay E. Low intensity peripheral muscle conditioning improves exercise tolerance and breathlessness in COPD. Eur Respir J. 1996; 9(12):2590-6.	RCT	1-	10 (sub-group of 48 patients)	COPD. 58 years old, FEV1 67% predicted	The Hairmyres home exercise programme	Usual care	12 weeks	Peripheral muscle endurance, peripheral muscle strength, whole body endurance, aerobic capacity	No effect	Not stated
Comments: Training programme likely insufficient										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Clark CJ, Cochrane LM, Mackay E, Paton B. Skeletal muscle strength and endurance in patients with mild COPD and the effects of weight training. Eur Respir J. 2000; 15(1):92-7.	RCT	1+	43	49 years, FEV1 77%	10 x 8 reps of 70% maximum. All major muscle groups	Control group	12 weeks	Isokinetic muscle strength. Endurance walk. Isotonic muscle strength (1RM)	Increase in isotonic strength (quadriceps 7.6 Kg), increase in isokinetic strength. Increase in endurance walk test.	Not stated
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Costes F, Agresti A, Court-Fortune I, *et al*. Noninvasive ventilation during exercise training improves exercise tolerance in	RCT	1-	7 controls 7 intervention	COPD FEV1 31.5% predicted mean age 63 years	NIV during pulmonary rehabilitation programme	Unassisted training programme	before and after pulmonary rehabilitation programme	Exercise capacity at steady state in incremental test NIV increased exercise tolerance, reduced dyspnoea, and prevented exercise-	Improvement in peak VO2 18% vs. 2% p<0.05 ns change in constant work load duration and in lactate levels	Not stated

patients with COPD. Journal of Cardiopulmonary rehabilitation. 2003;23:307-313.								induced oxygen desaturation both before and after training		
Comments: Pilot, un blinded study, very small numbers.										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Coventry PA, Hind D. Comprehensive pulmonary rehabilitation for anxiety and depression in adults with chronic obstructive pulmonary disease: Systematic review and meta-analysis Journal of Psychosomatic Research. 2007; 63:551–565.	Systematic review and meta-analysis	1+	269	Clinically stable, age >18, 80% patients at least with moderate to severe COPD	Comprehensive pulmonary rehabilitation	Usual care	10 weeks to 1 year	CES-D depression, SCL-90 R, STAI state anxiety, HADS	-0.33 SMD for anxiety, -0.58 SMD for depression	Medical Research Council Special Training Fellowship in Health Services Research
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Creutzberg EC, Wouters EF, Mostert R, *et al*. A role for anabolic steroids in the rehabilitation of patients with COPD? A double blind placebo controlled randomised trial. Chest. 2003;124:1733-42.	RCT	1+	63 (63 male) 33 intervention (19 maintenance low dose oral glucocorticosteroids), 30 placebo (12 maintenance low dose glucocorticosteroids)	Consecutively admitted to pulmonary rehabilitation, COPD, inpatients FEV1 <70% with an increase in FEV1 of <10% after inhalation of a B2-agonist. Clinically stable	50 mg Nandrolone deconoate (ND) in 1 mL arachis oil IM injection day 1, 15, 29, 43	I mL arachis oil	8 weeks	Body composition, Muscle function, exercise performance, Health status, erythropoitetic parameters	Fat free mass (mean); ND +1.7kg, placebo + 0.3kg (p=0.015). Intracellular mass (mean); ND +1.8 kg placebo –0.5 kg (p=0.002) Patients receiving low-dose oral glucocorticosteroids; Max inspiratory muscle strength; ND +6.0 cm H2O v –2.18 cm H2O (p=0.046) Peak workload; ND 20.47W v placebo 4.8W (p=0.023)	Supported by NV Organon

Comments: Good detail of randomised process.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Crisafulli E, Costi S, Luppi F, *et al*. Role of comorbidities in a cohort with COPD undergoing pulmonary rehabilitation. Thorax. 2008; 63:487-492.	Cohort	3	2962	2150 male and 812 female patients with COPD (FEV1 49(15)% predicted. Co-morbidity defined using the Charlson index. Groups were divided into Charlson score 0, 1, 2 and >2. Heart disease defined by the presence or absence of CHF and/or IHD	All subjects	A minimum of 15 inpatient or outpatient pulmonary rehabilitation sessions	NA	Comparison of group response based on level of co-morbidity. 51% had Charlson score of 0, 38% had a Charlson score of 1, 11% had a Charlson score of 2 and 2% had a Charlson score of >2. Outcome measures exercise capacity (6MWD), breathlessness (MRC score) and quality of life (SGRQ)	Using multiple logistic regression analysis patients with a higher Charlson index were less likely to gain a 54 m improvement in 6MWD (OR 0.72 (0.54-0.98), p<0.03) and gain a 4 point improvement in SGRQ (OR 0.51(0.38-0.68), p<0.001). Patients with heart disease were more likely to improve 6MWD (OR 2.36 (1.85-3.01), p<0.001) but less likely to improve SGRQ (OR 0.67 (0.55-0.83, p<.0.001)	Not stated

Comments: The vast majority of COPD patients with or without co-morbidity or heart disease gain significant improvement in 6MWD, MRC score and SGRQ after pulmonary rehabilitation. However, the presence of more co-morbidity is associated with a modest reduction in 6MWD and SGRQ but not MRC score improvement. Heart disease is associated with a greater 6MWD improvement but poorer SGRQ improvement

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Crisafulli E, Gorgone P, Vagaggini B, *et al*. Effect of standard rehabilitation in COPD outpatients with comorbidities. Eur Resp J. 2010; 36 (5):1042-1048.	Cohort	3	316	235 male and 81 female patients with COPD (FEV1 50(14)% predicted. Co-morbidity defined using the Charlson index. Groups were divided into Charlson score 0, 1, 2+. Heart disease defined by the presence	All subjects	8 week pulmonary rehabilitation with 3 hour+ session x 3/week. Minimum 21 sessions attended	NA	Comparison of the proportion of patients gaining a 54 m improvement in 6MWD, a 1 point improvement in MRC score and a 4 point improvement in SGRQ. Groups divided according to Charlson score of 0 (38%), 1 (34%) and 2+ (28%) and heart disease – 21% had	Using multiple logistic regression analysis co-morbidity and heart disease was not related to improvement in 6MWD and SGRQ after pulmonary rehabilitation. Fewer (61%) of patients with 0 co-morbidity achieved a 1 point	Not stated

				or absence of CHF and/or IHD				heart disease	improvement in MRC score compared to patients with 1 (84%) and 2+ (70%) co-morbidity. Heart disease was unrelated to MRC improvement	

Comments: Patients with more co-morbidities and heart disease are at least as likely to gain improvement in walking distance, breathlessness and quality of life after pulmonary rehabilitation.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Deacon S, Vincent EE, Greenhaff PL *et al.* Randomized Controlled Trial of Dietary Creatine as an Adjunct Therapy to Physical Training in Chronic Obstructive Pulmonary Disease. Am J Respir Crit Care Med. 2008; 178:233–239.	RCT	1+	80	"COPD patients" - no spirometric or history criteria - undergoing pulmonary rehabilitation	Loaded for 5 days with 22 g Creatine daily in four divided doses, followed by maintenance dose during PR of 3.76 g Creatine daily	Loading of 24g lactose daily in divided doses followed by a maintenance of 4g lactose daily	8 weeks (end of pulmonary rehabilitation)	ISWT, ESWT, FFM, muscle strength, CRDQ, muscle creatine	No significant differences seen	Charity: British Lung Foundation

Comments: A well conducted study. Claims of a definitive answer are tempered by the low power of the study (powered to detect a doubling of the effect of pulmonary rehabilitation).

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
de Blok BMJ, de Greef MHG, ten Hacken NHT, *et al*. The effects of a lifestyle physical activity counselling program with feedback of a pedometer during pulmonary rehabilitation in patients with COPD: A pilot study. Patient Education and	RCT	1-	21 enrolled. 16 completed (per protocol analysis)	Diagnosis of COPD, age 40-85. Literate in Dutch	Lifestyle physical activity counselling programme with pedometer+ pulmonary rehabilitation	Regular pulmonary rehabilitation programme	9 weeks	Daily physical activity (Primary). Physical fitness, HRQOL, ADLs, Depression, Self-efficacy (secondary)	No statistically significant difference between groups. . Control group increased by 19%, Intervention group by 69%)	Not stated

Counselling. 2006; 61: 48–55.
Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Dourado VZ, Tanni SE, Antunes LCO, *et al*. Effect of three exercise programs on patients with chronic obstructive pulmonary disease. Brazilian Journal of Medical and Biological Research. 2009; 42: 263-271.	Randomised to 3 different treatment groups	1-	47	COPD. Acute exacerbation excluded and co-morbidity i.e. cardio vascular disease excluded.	Strength training	Strength training (ST) vs. general low intensity training (LGT) vs. combination training (CT)	12 weeks	6MWD, AQ20, FEV1, BMI, FFM, SGRQ. Muscle strength, functional fitness	In the ST and CT groups, an additional improvement in 1-RM values was shown (P < 0.05) compared to the LGT group (ST = 10 ± 6 to 57 ± 36 kg; CT = 6 ± 2 to 38 ± 16 kg; LGT = 1 ± 2 to 16 ± 12 kg). The addition of strength training to low intensity general training increased muscle strength; however, it produced no additional improvement in walking endurance, dyspnoea or quality of life	Not stated

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
du Moulin M, Taube K, Wegscheider K, *et al.* Home-based exercise training as maintenance after outpatient pulmonary rehabilitation. Respiration. 2009; 77:139-145.	RCT	1-	20 patients recruited. 8 completers.	Only patients not planning to attend other forms of maintenance were included. Moderate COPD – FEV1 50 – 80% Exclusions – significant co-morbidity	Individualised training plan – to walk 125% of last 6MWD 3 x days or combined into 1 walk a day. Home based setting. Telephone contact 4 weekly for motivation.	Control groups no instruction re physical activity.	Baseline (completion of pulmonary rehabilitation programme), 3 and 6 months	Primary outcome 6MWD. Secondary endpoints – HRQOL (CRDQ), lung function (FEV1).	Significantly better 6MWD (p= 0.033), CRDQ scores (p= 0.027) and FEV1 (p= 0.007) in intervention group	Not stated

Comments: The authors conclude that their maintenance strategy had a significant effect on health outcomes in patients with moderate COPD. The initial out-patient pulmonary rehabilitation programme was only 3 weeks. The authors argue that short, intensive programmes are effective and commonplace in the German healthcare system. Outcomes were only measured up to 6 months, so we are not able to see the longer term effect of the intervention. The authors acknowledge the very small study sample and report that recruitment was difficult. The study was insufficiently powered, with only 10 patients in each arm. There was a very high dropout percentage of 60% in each arm. The authors suggest that as results were analysed using ITT, the effect size may have been larger. Only patients with moderate COPD not planning to attend other maintenance programmes were included, so results are only generalisable to a sub-group of patients graduating from a pulmonary rehabilitation programme. The authors report that maintenance groups are readily available to graduates of their programme, so it is possible that this group was less motivated than a cross section of all patients completing pulmonary rehabilitation. The control group may, therefore have been more likely to decline faster than a cross section, as they may not be motivated to continue with an active lifestyle per se. The reported improvements in 6MWD and CRDQ in the intervention group are below the level of clinical relevance. Despite these limitations, the unsupervised home exercise appears to, at the least; maintain the effects of a pulmonary rehabilitation.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Dyer F, Callaghan J, Cheema K, Bott J. Ambulatory oxygen improves the effectiveness of pulmonary rehabilitation in selected patients with Chronic Obstructive Pulmonary Disease Chronic Respiratory Disease. Chronic Respiratory Disease. 2012; 9 (2):83-91.	RCT	1-	55 randomised, 47 completed.	"patients with COPD" not using home oxygen meeting criteria for ambulatory oxygen	Pulmonary rehabilitation sessions twice weekly for 7 weeks with supplemental oxygen 2-6 litres.	Pulmonary rehabilitation only (no placebo)	End of pulmonary rehabilitation	ESWT; HADS; CRDQ	Major improvements in ESWT – O2 group improved almost 1 km through pulmonary rehabilitation. Additional benefit of 0.5 km versus room air group. No change in CRDQ or HADS	Charity

Comments: Small study (underpowered for clinically expected difference and sample size calculation not inflated for expected drop-outs). Randomisation process is described but only the walk test assessor was blinded (not participants/other authors/statistical analysis). No placebo was used for the standard care group, though they were assessed using an oxygen cylinder in the final walk test.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Emtner M, Porszasz J, Burns M, *et al* Benefits of Supplemental Oxygen in Exercise Training in Nonhypoxemic Chronic Obstructive Pulmonary Disease Patients. Am J Respir Crit Care Med. 2003; 168:1034–1042.	RCT	1+	29	COPD with FEV1<50%. Not hypoxaemic at rest.	7 week pulmonary rehabilitation programme; 3 l/min oxygen during exercise	7 week pulmonary rehabilitation programme; 3 l/min air during exercise	End of pulmonary rehabilitation	CPEX (incremental and constant tests in air and with 30% O2); ABG; lung volumes & transfer capacity; CRDQ; SF-36	10% additional reduction in respiratory rate at isotime; four SF-36 sections showed improvement with oxygen versus one with air. No additional improvement in the great majority of parameters measured	Charity

Comments: Largely a well conducted/described study. The discussion and abstract perhaps overstate the additional benefit of supplemental oxygen seen in the study.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Evans RA, Singh SJ, Collier R, *et al*. Pulmonary Rehabilitation is successful for COPD irrespective of MRC dyspnoea grade. Resp Med. 2009; 103 (7):1070-1075.	Cohort	3	450	55% male patients with COPD (FEV1 40(18)% predicted; 1.0(0.5)L) of who 395 (85%) completed pulmonary rehabilitation. MRC2 = 15%, MRC3 = 25%, MRC4 = 27% and MRC5 = 32%	All subjects	7 weeks outpatient PR – 2 week supervised sessions and daily home exercise	NA	Comparison of group response based on MRC2 vs. MRC3, 4 or 5. Outcome measure exercise capacity (ISWT)	No significant difference in change in exercise capacity in MRC2 vs. MRC3, 4 and 5. Median (IQR) improvement 66(50-83)m in MRC2 vs. 63(50-75)m MRC3 vs. 59(49-70)m MRC4 vs. 54(43-64) MRC5	Not stated

Comments: After completion of pulmonary rehabilitation patients with baseline MRC2 dyspnoea gain similar improvement in walking distance and breathlessness as MRC3, 4 and 5 patients

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Faager G, Söderland K, Skold CM, *et al.* Creatine supplementation and physical training in patients with COPD: A double blind, placebo-controlled study. International Journal of COPD. 2006; 1(4): 445–453.	RCT	1-	23	COPD by BTS criteria	Oral creatine. Creatine dose was 0.3 g/kg body weight/day during seven days and then 0.07 g/kg body weight/day during the remaining 7 weeks	Oral glucose powder - dose not described	8 weeks	ESWT, FEV1, muscle strength (grip and knee extensor)	No significant differences seen	Not stated

Comments: A small study reduced further in power by some outcomes having been assessed only in a subset. Randomisation and blinding not adequately described.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Fernandez AM, Pascual J, Ferrando C, *et al*. Home-based pulmonary rehabilitation in very severe COPD: is it safe and useful? Journal of	RCT	1-	42 (Intervention=27, control=15)	GOLD 4 COPD, on LTOT, no severe CVS co-morbidity, <80 years, Clinically stable for 2/12	2 initial hospital sessions, then 5/week home based unsupervised exercise, twice a month visits for first 2 months.	Control group (though received education)	1 year	Pulmonary function tests, 6MWT, SGRQ	Significant improvement in 6MWT, SGRQ at one year in rehab group	Not stated

Cardiopulmonary Rehabilitation & Prevention. 2009; 29(5):325-31					Adherence defined as one hour per day 5/week >80% of the time.					

Comments: Long period of rehab. Good results in very severe cohort. Low drop-out/mortality and excellent adherence in such a severe group.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Foglio K, Bianchi L, Ambrosino N. Is it really useful to repeat outpatient pulmonary rehabilitation programs in patients with chronic airway obstruction? A 2-year controlled study. Chest. 2001; 119(6):1696-704.	RCT	1-	61 randomised, 36 completed	26 patients with COPD by ATS criteria, 35 with asthma. All underwent 8 week pulmonary rehabilitation programme at baseline	Pulmonary rehabilitation at one year and two years	Pulmonary rehabilitation at two years	2 years (up to end of pulmonary rehabilitation session)	Lung function and volumes; ABG; CPEX; 6MWD; BDI &TDI; SGRQ; exacerbations (steroid course); admissions	Short term gains seen in symptoms, QOL, and exercise capacity with each rehab session but no additive effect from the additional session. The only exception was the reduction in exacerbations seen (all 19 of those in the control group had at least one exacerbation whereas 8/17 in the active arm did not.	Not stated

Comments: Randomisation process unclear. Though blinding is reported, it appears insufficient as the patients were free to disclose the information to the technicians and those undertaking medical care, trial visits, and analyses were not blinded. Small initial sample with large proportion of drop-outs.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Franssen FME, Broekhuizen R, Janssen PP, *et al*. Effects of Whole-Body Exercise Training on Body Composition and Functional Capacity in Normal-Weight Patients With COPD. Chest. 2004; 12:2021-8.	Cohort	2+	50	COPD. FEV1 <70% predicted. BMI >21 and FFM >15 (women)/>16 men	Inpatient pulmonary rehabilitation	n/a	8 weeks	Weight, FFM, exercise capacity, quadriceps strength	Weight increased by 0.6Kg. 35% increase in peak work rate and 17% increase in VO2	Not stated

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Fuld J, Kilduff LP, Neder JA, *et al.* Creatine supplementation during pulmonary rehabilitation in chronic obstructive pulmonary disease Thorax. 2005; 60:531–537.	RCT	1-	38	"Moderate to severe COPD"	5.7 g creatine monohydrate, equivalent to 5 g creatine and 35 g glucose per dose	glucose polymer only (40.7 g per dose)	12 weeks	FEV1, MIP, Weight, Fat free mass, upper and lower limb strengths, exercise test, shuttle walk test, SGRQ	No difference in exercise test results. Lower limb strength and endurance notably better than placebo (improvements over baseline of >15%); Handgrip endurance increased significantly but less markedly (8.0% increase in repetitions vs. 2.2%). Fat free mass improved by around 1 kg compared to placebo.	Wellcome Trust

Comments: There were several drop-outs with little explanation. The confidence intervals for "significantly different" endpoints overlap raising concern over the clarity of the analysis description. There are far more endpoints analysed than patients completing the trial raising the possibility of chance findings.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Garcia-Aymerich J, Lange P, Benet M *et al*. Regular physical activity reduces hospital admission and mortality in chronic obstructive pulmonary disease: a population based cohort study. Thorax. 2006; 61:772–778.	Cohort	2+	2386	Obstructive spirometry (FEV1/FVC <70%)	n/a	n/a	Mean F/u 12 years	physical activity, hospital admissions	n/a	Danish Heart Foundation, Generalitat de Catalunya

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Garrod R, Paul EA, Wedzicha JA.	RCT	1-	25 randomised; 22 completed	“severe stable COPD” ;	6 weeks pulmonary	6 weeks pulmonary	End of pulmonary	Spirometry; ISWT; HAD; CRDQ; ADL	1.5 unit fall in Borg score; others	Not stated

Supplemental oxygen during pulmonary rehabilitation in patients with COPD with exercise hypoxaemia. Thorax. 2000; 55(7):539-43.				FEV1<40%; less than 15% reversibility to salbutamol; all desaturated on exercise to <90%	rehabilitation with supplemental oxygen (4l/min)	rehabilitation with compressed air (4l/min)	rehabilitation	questionnaire	no difference	
Comments: The study was underpowered to provide any degree of certainty that the intervention was ineffective. No record of effect of oxygen on training undertaken. Investigators were not blinded raising the possibility of bias.										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Garrod R, Paul EA, Wedzicha JA. An evaluation of the reliability and sensitivity of the London Chest Activity of Daily Living Scale (LCADL). Respiratory medicine. 2002; 96:725-730.	Cohort	2+	59	Stable, severe COPD. In pulmonary rehabilitation programme	n/a	LCADL pre and post pulmonary rehabilitation	4 weeks	LCADL	Statistically significant reduction in LCADL score following pulmonary rehabilitation (-5.91 of total score)	Not stated
Comments										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Garrod R, Marshall J, Jones F. Self-efficacy measurement and goal attainment after pulmonary rehabilitation. International Journal of COPD. 2008; 3:791-6.	Cohort	2+	74 enrolled. Outcomes on 48 patients	Known COPD undergoing pulmonary rehabilitation	n/a	COPD self-efficacy scale (CSES) pre and post pulmonary rehabilitation	7 weeks	Chronic Obstructive Pulmonary Disease Self-Efficacy scale (CSES) (Primary). 6MWD, Health status, Quads strength, depression, breathlessness during ALD (secondary)	mean change (95% CI) in CSES scores = 0.27 (0.04-0.51): Significant correlations of CSES with 6MWD (r=0.37 p<0.01)LCADL (r=-0.33 p<0.01, SGRQ (r=-0.51 p<0.001)	The Health Foundation
Comments										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Gottlieb V, Lyngsø AM, Nybo B, *et al*. Pulmonary	RCT	1-	61	61 subjects aged 65+ years with moderate COPD	All subjects	7 week PR – 2 supervised exercise	18 months	Comparison of group response pulmonary rehabilitation vs.	Pulmonary rehabilitation subjects had	Not stated

Rehabilitation for Moderate COPD (Gold 2)-Does It Have An Effect? Journal of COPD. 2011; 8 (5):380-386.			(GOLD 2) of who 42 completed the trial (22/35 pulmonary rehabilitation and 20/26) usual care. 28/42 completing subjects female. FEV1 was 64(8)% predicted; 1.43(0.32)L PR vs. 67(9)% predicted; 1.57(0.41)L control		sessions/week		control. Outcomes exercise capacity (6MWD), HRQOL (SGRQ) and dyspnoea (Borg at end of 6MWT)	greater increase in 6MWD (46m) vs. control (4m). No difference in peak Borg between groups. SGRQ improved but magnitude unclear - 6.4(11.3) in text but 5.2 in table; however, not significant though no improvement in control. Benefit gained lost by 18 months follow-up	

Comments: Patients with moderate COPD (GOLD 2 – FEV1 50-80% predicted) improve walking distance with pulmonary rehabilitation compared to controls but lose benefit by 18 months

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Graves J, Sandrey V, Graves T, Smith DL. Effectiveness of a group opt-in session on uptake and graduation rates for pulmonary Rehabilitation. Chron Resp Dis. 2010; 7(3):159-64.	Cohort	2-	200 patients in control group, 400 in historical intervention group	Patients referred to pulmonary rehabilitation programme. Patients had own transport	Group opt-in session, 1 ½ hours, using CBT and information giving.	Conventional care – no opt-in session (historical)	To end of pulmonary rehabilitation programme (8 weeks)	DNA, graduation from pulmonary rehabilitation programme, reasons for drop out.	Reduction in drop out due to non-illness reasons (p=0.001)	Not stated

Comments: The authors conclude that the intervention has increased the overall efficiency of the pulmonary rehabilitation programme and they are able to treat more patients without increasing staffing. This intervention is interesting and there was a clear reduction in drop out following its' introduction. The study design raises a high possibility of confounding, with staff being more aware of the need to prevent drop out this may have affected post-intervention programme delivery. Therefore this study cannot be more highly rated as a source of evidence. The study report did not indicate that this potential confounder had been considered during analysis. The positive outcome obtained following introduction of this intervention cannot be confidently attributed to the intervention alone.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Green RH, Singh SJ, Williams J, Morgan MDL. A randomised controlled trial of four weeks versus seven weeks of pulmonary rehabilitation in	RCT	1+	44 (4 weeks=23, 7 weeks =21)	Diagnosed with COPD (FEV1 <80%, ratio FEV1/FVC <70%) and consistent symptoms	Pulmonary rehabilitation duration 4 weeks v 7 weeks.	4 weeks pulmonary rehabilitation	4 week group measured at 0 and 4 weeks. 7 week group measured at 0 and 7 weeks.	ISWT, Treadmill Endurance Test, CRDQ	Mean difference between groups: ISWT - 16.9 metres (p=0.415) CRDQ dyspnoea - 0.8 (p=0.021), mastery - 0.84(p=0.027), , emotion -0.89	Not stated

chronic obstructive pulmonary disease. Thorax. 2001; 56: 143-145.									(p=0.003),	
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Greening NJ, Evans RA, Williams JEA, *et al*. Does body mass index influence the outcomes of a walking-based pulmonary rehabilitation programme in COPD? Chronic Respiratory Disease. May 2012; 9: 99-106.	Cohort	2+	601	COPD. GOLD II-IV	Pulmonary rehabilitation	Across different BMI	6 weeks	ISWT, ESWT, CRDQ	Similar across all groups	NIHR CLAHRC LNR
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Griffiths TL, Burr ML, Campbell IA *et al.* Results at 1 year of outpatient multidisciplinary pulmonary rehabilitation: a randomised controlled trial. Lancet. 2000; 355: 362-368.	RCT	1++	200	COPD, FEV1 <60% predicted (<20% reversibility), Clinically stable for 2 months	Pulmonary rehabilitation	Control group	1 year	Walking capacity, SF-36, HADS, SGRQ, health care utilisation	Reduction in number of hospital days. Increased walking capacity and health status	Wales Office of Research and development.
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Grosbois JM, Lamblin C, Lemaire B, *et al.* Long-term benefits of exercise maintenance after outpatient rehabilitation program in	Prospecti ve non randomis ed trial	2-	71 patients allocated to 4 groups. Group A 18, group B 18, Group C 18 and group D 17. 58 patients completed study.	Moderate to severe COPD. Dyspnoea on exertion limiting ADL's, FEV1<70%, stable with optimal drug management, no	Group A – twice a week supervised maintenance exercise, group B – once a week supervised maintenance	Group D no maintenance exercise	18 months	FEV1, exercise capacity, dyspnoea.	Significant post rehabilitation deterioration in FEV1 in control group, but maintained in intervention groups. Significant	Not stated

patients with chronic obstructive pulmonary disease. J Cardiopulm Rehab. 1999; 19(4): 216-225.				IHD or muscular skeletal disorder.	exercise, group C, unsupervised home exercise.				difference in exercise capacity at 18 months in favour of intervention groups. No differences in dyspnoea at any point between groups.	

Comments: Non – randomised – patients self-selected groups. Definite benefits of maintenance compared to no maintenance, No difference between unsupervised and supervised maintenance. Daily home exercise appears to maintain workload as does weekly exercise session. The authors conclude that there were definite benefits of exercise maintenance after outpatient pulmonary rehabilitation. There are limitations within the methodology increasing the risk of selection bias and the study has poor statistical power so can only be coded -.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Guell MR, de Lucas P, Gáldiz JB, *et al*. Home vs. hospital-based pulmonary rehabilitation for patients with chronic obstructive pulmonary disease: A Spanish multicenter trial. Archivos de Bronconeumologia . 2008; 44(10): 512-518.	RCT	1-	51 patient, 28 hospital, 23 home	Moderate to severe (stable) COPD	Exercise and education	2 education sessions and 4 supervised exercise sessions over 2 weeks and then randomised to home or hospital based exercise	6 months	6MWT, CRDQ	Both intervention groups improved at 9 weeks and 6 months. 6MWT at 9 weeks, difference = 8.69m (p=0.61), at 6 months difference = 6.55m (p=0.73). CRDQ (D) 9 weeks difference =0.21 (p=0.33), at 6 months difference =0.13 (p=0.65)	Not stated

Comments: small study-, no power calculation described, probably underpowered, outcome assessment blinded

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Guell R. Resqueti V, PT, Sangenis M, *et al.* Impact of pulmonary rehabilitation on psychosocial morbidity in patients with severe COPD.Chest. 2006; 129(4): 899-904.	RCT	1-	Pulmonary rehabilitation = 18, control group = 17	COPD aged <75 years, FEV1<70% predicted, no home oxygen, no exacerbations in past 2 months	Non-psychologically based 16 week pulmonary rehabilitation programme	Usual care	16 weeks	6MWD, Milton Behavioural Health Inventory, revised Symptom Checklist (SCL-90-R), CRDQ	6MWD Control = -22 pulmonary rehabilitation = +63 CRDQ change in scores Dyspnoea: control group -0.2, pulmonary rehabilitation +0.8 Fatigue: control group -0.5,	SEPAR

									pulmonary rehabilitation +0.2 Emotion: control group -0.4, pulmonary rehabilitation +0.3 Mastery: control group 0, pulmonary rehabilitation +0.6	

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Harris M, Smith BJ, and Veale AJ, *et al*. Providing reviews of evidence to COPD patients: Controlled prospective 12 month trial . Chronic Resp Dis. 2009; 6 (3):165-173.	Controlled before and after design. (Not randomised).	2-	249 included at baseline, intervention arm 125, control arm 124. Pulmonary rehabilitation was explored as a subgroup. Numbers unknown. Completed to 12 months intervention 100, control, 101	Mod to severe COPD, able to read English. Exclusions, dementia, lung cancer or unstable illness.	Patients were given a manual of evidence (summary of Cochrane reviews) for COPD interventions. The manual contained 'cues' and tips for questions to discuss with the doctor.	Patients who were given a conventional pamphlet containing information re COPD	12 months	Enrolment in pulmonary rehabilitation Plus rates of influenza vaccination, rate of bone densitometry testing Secondary measures – CRDQ mastery, knowledge of COPD, Communication with usual doctor; satisfaction with disease related information, anxiety.	Enrolment in rehabilitation showed sig change for most socio-disadvantaged group	The Australian commonwealth Dept. of Health and Ageing. TQEH research foundation.

Comments: The authors conclude that providing research evidence to patients with COPD did not lead to an improved application of that evidence, although patients reported they found it useful. There appears to be a significantly higher uptake in pulmonary rehabilitation uptake in the intervention group, but only in the higher socioeconomic disadvantaged group. Pulmonary rehabilitation uptake was one of 3 self-management applications that were addressed in this study and numbers of patients in this subgroup are not reported. It is therefore difficult to apply the findings to the guideline question, however the study adds to the body of evidence supporting the hypothesis that pre-rehabilitation interventions may increase uptake. Differences in groups at baseline – 19 patients in intervention group (compared to 3 in control group) had previously attendedpulmonary rehabilitation. Socioeconomic disadvantage appeared to be a modifier.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Hawkins P, Johnson LC, Nikoletou D, *et al* Proportional assist ventilation as an aid to exercise training in severe COPD. Thorax. 2002; 57:853-9.	RCT	1-	10 intervention and 9 controls	COPD severe FEV1 mean 27% predicted -all men bar 2 in the control group who were women. PaCO2 mean 5.8 kPa at baseline so not type II failure.	Proportional assist ventilation via BiPAP mean first volume assist at 12.7 cms H2O exercise cycle ergometer three times a week for 6 weeks for 30	Unassisted	Tested two days before start of programme and on two days in the week after the programme completed	Spirometry lactate peak heart rate peak work rate training intensity as weight/work peak all as change from baseline	The ventilation assist group had a statistically significant increased weight/wpeak at 6 weeks (CI 3.2-27.1) p=0.016) as did work rate after training in the	British Lung Foundation and Respironics who also provided the ventilators

					minutes a session with progressive increase of work rate over the time course of the programme				assist group 18.$% increase p=0.005 and lactate at same work rate was significantly less (reduced by 30% p=0.002) compared to baseline

Comments: Small un blinded study

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Heppner PS, Morgan C, Kaplan RM, Ries AL. Regular walking and long-term maintenance of outcomes after pulmonary rehabilitation. Journal of Cardiopulmonary Rehab. 2006; 26(1): 44-53.	RCT	1-	164 patients randomised to 2 groups	107 patients had mod – severe COPD, 16 had either restrictive lung disease or mixture of restrictive and obstructive Mean FEV1 = 47%	12 months maintenance programme. Weekly telephone calls and monthly supervised sessions	12 months standard care – referral back to health care provider, documented homecare programme and monthly alumni meetings	24 months	Walking frequency HRQOL Dyspnoea 6MWD Self-efficacy for walking Hospital in patient days emergency room visits FEV1	44% of maintenance group were found to be regular walkers, 38% of control group. Therefore data was pooled from those groups in order to focus on regularity of walking. At 12 months, regular walkers had sig better HRQOL than irregular walkers (p=0.01) Post rehabilitation decline in dyspnoea occurred less in regular walking group than irregular walking group (p= 0.01) No differences in rate of decline in 6MWD between groups. Regular walkers maintained post rehabilitation self-efficacy compared	Not stated

									to irregular walkers (p=0.01)	

Comments: The subjects from the original study and control groups were pooled. Regular walking was associated with long term maintenance of the functional benefits of a pulmonary rehabilitation programme. Regular walkers had better HRQOL, less impairments from dyspnoea and better self-efficacy for walking. Monthly supervised reinforcement sessions made no difference to whether patients became regular walkers or not. This study gives limited information but does suggest that regular walking may be a protective factor for the loss of benefits following pulmonary rehabilitation. The study was originally designed to explore the effects of maintenance on outcomes. The data about walking was observed at completion of the study. This raises the possibility of confounders.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Hoff J, Tjønna AE, Steinshamn S, *et al.* Maximal strength training of the legs in COPD: a therapy for mechanical inefficiency. J. Med Sci Sports Exerc. 2007; 39(2):220-6.	RCT	1+	12	COPD (GOLD guidelines), age 40-70, FEV! <60%. Metabolic disease, cardiovascular disease, steroid use in last 6 months.	8 weeks resistance training	Control	8 weeks	Pulmonary function tests, haemoglobin, lactate, 1RM strength, rate of force development (70% 1RM), mechanical efficiency	36 Kg 1RM increase, 1957 N/s increase dynamic rate of force development, 332 N increase in static peak force, no increase in dynamic peak force.	Norwegian Research Council

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Holland A, Hill CJ, Conron M, *et al.* Short-term improvement in exercise capacity and symptoms following exercise training in interstitial lung disease. Thorax. 2008; 63: 549-554.	RCT	1+ (but only exercise)	57 patients with ILD (34 IPF)	Patients attending hospital with ILD	8 weeks of supervised exercise training	Weekly telephone support	26 weeks	Functional exercise capacity, maximal exercise capacity, quality of life and dyspnoea.	6MWD increased (mean difference to control 35m, 95% CI 6 to 64 m). A significant reduction in MRC (0.7 points, 95% CI 0.1 to 1.3); dyspnoea improved (p=0.04) and fatigue (p=<0.01) on CRDQ. Exercise training reduced heart rate at maximum isowork load (p=0.01). After 6 months no differences between the training and control group for any outcome	Victoria Tuberculosis and Lung Association.

variable.

Comments: Small numbers. Exercise training improves exercise capacity and symptoms in patients with ILD, but these benefits are not sustained 6 months following intervention.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Johnson JE, Gavin DJ, Adams-Dramiga S. Effects of training with heliox and noninvasive positive pressure ventilation on exercise ability in patients with severe COPD. Chest. 2002; 122(2):464-72.	RCT	1-	39 enrolled. 32 completed	COPD with FEV1<50% predicted	6 weeks pulmonary rehabilitation with supplemental Heliox (79% helium, 21% oxygen), or supplemental bi-level pressure support NIV (8-12 / 2)	6 weeks pulmonary rehabilitation	End of pulmonary rehabilitation	Treadmill test;	No effect with Heliox. NIV increased exercise time and workload acutely. NIV during training increased %change in unassisted exercise time (89.6+/-57.7 versus 37+/-33%; p=0.016) but not workload compared with unassisted training.	Not stated

Comments: Not double-blind; Underpowered to see clinically meaningful improvements; very low NIV pressures used. More dropped out in NIV group. No information about randomisation process.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Kayahan B, Karapolat H, Atýntoprak E, et al. *et al.* Psychological outcomes of an outpatient pulmonary rehabilitation program in patients with chronic obstructive pulmonary disease. Respiratory Medicine. 2006; 100(6): 1050-7.	Cohort study	2-	26 pulmonary rehabilitation 19 control	COPD aged 50-75yrs, COPD, smoked >20yrs, no exacerbations in past 8 weeks	8 week pulmonary rehabilitation programme	usual care - not described	8 weeks	HAM - A (anxiety measure)HAM - D (depression measure), dyspnoea VAS, 6MWD, SGRQ	HAM –A (anxiety measure) pulmonary rehabilitation = -3.04, control = + 0.82 p=0.042 (between group); 6MWD pulmonary rehabilitation = +121.54m, control = + 15.12m p=<0.05; SGRQ pulmonary rehabilitation = -16.79, control = -3.65 p<0.05	Not stated

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Ko FW, Dai DL, Ngai J, *et al*	RCT	1+	30 in each arm,	Patients admitted to hospital with	Pulmonary rehabilitation	Usual care to include	1 year following	6MWD MRC	No statistical differences	Hong Kong lung foundation grant.

Effect of early pulmonary rehabilitation on health care utilization and health status in patients hospitalised with acute exacerbations of COPD. Respirology. 2011; 16: 617-624.				acute exacerbation COPD. FEV1/FVC ratio <70%, FEV1< 70%, Over 40 years. Exclusions: major joint problems and severe angina, or who had attended pulmonary rehabilitation in preceding year.	programme group 3 times a week for 8 weeks	instruction to patient to do home walking	discharge	Borg SGRQ CPE acute exacerbation COPD Hospitalisations A and E visits	between groups in any parameter. SGRQ was statistically better in the pulmonary rehabilitation group (p=0.04). Trend towards fewer admissions in first 3 months in pulmonary rehabilitation programme group but this diminished over time.	Respiratory research fund Chinese university of Hong Kong

Comments: Conclusions – better HRQOLin pulmonary rehabilitation programme up to 6 months without reduction in healthcare utilization at 1 year. Patients not medically optimised prior to pulmonary rehabilitation.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Kongsgaard M, Backer V, Jørgensen K *et al*. Heavy resistance training increases muscle size, strength and physical function in elderly male COPD-patients—a pilot study. Respiratory Medicine. 2004; 98 (10):1000-1007.	RCT	1-	18	COPD, Age 65-80, non lower limb fracture in previous 6 months, dependence on more than one walking devise, male	4 sets of 8 reps at 80% 1RM	Control (breathing exercises)	12 weeks	Isometric and isokinectic strength, 5RM strength, lung function, ADLs, Gait climbing time	37% increase in 5RM quads strength	Not stated

Comments: Male only. Per protocol analysis

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Kovelis D, Zabatiero J, Oldemberg N, *et al*, Responsiveness of three instruments to assess self-reported functional status in patients with COPD. Journal of COPD. 2011; 8:334-	Prospective cohort study	2-	22	Confirmed diagnosis of COPD according to GOLD, stable disease, no other comorbidities that would impair ADL	12 week training programme of 1 hour sessions attending 3 times per week.	None	12 weeks	PFSDQ-M, LCADL, MRC scale, SRGQ, 6 MWD	PFSDQ-M: Dyspnoea 0.26, Fatigue 0.16, change in ADL 0.33 LCADL: self-care = 0.6, domestic 0.26, Activity= 0.61, leisure = 0.61, total= 0.45: MR= 0.36	Grant from National Council for Scientific and Technological Development, Brazil

9.
Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Kubo H, Honda N, Tsuji F, *et al.* Effects of dietary supplements on the Fischer ratio before and after pulmonary rehabilitation. Asia Pac J Clin Nutr. 2006 15;(4): 551-55.	Intervention trial	2-	8 (7 male) Arm 1; 4 male Arm 2; 3 male	COPD (Emphysema) Stable	4 grams protein (Branched chain amino acids) contained in 200ml liquid supplement drink +pulmonary rehabilitation (1 session per week for 8 weeks)	Pulmonary rehabilitation alone (as intervention)	8 weeks	6 MWD, QOL (CRDQ), Fischer ratio, Serum albumin	Results only provided in graphical format. No numerical data provided.	Not stated

Comments: Not randomised or blinded. Very small. No statistical analysis details. Diet self-reported therefore increasing variability, no data regarding compliance with home exercise, no measure of lean tissue.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Lan CC, Yang MC, Lee CH, *et al.* Pulmonary rehabilitation improves exercise capacity and quality of life in underweight patients with chronic obstructive pulmonary disease. Respirology. 2011; 16: 276-83.	Controlled trial (non-randomised)	1-	44	COPD, stable for 3 months.	Pulmonary rehabilitation	Underweight versus non-underweight	12 weeks	Weight (secondary). CPE (primary), SGRQ.	Underweight group increased weight by 0.8kg. Significant improvements in peak VO2. No significant difference in peak workload between groups.	Not stated

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Lacasse Y, Goldstein R, Lasserson TJ, *et al.* Pulmonary rehabilitation for chronic obstructive pulmonary disease. Cochrane Database of Systematic	Systematic review and meta-analysis	1++	CRDQ n=618, SGRQ n= 384, 6MWD n=669	Clinical diagnosis of COPD, >90% had COPD, FEV1 <70% predicted	Comprehensive pulmonary rehabilitation	Usual care	6 weeks to one year	CRDQ, SGRQ, 6MWD	Improvements in CRDQ (range from 0.76- 1.06), SGRQ (range from 4.68-6.27), 6MWD 48m	None

Reviews. 2006. DOI: 10.1002/14651858. CD003793.pub2.
Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Larson JL, Covey MK, Wirtz SE, *et al.* Cycle Ergometer and Inspiratory Muscle Training in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 1999; 160:500-507.	RCT	1-	53 total: 13 IMT; 14 CET; 14 CET &IMT; 12 health education	Moderate to severe COPD by usual definitions	[4 months of] IMT: threshold loading device with incremental resistance to 60% Pimax; CET: 5 days a week on bike, tailor programme	Health education (general and related to COPD)	End of intervention	Pimax; CPEX outcomes; submaximal ET outcomes; respiratory muscle endurance; dyspnoea score	No clear difference in VO2; no difference in CRDQ; improvement in Rating of Perceived Breathlessness and Rating of Perceived Leg Fatigue of 20% versus no CET	National Institute of Nursing Research, National Institutes of Health, RO1-NR01428.

Comments: Randomisation and blinding not described. Analyses appear to be against baseline. No clear primary outcome and no adjustment for multiple testing

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Liddell F, Webber J. Pulmonary rehabilitation for chronic obstructive pulmonary disease: a pilot study evaluating a once weekly versus twice weekly supervised programme. Physiotherapy. 2010; 96:68-74.	Pilot study	3	30 patients with COPD	COPD patients on waiting list for pulmonary rehabilitation.	Once weekly pulmonary rehabilitation for 8 weeks	Twice weekly pulmonary rehabilitation for 8 weeks	Not stated	ISWT, ESWT, SGRQ	Significantly underpowered. ITT median (IQR) ISWT: once weekly: 60 (0 - 70)m; twice weekly 50 (0-60)m	Not stated

Comments: Pilot feasibility study enrolling 36 patients, 6 excluded at commencement of study and only 20 patients completed study. Limitations due to small numbers. Recommended further research to demonstrate whether once weekly pulmonary rehabilitation is as effective as twice weekly.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Lindsay, M, Lee A, Poon P, *et al.* Does pulmonary rehabilitation give additional benefit over tiotropium therapy in primary	RCT	1-	50	COPD patients (FEV1 <80% predicted and FEV1/FVC ratio < 70%	18mcg tiotropium +6 weeks pulmonary rehabilitation programme	18mcg tiotropium	3 months	FEV1, 6MWD, VAS, CRDQ	6MWD – Pulmonary rehabilitation- +22.98 metres, control- +30.8 m; (NS) CRDQ dyspnoea	Chinese University of Hong Kong

care management of chronic obstructive pulmonary disease? Randomized controlled clinical trial in Hong Kong Chinese. Journal of Clinical Pharmacy & Therapeutics. 2005; 30(6): 567-73.									Pulmonary rehabilitation- +1.18 Control +1.12 (NS), CRDQ fatigue Pulmonary rehabilitation- +0.38, control +0.28 (NS); CRDQ emotional Pulmonary rehabilitation - +0.38 control 0.28 (NS); CRDQ mastery Pulmonary rehabilitation - +0.34, control +0.34 (NS)	

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Mador MJ, Deniz O, Aggarwal A, *et al* Effect of Respiratory Muscle Endurance Training in Patients with COPD Undergoing Pulmonary Rehabilitation. Chest. 2005; 128:1216-1224.	RCT	1-	29 total: 15 combined 14 pulmonary rehabilitation alone	Description of COPD but no threshold for inclusion given	8 weeks. Standard pulmonary rehabilitation programme plus normocapnoeic hyperpnoea	Standard pulmonary rehabilitation programme including endurance training	End of intervention	CRDQ; CPEX outcomes; respiratory muscle endurance/Pimax	Improvement with IMT greater for respiratory muscle endurance (20%) and Pimax (10%)	Swiss National Science Foundation

Comments: Per protocol analyses only (9 drop-outs). Randomisation and blinding not described, classes of 3-5 not individuals randomised.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Man WD, Grant A, Hogg L, *et al*. Pulmonary rehabilitation in patients with MRC Dyspnoea scale 2. Thorax. 2011; 66:263 doi:10.1136/thx.	Cohort	3	442	45% male patients with COPD who completed pulmonary rehabilitation. 126 patients MRC2 vs. 316 patients MRC3-4. MRC2 58% pred. Vs.	All subjects	8 week pulmonary rehabilitation– 2 supervised and 1 unsupervised session/week	NA	Comparison of group response based on MRC2 vs. MRC3-4. Outcome measures exercise capacity (ISWT), dyspnoea	No significant difference outcomes MRC2 vs. MRC3-4. Mean ISWT improvement 83(7)m MRC2 vs.	National Institute for Lung Research UK

2010.136085.				MRC3-4 54%				(CRDQ-D) and anxiety/depression (HAD)	68(5)m MRC3-4. CRDQ-D improvement 0.75(0.11) MRC2 vs. 0.75(0.07) MRC3-4. Similar median HAD-A and HAD-D improvement	

Comments: Patients with baseline MRC2 dyspnoea gain similar improvement in walking distance and breathlessness as MRC3-4 patients

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Maltais F, Bourbeau J, Shapiro S, *et al.* Effects of home-based pulmonary rehabilitation in patients with chronic obstructive pulmonary disease: A randomized trial. Annals of Internal Medicine. 2008; 149(12): p. 869-878.	RCT	1+	Baseline = 252 Outpatient 126 Home 126	Moderate to severe (stable) COPD	Exercise	Outpatient vs. home based programme. Centre based education - followed by randomisation to either home or hospital exercise	1 year	CRDQ, SGRQ, spirometry, 6MWT, incremental cycle test	Non-inferiority study - Primary outcome between group difference at 3 months 0.05(-0.21 to 0.29) p=0.74	Canadian Institute of health Research & Respiratory Health Network of the Fonds de la Recherche en sante de Quebec

Comments: Designed and powered as a non-inferiority study but outcomes not blinded, therefore increased risk of bias

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Mendes De Oliveira JC, Filho FS, Sampaio LM, *et al.* Outpatient vs. home-based pulmonary rehabilitation in COPD: A randomized controlled trial. Multidisciplinary Respiratory Medicine, 2010; 5(6): 401-408.	RCT	1-	117 patients: 42 home rehabilitation, 46 outpatient, 29 control,	Moderate to severe (stable) COPD	Exercise	Exercise at home or hospital (all received education prior to randomisation)	12 weeks	6 minute walking test and BODE	No significant difference between intervention groups for 6MWT(p=0.44) &, BODE (p=0.90)	Brazilian fostering agencies Fundação de Amparo a Pesquisa do Estado de São Paulo. Conselho Nacional de Desenvolvimento Científico e Tecnológico.

Comments: Poorly described power calculation, not blind outcome assessment, no assessment of HRQOL

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding

Moullec G, Ninot G, Varray A, et *al.* An innovative maintenance follow–up programme after a first in patient pulmonary rehabilitation. Respiratory Medicine. 2008; 102:556-566.	Controlled trial	**1-(but not randomised)**	40; 27 completed	Moderate to severe COPD Exclusions: LTOT or significant medical / psychiatric disorders	Maintenance: exercise (3.5h/week) health education (2h/month), psychosocial support (1h/month)	Letter outlining standard recommended care post rehabilitation	1 year	Primary: 6MWD Secondary included QOL, maximal exercise test, physical activity, attendance	Change in ISWT: 75.8 (32-119.6)m favouring maintenance QOL (SGRQ: Symptoms): -18.5 (-30.9, -6.2)	Fond d'Aide à la Qualité des Soins de Ville (FAQSV) of the Union Régionale des Caisses d'Assurance Maladie (URCAM). Agence Régionale de l'Hospitalisation (ARH) of the region Languedoc-Roussillon in France

Comments: No comment re blinding or randomisation. Consecutive assignment not random allocation. Small, underpowered study. Outcomes well described. The intense maintenance strategy appears to offer significant benefit. In the UK, this might be considered to be year-long rehabilitation. However it demonstrates that with continued supervision of exercise benefits are maintained and improved upon after the initial in-patient phase of rehabilitation.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Newall C, Stockley RA, Hill SL. Exercise training and respiratory muscle training in patients with bronchiectasis. Thorax. 2005; 60: 943-948.	RCT	1-	32 randomised to 3 groups 2 patients dropped out during the training programme from each training group, a further 2 in each training group dropped out during the follow up. 6 in total.	Patients with bronchiectasis confirmed by high resolution computed tomography. Excluded if COPD too	Pulmonary rehabilitation plus inspiratory muscle training (12 patients - 9 at follow-up)	Pulmonary rehabilitation with sham IMT (11, 8 at follow-up) & a control group (no intervention - 9)	3 months	Lung function, respiratory muscle strength, ISWT, maximal incremental treadmill test, submaximal exercise test, SGRQ, sputum volume	Changes in ISWT in both pulmonary rehabilitation groups at 3 months 96.7 (59.6 to 133.7) m in pulmonary rehabilitation plus sham IMT. 124.5 (63.2 to 185.9)m in pulmonary rehabilitation IMT no change in control 11.0 (216.9 to 38.9) 0.002 Changes statistically significant between both pulmonary rehabilitation groups and control not between pulmonary	Not stated

rehabilitation groups

Comments: Table 1 is misleading- says baseline characteristics of 32 who completed, results indicate only 27 patients completed (17 in total in both pulmonary rehabilitation groups). Compared to control pulmonary rehabilitation was effective at improving exercise tolerance in bronchiectasis. Randomisation computer generated. No discussion of blinding. Study underpowered to detect additional effects of IMT on the pulmonary rehabilitation.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Ninot G, Moullec G, Picot MC, *et al*. Cost-saving effect of supervised exercise associated to COPD self-management education program. Respiratory Medicine, 2011; 105(3): 377-85.	RCT	1-	38	61-65 years old, principally male (84%), FEV1 % pred = 55%, 6MWT= 397 (usual care), 450 (intervention), SGRQ= 41-44	4 weeks pulmonary rehabilitation (cycle exercise + self-management education)	Usual care	12 months	6MWT, SGRQ, Voorips score, Cycle workload, Nottingham health profile, healthcare utilisation	Significant increase in 6MWT, SGRQ symptom domain, Voorips score	Hospital

Comments: Some statistical question remains. Outcomes at one year. No post pulmonary rehabilitation measures done.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Nishiyama O, Kondoh Y, Kimura T, *et al.* Effects of pulmonary rehabilitation in patients with idiopathic pulmonary fibrosis. Respirology. 2008; 13 (3):394-399.	RCT	1-	30 patients Randomised to 15 in each group. 2 dropped out from pulmonary rehabilitation group. 28 patients completed study	Patients with IPF attending out-patient clinic= aged >50 - <75 Exclusion of other causes of interstitial lung disease	Pulmonary rehabilitation - 10 week	Control 15 patients competed	10 weeks	Pulmonary function, blood gases, 6MWT, dyspnoea, SGRQ	Difference in change between groups for 6MWD 46.3 (8.3–84.4)m Change in total SGRQ score between groups - 6.1 (-11.7–0.5)	Grant-in-Aid for interstitial lung diseases from the Japanese Ministry of Health, Labor andWelfare.

Comments: Randomisation made using sealed envelopes, no mention of blinding of assessor, small sample size 13 in rehab group completed, 15 in control group. No discussion of sample size a priori and small sample size likely to overestimate treatment effect. Difference in change between groups was significant at p<0.01 but confidence intervals wide and not encompassing MCID. No description of what the control group received. Patients with only relatively mild impairments entered and short term evaluation only. Non exercise element of pulmonary rehabilitation poorly described.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Norweg AM, Whiteson J, Malgady R *et al.* The Effectiveness of Different Combinations of Pulmonary Rehabilitation	RCT	1-	43: Exercise training plus activity training (ETAT) = 18 Exercise training plus lecture series (ETLS) = 10 Exercise training alone (ETA) = 15	Patients referred to an outpatient pulmonary rehabilitation programme	ETAT	1. ETA. 2. ETLS.	Up to 24 weeks	Chronic Respiratory Disease Questionnaire; COPD Efficacy Scale; Pulmonary Functional	ETAT; less dyspnoea (p≤0.04) fatigue (p≤0.01) increased activity involvement (p≤0.02) & total functional status (p≤0.02) in short	New York State Occupational Therapy Association Grant.

Program Components. A Randomised Controlled Trial. Chest. 2005; 128: 663-672.								Status and Dyspnoea Questionnaire (PFSDQ). 6MWD	term only for older patients. ETAT; achieved higher gains in QOL (p=0.04) by week 24. ETLS; sig worse emotional function & functional status in older patients (p≤0.03)	

Comments: Confidence in findings low due to several factors suggesting a high risk of bias; Low numbers, lacked power, Authors acknowledge patients predominantly highly educated. Main author not blinded to group assignment. Significant baseline differences (age). Results not analysed as ITT.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
O'Neill B, McKevitt AM, Bradley J, *et al.* A comparison of twice weekly versus once weekly supervision during pulmonary rehabilitation in Chronic Obstructive Pulmonary Disease. Arch Phys Med Rehabil. 2007; 88:167-172.	Randomised control parallel group study	2-	91. 66 completed	COPD patients recruited from pulmonary rehabilitation outpatient clinic	Once weekly supervised pulmonary rehabilitation sessions for 6 weeks (and 2 unsupervised)	Twice weekly supervised pulmonary rehabilitation sessions for 6 weeks (and 1 unsupervised)	6 months	Included ISWT, ESWT, CRDQ,	Mean (95% CI) difference in changes between groups ISWT 13.5m (-10, 37m) ESWT 72s (-96, 241s); CRDQ 2.54 (-3, 8)	Not stated

Comments: Randomised study comparing once weekly with twice weekly supervised sessions of pulmonary rehabilitation. No difference in outcomes and minimal improvement in both arms, any beneficial effects of pulmonary rehabilitation had diminished by 6 month follow up. Limitations of study include high dropout meant that study was not powered and as such the number of patients completing the programme may have been too low to demonstrate a difference between two groups. Not powered originally for equivalence. Blinded assessor for outcomes.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
O'Shea F, Taylor J, Paratz D. Progressive Resistance Exercise Improves Muscle Strength and May Improve Elements of Performance of Daily Activities for People With COPD A Systematic	Systematic review	1++	18 controlled trials included (5 relating specifically to PICO) n= 679	Severe COPD participants mean FEV1 % predicted 45.9% and mean age 63.7	Resisted training	Endurance and resisted training programmes compared with resisted training only	miscellaneous	Muscle strength, ADL	Meta-analysis found large sizes for increases in leg press strength (Mw change, 16.2%; 0.96; 95% CI, 0.26 to 1.66 [p 0.006]; Q 7.74 [p	The authors have reported to the ACCP that no significant conflicts of interest exist with any companies/organizations whose products or services may be

Review Simone D. Chest 2009; 136(5):1269-1283.									0.11])20,21,25,29, 34; whereas, small s favouring progressive resistance exercise were shown for latissimus dorsi strength (Mw change, 18.3%; 0.43; 95% CI, 0.07 to 0.8 [p 0.02]; Q 3.09 [p 0.37]).22,28,31,33 No difference in biceps strength (Mw change, 18%; 0.23; 95% CI, 0.25 to 0.71 [p 0.34]; Q 0.05 [p 0.82]) was demonstrated after progressive resistance exercise when compared with no intervention or aerobic training. Concurrent progressive resistance exercise and aerobic training compared with aerobic training alone (0.19; 95% CI, 0.30 to 0.69 [p 0.44]; Q 8.4 [p 0.76]).	discussed in this article.
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
O'Shea, S., Taylor N, Paratz J. A predominantly	RCT	1-	54	COPD, No pulmonary rehabilitation in	Home based resistance programme	Versus usual care	24 weeks	Strength (hand held dynamometer).	Increased strength by 3.8 kg at 12 weeks.	Equipment grant: Thermaband

home based progressive resistance exercise program increases knee extensor strength in the short term in people with chronic obstructive pulmonary disease. A randomised controlled trial. Aus J of Physiotherapy. 2007; 53: 229-237.				previous 12 months, unstable disease preventing resistance training	using rubber resistance bands			Knee extensor, hip abductor, Shoulder horizontal flexor, Shoulder flexor.	Not maintained by 24 weeks	

Comments: Only 15 subjects in training group completed training completely (per protocol).

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Ortega F, Toral, J. Cejudo, P. *et al.* Comparison of effects of strength and endurance training in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2002; 166: 669-674.	RCT	1-	72 patients entered study, 7 dropped out.	COPD irreversible obstruction.	Training programme 3 alternate days a week for 12 weeks	Endurance training alone, vs. strength training alone, vs. combined endurance and strength vs. control.	12 weeks	SWT, FEV1, breathlessness, HRQOL	At 12 weeks post training, all exercise groups showed sig increases in endurance testing compared to baseline. Endurance group improvements were sig higher than in strength group alone. Combined group acquired most benefits of each intervention	Supported by grants from Fondo de Investigaciones Sanitarias (FIS 97/0472) and Consejerı´a de Salud, Junta de Andalucı´a (96/67), Spain

Notes: The data is based on small sample sizes which limits generalisation. Authors conclude there may be type 2 error. Post programme improvement in SWT only statistically significant in strength group which raises concern re the efficacy of the programme itself.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Panton LB, Golden	Reviewed	1-	17	COPD, no	Combined	Aerobic	12 weeks	Muscle strength,	Small non-	Tennessee

J, Broeder CE, et *al*. The effects of resistance training on functional outcomes in patients with COPD. Eur J Appl Physiol. 2004; 91:443-9.	in O'Shea systematic review. Controlled trial (not randomised)			evidence of recent acute exacerbation. No contradictory co-morbidities	resistance / aerobic programme	programme only		12 MWD ADL's	significant trend towards improved walking distance but no improvement in walking distance for control group.	university grant
Comments: No improvement in 12 minute walking test in control group. Most of the subjects had been attending the programme for at least 2 years prior to the study. High risk of bias.										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Paz-Diaz, H. Montes de oca M, Lopez JM, Celli BR. Pulmonary rehabilitation improves depression, anxiety, dyspnoea and health status in patients with COPD. American Journal of Physical Medicine & Rehabilitation, 2007; 86(1):30-6.	RCT	1-	Pulmonary rehabilitation = 10, control = 14	Severe COPD	A 2 month pulmonary rehabilitation programme attending 3 days per week in groups of 2 -3. No mention of education programme.	Usual care - visited physician every 3 weeks.	2 months	Beck depression inventory, STAI, MRC, SGRQ	Beck Depression Inventory pulmonary rehabilitation= -8 control = -2; pulmonary rehabilitation change p<0.01; SGRQ pulmonary rehabilitation = - 8 control = +3 PR change p<0.01; STAI trait pulmonary rehabilitation = - 16 control = +2 pulmonary rehabilitation change p=0.06	Not stated
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Petersen MAW, Mittendorfer B, Magkos F, *et al*. Physical activity counteracts increased whole-body protein breakdown in chronic obstructive pulmonary disease	Case-control study	2+	19 (pulmonary rehabilitation= 9, Control=10)	COPD, >20 pack years, MRC III-V	7 week pulmonary rehabilitation programme. Controls received education	Control group (though received education)	7 weeks	ISWT, SGRQ, systemic inflammatory markers, Leucine concentration	Improved exercise performance in terms of ISWT, though not health status or calculated VO2 max. There was a decrease in protein	Centre - Danish National Research Foundation (# 02-512-55). Study - The Danish Lung Association, the Danish Medical Research Council (# 22-01-009), the

patients. Scandinavian Journal of Medicine & Science in Sports. 2008; 18(5):557-64.									breakdown following training.	Commission of the European Communities, the US National Institutes of Health grants AR 49869, DK 56341, grants from the University of Copenhagen, the Copenhagen Hospital Corporation, the Pharmacist Foundation of 1991, the Legacy of Ebba Celinder, and the Foundation of Managing Director Jacob Madsen & Spouse Olga Madsen

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Phillips WT, Benton MJ, Wagner CL, Riley C. The effect of single set resistance training on strength and functional fitness in pulmonary rehabilitation patients. Journal of Cardiopulmonary Rehabilitation. 2006; 26:5 330-337.	Randomised trial. Reviewed in O'Shea systematic review	1-	20	Pulmonary rehabilitation patients	Endurance programme combined with resistance training	Endurance based 8 week programme	8 weeks	Function	Significant improvement in muscle strength and functional ability	

Comments

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Puente-Maestu L, Sánz ML, Sánz P, *et*	RCT	1-	49 patients	Moderate to severe (stable)	Exercise	Hospital (treadmill)vs.	8 weeks	CRDQ, incremental and	Both groups improved.	Not stated

***al.* Comparison of effects of supervised versus self-monitored training programmes in patients with chronic obstructive pulmonary disease. Eur Respir J. 2000 Mar;15(3):517-25.**				COPD		home (pedometer based)		endurance cycle test.	CRDQ not different between groups	

Comments: No power calculation, probably underpowered, outcome assessment not blinded, explored physiological response in detail.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Puhan MA , Gimeno-Santos E, Scharplatz M, *et al.* Pulmonary rehabilitation following exacerbations of chronic obstructive pulmonary disease. Cochrane Database of Systematic Reviews. 2011; DOI: 10.1002/14651858. 005305.pub3.	Cochrane Review	1++	Nine trials involving 432 patients (Hospital readmission 250, mortality 110, HRQOL 259 , exercise capacity 428	>90% of the patients had COPD Post- in or out patient care following acute exacerbation.	Any in-patient or out-patient pulmonary rehabilitation programme, including at least physical exercise. Programmes commenced either immediately after initiation of acute exacerbation treatment or up to 3 weeks afterwards.	Conventional community care following acute exacerbation COPD.	Admission to hospital: ranged 3 to 18 months, mean 25 weeks. Mortality range 3 to 48 months, mean 107 weeks.	Hospital admissions HRQOL acute exacerbation rates Outpatient visits Length of readmissions Mortality Exercise capacity Withdrawals Adverse effects Costs	Early pulmonary rehabilitation sig reduced hospital admissions (pooled odds ratio 0.22 [95% CI 0.08 to 0.58] with a number needed to treat (NNT) of 4 [95% CI 3 to 8], over 25 weeks. Pulmonary rehabilitation reduced mortality (OR 0.28; 95% CI 0.10 to 0.84), NNT 6 [95% CI 5 to 30] over 107 weeks). Sig difference in HRQOL, 6MWD and SWT favours pulmonary rehab.	1 salary funded by Helmut Horten foundation Switzerland

Comments: Authors state that effect size may be overestimated as study samples small, however with such large effect size, unlikely that can be attributed to bias only. Patients may be more willing to change behaviour

after acute exacerbation. Possibility of interruption to pulmonary rehabilitation if patients re-exacerbate. Authors suggest methodologically sound and large studies. Also analyses of cost effectiveness.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Puhan MA, Spaar A, Frey M, *et al.* Early versus Late Pulmonary Rehabilitation in Chronic Obstructive Pulmonary Disease Patients with Acute Exacerbations: A Randomized Trial. Respiration. 2012; 83:499-506.	RCT	1-	36 (19 intervention; 17 control)	COPD patients treated for exacerbation; GOLD II-IV; Age 40+; at least 2 exacerbations in the last 2 years; INPATIENT or OUTPATIENT care for acute exacerbation	"Early Pulmonary rehabilitation" within 2 weeks	"Late pulmonary rehabilitation" 6 months after randomisation	18 months	Exacerbation rate, health related quality of life, mortality	No statistically significant differences between groups.	The Swiss Lung League, the Lung Leagues of the cantons of Aargau, Grisons, Lucerne, Nidwalden, Solothurn, Thurgau, Valais, Vaud and Zurich, the Klinik Barmelweid, the 4 clinics of Crans-Montana (Quadrimed), the Höhenkliniken of Zurich, Astra Zeneca Switzerland.

Comments: Underpowered due to problems with recruitment; high numbers of dropout and deviations from planned programme; mixture of in-patient and outpatient pulmonary rehabilitation; not all patients had hospitalised exacerbations.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Reuveny R,Ben-Dov I, Gaides M, Reichert N. Ventilatory support during training improves training benefit in severe COPD. Israeli Medical Association Journal. 2005; 7:151-155.	RCT	1-	9 intervention 10 controls	COPD severe FEV1 32% pred. Only 2 women. Baseline ABG not given but ETCO2 post exercise was low normal so very unlikely to have type II failure.	BiPAP during training using a treadmill 45 minutes twice a week, to maintain constant workload, for 2 months in total	No assistance	1 week before and at the end of training	VO2 max training speed anaerobic threshold exercise lactate level exercise ventilation	Intervention group had improvements compared to the control group training speed increased by 94% vs. 41% p<0.005, increased in VO2 max 23% compared to baseline p<0.005 whilst no change in peak lactate.	Israel Lung Foundation

								End tidal CO2 was lower 38 mmHg vs. 40 in the controls p<0.05.	

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Riario-Sforza G.G, Incorvaia C, Paterniti F, *et al*. Effects of pulmonary rehabilitation on exercise capacity in patients with COPD: a number needed to treat study. Intern J of Chronic Obstruct Pul Dis. 2009; 4: 315-9.	Case-control study	2-	284 (Rehab=222, Control= 62)	COPD, attending a pulmonary rehabilitation programme.	6 week pulmonary rehabilitation programme	Control group	6 weeks	6MWT	NNT=2 for GOLD II-IV, NNT=8 for GOLD I (per protocol analysis)	Not stated

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Ries AL, Kaplan RM, Limberg TM, Prewitt LM. Effects of pulmonary rehabilitation on physiologic and psychosocial outcomes in patients with chronic obstructive pulmonary disease. Annals of Internal Medicine. 1995; 122:823-833.	RCT	2+	119 patients in total randomised 57 to the intervention group	Mild to severe COPD 32 women no other serious medical conditions at time of enrolment ex-smokers or smokers committed to quitting age 61.5 vs. 63.6 (control) mean FEV1 1.2 litres no % predicted given ratio 42%.	8 weeks pulmonary rehabilitation programme 12 x 4 hour sessions including education exercise psychosocial support and specific respiratory care education followed by monthly refresher for one year	8 weeks education only programme 4 x 2 hour video sessions	6 years	Survival pulmonary function tests; maximal exercise tolerance, self-efficacy; Quality of well-being; CES-D; university of California SOB Q Health Care utilisation	Survival: 67% rehab vs. 56% control p=0.32 Rehab produced significantly greater improvements in exercise endurance; maximum exercise tolerance; symptoms of perceived breathlessness and muscle	NHLBI

									fatigue; reported SOB with activities and self-efficacy for walking (latter - rehab improved 1.4 (3.1); control 0.1 (2.9), p≤0.05	
Comments:										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Ries RM, Kaplan R, Myers R, Prewitt LM. Maintenance after pulmonary rehabilitation in chronic lung disease: a Randomized trial. Am J Respir Crit Care Med. 2003; 15; 167(6):880-888.	RCT	1+	172 were randomised to experimental group (87) or control (85) 148 completed 12 month follow up, 131 completed 24 month follow up	Chronic lung disease	Maintenance intervention consisting of weekly telephone calls and monthly supervised reinforcement sessions for 12 months	Standard care control group referral back to usual healthcare provider. Invited to regular monthly alumni meetings.	6, 12 and 24 months following rehab	Pulmonary function Exercise tolerance Dyspnoea HRQOL Healthcare use	Modest effect in experimental group. During intervention year, sig better maintained exercise tolerance, health status and hospital days in experimental group. After 24 months, both groups had returned to levels of ET and HRQOL slightly above pre-rehabilitation levels. In 2nd year healthcare utilization significantly lower in experimental group. No difference in survival.	Not stated

Comments: Authors concluded that a maintenance programme of phone calls plus monthly contact had modest effect on health benefits but did not prevent regression of benefits after intervention. It may be the intervention that was not effective enough. Health care utilization dropped.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Ringbaek T, Brondum E, Martinez G *et al.* Long-term effects of 1-year maintenance training on physical functioning and health status in patients with chronic obstructive pulmonary disease: A randomized controlled study. J Cardiopulm Rehab and Prevention 2010; 30: 47-52.	RCT	1-	96 patients in total – intervention n=55, control n=41.	Stable COPD FEV1<80% predicted, ration <70% predicted. Motivated. Completion of 7 week pulmonary rehabilitation programme. Exclusions – significant co morbidities	Instructed to continue unsupervised training at home plus weekly supervised training sessions 1st 6 months, fortnightly for 2nd 6 months.	Instructed to continue unsupervised training at home	3,6,12, and 18 months	Primary outcome – ESWT and SGRQ. Secondary outcomes – hospitalization, admission rates, length of stay, adherence to training, attendance.	Authors report sig improved walking time, but no report of effect size. No sig differences in SGRQ at any time. No difference in hospitalization.	Not stated

Comments: The results appear unclear. Unclear how many patients completed the study. High percentage of drop out – authors state comparable but higher in control group which may affect results. Decline in SGRQ in both groups after 6 months. No difference between groups to first hospitalization. Improved ESWT which disappeared when intervention stopped.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Romagnoli M, Dell'Orso D, Lorenzi C, *et al*. Repeated pulmonary rehabilitation in severe and disabled COPD patients. Respiration. 2006;73(6):769-76.	RCT	1-	35 randomised, 29 completed	COPD by GOLD standard; FEV1<50% predicted; MRC at least 3; all completed an initial 18 week pulmonary rehabilitation programme	Further pulmonary rehabilitation programmes at 6 and 12 months	Further pulmonary rehabilitation programmes at 12 months	12 months in total	Full lung function including MIP; ABG; 6MWD; Dyspnoea and fatigue at peak effort (modified Borg); SGRQ; hospital admissions	The additional rehab session reduced SGRQ symptom sub-score but did not affect the other outcomes tested	Not stated

Comments: Randomisation and blinding not well described. Per-protocol analyses only. Large number of analyses (multiple end-points, time points, and comparisons) using parametric statistics for data that is bounded and not normally distributed.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Rooyackers JM, Dekhuijzen PN, Van Herwaarden CL, Folgering HT. Training with	RCT	1-	24 randomised.	COPD by ATS criteria. Hypoxic on exercise.	10 weeks pulmonary rehabilitation with 4l /min oxygen via nasal cannulae	10 weeks pulmonary rehabilitation (no placebo)	End of pulmonary rehabilitation	CPEX (incremental and constant); Lung volumes and transfer factor; 6MWD; stair-	No additional benefit of supplemental oxygen	Charity: Netherlands Asthma Foundation (90.22).

supplemental oxygen in patients with COPD and hypoxaemia at peak exercise. European Resp Journal. 1997; 10(6):1278-84.								climbing; peripheral muscle endurance; CRDQ		

Comments: Not blinded; randomisation process not described; no placebo gas; study underpowered for clinically meaningful gains; analysis of bounded data as if normally distributed

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Sabit R, Griffiths TL, Watkins AJ, *et al*. Predictors of poor attendance at an outpatient pulmonary rehabilitation programme. Respir Med. 2008; 102 (6): 819-824.	Qualitative	3	239	159 male, 80 female patients with COPD (FEV1 40(15)% predicted)	All subjects	Subjects completed either 6 or 18 week outpatient pulmonary rehabilitation. Sessions x 3/week for up to 2 hours	NA	Attendance rate	A higher attendance rate was seen in non-smokers. 17.7% smokers attended at least 2 out of 3 pulmonary rehabilitation sessions while 56.5% attended fewer than 2 out of 3 sessions ($p<0.01$). Using multiple regression analysis smoking status contributed to attendance.	Welsh office R&D (WORD)

Comments: Current smoking contributes to lower attendance at pulmonary rehabilitation sessions

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Scorsone D, Bartolini S, Saporiti R, *et al.* Does a low-density gas mixture or oxygen supplementation improve exercise training in COPD? CHEST. 2010 Nov; 138(5):1133-9.	RCT	1-	30	History of COPD with airflow obstruction (not otherwise clarified)	Thrice weekly for 8 weeks supervised exercise programme plus 40% supplemental oxygen or heliox (60/40)	Thrice weekly for 8 weeks supervised exercise programme	End of programme	CPEX (incremental and constant load); lung volumes & transfer factor.	No additional benefit	Government

Comments: The study appears to be at low risk of bias as described. However, the small size of the trial (10 patients per arm) is insufficient to exclude a clinically meaningful benefit from the active interventions studied given the inter-individual variation.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Sewell L, Singh SJ, Williams JEA, *et al.* (2006) How long should outpatient pulmonary rehabilitation be? A randomised controlled trial of 4 weeks versus 7 weeks. Thorax. 2006; 61: 767-771.	RCT	1+	100 (control 4 weeks = 50, pulmonary rehabilitation 7 weeks= 50)	COPD	Pulmonary rehabilitation duration 4 weeks supervised +3 weeks unsupervised v 7 weeks supervised		Outcomes measured at 0, 4 (in 4 week group only), 7 weeks and finally 6 months.	ISWT, ESWT, CRDQ, BPQ	ESWT diff between groups =124.6 seconds (p=0.024)	Funded by a Trevor Clay grant from the British Lung Foundation

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Sewell L; Singh S; Williams JEA, *et al*. Can individualised rehabilitation improve functional independence in elderly patients with COPD? CHEST. 2005. 128. 1194-1200.	RCT	1-	180	Patients with COPD referred to pulmonary rehabilitation assessment clinic	ITEP – Individually targeted exercise programme	GEP- conventional general exercise programme	Baseline, 7 weeks pulmonary rehabilitation then after pulmonary rehabilitation intervention.	Physical activity monitors; Canadian Occupational Performance Measure; ISWT; Chronic Respiratory questionnaire - self reported.	Both ITEP & GEP made significant improvements within group in all outcomes however no significant 'Between group' differences were observed in any outcome.	Trent Regional Research Scheme

Comments: Pragmatic study however lost power in GEP arm due to higher than expected drop outs. Results not ITT.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Simpson K, Killian K, McCartney N, *et al.* Randomised controlled trial of weightlifting exercise in patients with chronic airflow limitation. Thorax. 1992; 47:70-75.	RCT	1-	34 (28 completed)	COPD. 73 years old. FEV1 39% predicted.	10 repetitions resistance training, progressing from 50% to 85% max. Maximum redone every 6 sessions.	Control	8 weeks	Strength	61N increase in quads strength (25%)	Medical Research Council of Canada

Comments: Difference in baseline gender (corrected with % predicted values)

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Skumlien, S. Skogedal EA, Bjφrtuft φ, *et al.* Four weeks' intensive rehabilitation generates significant health effects in COPD patients. Chronic Respiratory Disease. 2007; 4(1): 5-13.	Cohort study	2+	Pulmonary rehabilitation= 40, control = 20	COPD patients living within 6 hours of travel from clinic.	4 week in patient pulmonary rehabilitation programme.	Usual care - control patients on pulmonary rehabilitation waiting list	Pulmonary rehabilitation subjects – 4 weeks Control subjects – assessed 4 months prior to start of pulmonary rehabilitation then at start of pulmonary rehabilitation programme	Work rate peak, SGRQ, 6MWD, TET	Work rate peak, watts pulmonary rehabilitation +26 Control +7 p <0.05; 6MWD pulmonary rehabilitation +14 (n=33) Control +-5 NS; SGRQ (total scores) pulmonary rehabilitation -66 (n=33) Control -0.5	Not stated

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Stav D, Raz M, Shpirer I. Three years of pulmonary rehabilitation: inhibit the decline in airflow obstruction, improves exercise endurance time, and body-mass index, in chronic obstructive pulmonary disease. BMC Pulmonary Medicine. 2009; 9:26.	Controlled trial	2+	80 (40 in each group)	COPD, On LABA or ICS/LABA, <70 years, FEV1 30-60% predicted, stable 2 months prior to recruitment	3 years, twice weekly supervised exercise + unsupervised, psychologist as needed	Control group	3 years	Cycle incremental, cycle endurance, FEV1, BMI	75ml difference in FEV1 in 3 years. Improved and sustained exercise performance. BMI remained stable in rehab group (reduced in control group)	Tel Aviv Lung Association

Comments: Long period of rehab. Small clinical difference in FEV1

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Steiner MC, Barton R, Singh SJ, Morgan	RCT	1+	85 (60 completed)	At least moderate COPD by BTS	125 ml supplement drink:	Non-nutritive	8 weeks	ISWT, ESWT, handgrip, quads	No difference in exercise	University Hosptals Leicester

MDL. Nutritional enhancement of exercise performance in chronic obstructive pulmonary disease: a randomised Controlled trial. Thorax. 2003; 58:745–751.				criteria excluded if BMI >30 or diabetic	570 kcal daily in the following macronutrient composition: carbohydrate 60%, fat 20%, protein 20%. Both had pulmonary rehabilitation.	visually identical placebo Pulmonary rehabilitatio n.		strength, weight, FFM,	capacity, supplement group gained weight (0.63kg). Control group lost weight (0.58Kg), p=0.004	and Nutricia, Zoetermeer, The Netherlands.

Comments: Only 60 patients completed the study so the findings should not be interpreted as definitive

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Strijbos JH, Postma D, van Altena R, *et al.* A comparison between an outpatient hospital-based pulmonary rehabilitation program and a home-care pulmonary rehabilitation program in patients with COPD. A follow-up of 18 months. CHEST. 1996; 109(2):366-72.	RCT	1-	50 patients 18 hospital, 17 home care 15 control	Moderate to severe (stable) COPD	Exercise and education	Hospital vs. home vs. control	18 months	Spirometry, cycle test, Borg, 4 min walk distance (primary outcome not identified)	Both intervention groups improved in exercise test (w max) at 3 months. Home group maintained benefit at 12 and 18 months (p<0.05)	Not stated

Comments: Small study-underpowered, outcome assessment not blinded.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Toledo A, Borghi-Silva A, Malosá Sampaio LM, *et al.* The impact of non-invasive ventilation during the physical training in patients with moderate-to-severe chronic obstructive pulmonary disease (COPD). Clinics.	RCT	1-	18	COPD patients; FEV<60% predicted; clinically stable for 6 months	Bi-level ventilation (IPAP 10-15cmH2O; EPAP 4-6cmH2O). Training programme: 12 weeks, 30 minutes three times a week, treadmill walking 70% maximum speed	Unassisted training programme	Before and after training	Incremental treadmill walk, blood lactate, respiratory muscle strength, isotime Borg, isotime oxygen saturations	Both groups showed improvements in walk distance, respiratory muscle strength and peripheral oxygen saturation, and a reduction in Borg dyspnoea	Not stated

2007;62(2):113-20.									scores. Blood lactate significantly decreased and VO2 significantly increased in NIV group. Only change in blood lactate stated to be significantly different between groups.	

Comments: No information about randomisation process. Patients and investigators not blinded. Underpowered/small numbers. Statistical testing for difference between groups not mentioned for all outcomes.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Trappenburg JC, Troosters T, Spruit MA, *et al*. Psychosocial conditions do not affect short-term outcome of multidisciplinary rehabilitation in chronic obstructive pulmonary disease. Arch Phys Med Rehabil 2005 86(9):1788-92	Cohort	3	81	Patients with COPD (FEV1 40(15)% predicted	All subjects	12 week outpatient rehabilitation with 2 hour sessions, 3 / week	NA	Change in psychological metrics (HAD, PAIS-SR), social support / interactions (SSL-N), QAL (CRDQ, HRQOL) functional capacity (6MWT, Max aerobic capacity)	Significant improvements in functional exercise capacity, HRQOL, functional status, depression and anxiety observed. Baseline psychological measures did not relate to change in functional capacity.	University Grant

Comments: Outcome from this prolonged pulmonary rehabilitation programme was independent of baseline psychological and socioeconomic status. Study limitations include study selection bias.

Bibliographic citation	Study type	Ev level	Number patients	Patient characteristics	Intervention	Comparison	Length of Follow-up	Outcome measures	Effect Size	Source of Funding

Troosters T, Gosselink R, Decramer M. Short and long term effects of outpatient rehabilitation in patients with chronic obstructive pulmonary disease. Am J Med. 2000; 109:207-212.	RCT	1-	100 enrolled, 62 analysed	COPD, FEV1 <65% predicted, <75 years, clinical stable	Exercise training, concurrent aerobic and resistance training for 6 months	**Control**	**18 months**	Isometric strength, maximal exercise performance, quality of life, health economic, functional 51entilat performance	18Nm increase in quads strength at 6 months, 15Nm at 18 months	Fonds voor Wetenschappeliik Onderzoek-Vlaanderen, Levenslijn grant

Comments: Per protocol analysis (only 62% included)

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
van 't Hul A, Gosselink R , Hollander P, *et al.* Training with inspiratory pressure support in patients with severe COPD. European Respiratory Journal. 2006; 27 (1): 65-72.	RCT	1-	37 randomised; 29 completed	COPD patients; 40-75 years; FEV<60% predicted; 51entilator limitation to exercise capacity; resting PaO2>8kPa	Inspiratory pressure Support 10 (IPS10) cmH2O (training: 8 week cycling programme, 45 minutes three times a week).	Sham Inspiratory pressure Support 5 cmH2O (training: 8 week cycling programme, 45 minutes three times a week).	Pre and post training	ISW, SGRQ, Constant Load cycle endurance (75% of Wpeak)	Significantly higher training intensity in IPS10 group; change in ISW statistically significantly higher in IPS10 group (31+/-21m versus 13+/-31m); change in cycling endurance significantly higher in IPS10 group (7.4+/-5.4 versus 3.9+/-6.0 minutes); no change in SGRQ	Dutch Asthma Foundation

Comments: Improvement in ISW unlikely to be clinically significant. Underpowered. No measurement of breathlessness. SGRQ unchanged. Apart from cycling, no other component generally seen in outpatient programme provided. However investigator made measurements blinded and patients used sham ventilator.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Vincent E, Sewell L, Wagg K*, et al.*, Measuring a change in self-efficacy following pulmonary rehabilitation: an evaluation of the PRAISE tool. CHEST. 2011; 140: 1534-9.	Detailed a reliability study and a prospectiv e observati onal uncontroll ed cohort study	2+	29 patients analysed for reliability study and 225 patients recruited to sensitivity study	Clinically stable COPD attending pulmonary rehabilitation	7 week pulmonary rehabilitation programme attending 2 times per week	None	7 weeks	PRAISE score, MRC, ISWT	Change in PRAISE after pulmonary rehabilitation = 3.59, mean change in ISWT= 83.44 metres.	British Lung Foundation Project grant

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Vivodtzev I, Pépin JL, Vottero G, *et al.* Improvement in quadriceps strength and dyspnoea in daily tasks after 1 month of electrical stimulation in severely deconditioned and malnourished COPD. Chest. 2006; 129(6):1540-1548.	RCT	1- (very select population)	17	Severe COPD, FEV1 <50%, BMI <22, QMVC <50%, Endurance bike <5 minutes at 20W, Recent hospital stay requiring 1/12 inpatient rehab, Clinically stable	Usual rehabilitation + NMES	Usual rehabilitatio n	4 weeks	Quality of life (MRF 28), 6MWT, quadriceps strength, muscle composition (n=11)	Improvement in quadriceps strength, No difference in walking (possibly underpowered) , Improvement in dyspnoea in daily tasks domain of MRF 28	Grants from the Association pour le Traitement, la Re´e´ducation et la Re´ adaptation des Insuffisants Respiratoires (ATRIR), “Bourse Andre´ Dion,” Nyons, France

Comments:

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding

Vonbank K, Strasser B , Mondrzyk J *et al.* Strength training increases maximum working capacity in patients with COPD--randomized clinical trial comparing three training modalities. **Respiratory Medicine (2012) 106(4), 557-563.**	RCT	1+	43 randomised 36 completed	Stable COPD mean FEV1% 55 mean age 60 years	Progressive strength training (ST)2 x week 12 weeks	vs. endurance training (ET) and vs. combined strength and endurance (CT)	12 week training period	Cardiopulmonary exercise testing, FEV1, muscle strength, QOL	Muscle strength (leg press, bench press and bench pull) improved in all three training groups with a significant higher improvement in the ST (mean (SD) 39.3 (27.7)%, 20.9 (19.8)%, 20.3 (10.3)% and the CT (43.3 (40.2)%, 18.1 (12.4)%, 21.6 (26.6%) compared to the ET alone 20.4 (32.3)%, 6.4 (16.3)%, 12.1 (15.5)%. no diff between groups for other outcomes	Austrian national research fund

Comments										
Bibliographic citation	**Study type**	**Ev lev**	**Number patients**	**Patient characteristics**	**Intervention**	**Comparison**	**Length of follow up**	**Outcome measures**	**Effect size**	**Source of funding**
Wadell K, Henriksson-Larsen K, Lundgren R. Physical training with and without oxygen in patients with chronic obstructive pulmonary disease and exercise-induced hypoxaemia. Journal of Rehabilitation Medicine.	RCT	1-	22 randomised, 20 completed	COPD by ERS criteria	8 weeks of thrice weekly exercise with oxygen 5l/min via nasal cannulae	8 weeks of thrice weekly exercise	End of exercise programme	6MWT; distance walked in training; venous pCO2; serum lactate; oxygen saturation; Borg	No difference	Charity and industry

2001;33(5):200-205.

Comments: Single blind study. The small heterogeneous sample experienced a large training effect hence the study was underpowered to detect additional effects of oxygen supplementation

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Wanke T , Formanek D, Lahrmann H, *et al.* Effects of Combined Inspiratory Muscle Training and Cycle Ergometer Training on Exercise Performance in Patients with COPD. European Respiratory Journal. 1994; 7:2205-2211.	RCT	1-	42 total: 21 IMT & CET and 21 CET alone	COPD by usual definition (all severities)	8 weeks. CET: 4 x week tailored exercise on cycle ergometer, IMT: extensive resistance training and endurance training using individualised threshold device	CET only. No sham, no peripheral muscle training	End of intervention	Inspiratory pressures, CPEX parameters	Multiple significant results with IMT versus CET: 15-20% greater increase in inspiratory pressures. 10% greater VO2max/Wmax /Vtmax	Austrian National Bank

Comments: 18 of initial 60 dropped out but reasons not well covered and differential rate not given. Randomisation process not covered. Study not blinded. Most analyses are given versus baseline.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Waterhouse JC, Walters SJ, Oluboyede Y, Lawson RA et al. A randomised 2 x 2 trial of community versus hospital pulmonary rehabilitation for chronic obstructive pulmonary disease followed by telephone or conventional follow up. Health Technol Assess 2010; 14(6).	RCT	1++	240 4 groups	COPD diagnosis based on GOLD criteria MRC 3 or worse Clinically stable Exclusion: inability to understand educational talks, prognosis of 2 years or less; LTOT or significant desaturation; musculosketal problems precluding exercise training; no access to phone; unstable / uncontrolled cardiac disease	4 arms; Community pulmonary rehabilitation plus phone call follow up; Community pulmonary rehabilitation no phone call follow up; Hospital pulmonary rehabilitation plus phone call follow up; hospital pulmonary rehabilitation no phone call follow up. Here: phone call maintenance	No phone call maintenance	18 months	ESWT, SF-6D	ESWT 56.9 (-25.2, 139)m, p=0.174 SF-6D 0.02 (0.04, 0.00), p=0.09	HTA

Comments: Well-designed study exploring the value of community vs. hospital based rehabilitation. Second phase of study evaluated benefit of telephone call, no benefits identified in any outcomes.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding

Wedzicha JA, Bestall JC, Garrod R, *et al*. Randomised controlled trial of pulmonary rehabilitation in severe chronic obstructive disease patients, stratified with MRC dyspnoea scale. European Respiratory Journal. 1998; 12 (2):363-369.	RCT	1+	126	Patients with COPD stratified into MRC 3 -4 (n=66) and MRC 5 (n=60). Approximately half of overall group male. MRC 3-4 patients FEV1 approximately 0.98L; 37% predicted. MRC 5 patients FEV1 approximately 0.82L; 37% predicted. Each group (MRC 3-4 and MRC 5) randomised to exercise and education or education only	All subjects	8 week pulmonary rehabilitation – 2 supervised exercise and education sessions/week (exercise group) vs. 2 education sessions/week (control). Outpatient exercise for MRC 3-4 and home exercise MRC 5	End of pulmonary rehabilitation	Comparison of group response exercise (pulmonary rehabilitation and education) vs. control (education) in patients who completed. MRC 3-4: 29 completed exercise vs. 27 control. MRC 5: 26 completed exercise vs. 28 control. Outcome measures exercise capacity (ISWT), HRQOL (SGRQ and CRDQ)	MRC 3-4 patients improved ISWT 88m with exercise significantly more than -16m control. Also significant improvement CRDQ 14 exercise vs. 6 control. No difference SGRQ between groups. MRC 5 subjects showed no significant improvement ISWT, CRDQ or SGRQ in either exercise or control groups	UK NHS Research and Development programme

Comments: Patients who are severely dyspnoeic and housebound with breathlessness (MRC 5) fail to gain benefit from 8 week home exercise programme whereas patients with moderate dyspnoea (MRC 3-4) improve exercise capacity and 1 measure of heath related quality of life after outpatient pulmonary rehabilitation.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Weiner P, Azgad Y, Ganam R. Inspiratory muscle training combined with general exercise reconditioning in patients with COPD. Chest. 1992; 102:1351-56.	RCT	1-	36 total: 12 IMT & general exercise reconditioning; 12 general exercise reconditioning; 12 nil	"Chronic airflow limitation"	6 months. IMT: threshold device increased toward 80% Pimax, frequency of use unclear; General exercise reconditioning: cycling then rowing then weights, frequency unclear. Sham IMT was used in general exercise	"No intervention " group did not have sham IMT or other contact. ?standard care	End of intervention	Pimax; respiratory muscle endurance; 12 MWT	200m mean increase in GENERAL EXERCISE RECONDITIONING and IMT group, no change in other groups	Not stated.

					reconditioning group.					

Comments: Not truly randomly assigned - a matching process is described. Control group poorly described.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
White RJ, Rudkin S, Harrison S, *et al.* Pulmonary rehabilitation compared with brief advice given for severe chronic obstructive pulmonary disease. Journal of Cardiopulmonary Rehabilitation. 2002; 22(5): 338-44.	RCT	1+	103 patients	Moderate to severe (stable) COPD	Exercise	Hospital based pulmonary rehabilitation home vs. brief intervention	3 months	CRDQ & ISWT	Both intervention groups improved at 3 months. CRDQ (D) weeks difference =0.4 (p>0.05)) ISWT difference = 34.1m (p<0.05).	Funding Academic Institution (Frenchay Respiratory Fund)

Comments: Power calculation assumed superiority, probably underpowered, outcome assessment blinded.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Wijkstra PJ, Ten Vergent EM, van Altena R, *et al.* Long term benefits of rehabilitation at home on quality of life and exercise tolerance in patients with chronic obstructive pulmonary disease. Thorax. 1995; 50:824-828.	Pilot RCT	1-	45. 33 completed. 3 arms	Diagnosed COPD. FEV1 <60% predicted; post bronchodilator FEV1/IVC < 50%	Maintenance strategies post rehabilitation	Control (no intervention including no original rehabilitation)	18 months	QOL: CRDQ	Mean difference not described.	Nederlands Astma Fonds (89.29) and the Foundation Astmabestrijding.

Comment: The authors concluded that after a 3 month course of rehabilitation benefits were observed in the groups that had either weekly or monthly supervised rehabilitation sessions. The sample size for each of the three groups was very small (n=11,12 & 13 for each of the three groups weekly, monthly and control respectively). Not blinded, mean differences between groups not described. 6MWT compared to baseline and not between groups. Assume same study as Wijkstra 1996.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Wijkstra P J, van der Mark TW, Kraan J, *et al.* Long term effects of home rehabilitation	Pilot RCT	1-	45. 33 completed. 3 arms	Confirmed diagnosis of COPD	Maintenance 1/week; 1/ month following intensive pulmonary	Control arm who had no initial pulmonary rehabilitatio	18 months	Wmax; lung function, 6MWD and inspiratory muscles.	Mean difference not described for WMax. Stated to not be	Nederlands Astma Fonds and Foundation Astmabestrijding

on physical performance in chronic obstructive pulmonary disease. Am. J. Resp. Crit. Care. Med. 1996; 153:1234-41.					rehabilitation	n			significantly different between groups.

Comments: The authors concluded that after a 3 month course of pulmonary rehabilitation benefits were observed in the groups that had either weekly or monthly supervised pulmonary rehabilitation sessions. The sample size for each of the three groups was very small (n=11,12 & 13 for each of the three groups weekly, monthly and control respectively). No power calculation reported. Blinding not documented.

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Withers NJ, Rudkin ST, White RJ. Anxiety and Depression in Severe Chronic Obstructive Pulmonary Disease: The Effects of Pulmonary Rehabilitation. J Cardiopulm Rehabil. 1999; 19(6):362-365.	Cohort	3	95	62 male and 33 female patients with COPD (FEV1 0.8(0.31)L). Anxiety and depression defined using the Hospital Anxiety and Depression Questionnaire with scores of 10+ indication a high level of anxiety and depression	All subjects	6 week outpatient pulmonary rehabilitation with 3 hour sessions 2x/week	NA	Comparison of improvement in ISWT in patients with/without high level of anxiety and depression.	Similar improvement in ISWD in patients with (30m) and without (25m) high depression score. Greater improvement in ISWD in patients with (50m) vs. without (20m) high anxiety score ($p<0.05$)	Not stated

Comments: COPD patients with high HAD anxiety and depression scores gain similar or greater improvement in walking distance compared to patients with normal scores

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Young P, Dewse M, Fergusson W, Kolbe J. Respiratory rehabilitation in chronic obstructive pulmonary disease: predictors of nonadherence. Eur Respir J 1999 13: 855-859.	Qualitative	3	91	50-55% male patients with COPD (FEV1 34(13)% predicted, mean FEV1 0.9L)	All subjects	Subjects completed 4 week pulmonary rehabilitation programme	NA	Completion rate defined as those referred to pulmonary rehabilitation who agreed to attend and completed the 4 week programme	A lower proportion of non-smokers (8%) completed the programme than non-smokers (28%, $p<0.02$). Current smokers had odds of 0.3 (0.1-0.9) of pulmonary rehabilitation completion	Not stated

Comments: Completion rate was good in both groups but fewer current smokers completed pulmonary rehabilitation programme

Bibliographic citation	Study type	Ev lev	Number patients	Patient characteristics	Intervention	Comparison	Length of follow up	Outcome measures	Effect size	Source of funding
Zainuldin R, Mackey MG, Alison JA. Optimal intensity and type of leg exercise training for people with chronic obstructive pulmonary disease (Review). The Cochrane Collaboration. 2011; Issue 9(11).	Meta-analysis	1++	Eight included studies were analysed (367 participants)	COPD patients defined by FEV1/FVC ratio < 0.7	Continuous exercise training	Interval training	12 sessions or more	Primary outcomes were at peak exercise (peak work rate, peak oxygen consumption, peak minute ventilation and lactate threshold), at isowork or isotime, endurance time on a constant work rate test and functional exercise capacity (six-minute walk distance).	When comparing continuous and interval training, there were no significant differences in any of the primary outcomes, except for oxygen consumption at isotime (MD 0.08; 95% CI 0.01 to 0.16) but the treatment effect was not considered clinically important.	Cochrane airways collaboration-unfunded

Comments:

Title: The British Thoracic Society Guideline on Pulmonary Rehabilitation in Adults

Short Title: BTS Pulmonary Rehabilitation Guideline

Web Appendix 4 - ABBREVIATIONS FOR EVIDENCE TABLES

6MWT	6 minute walk test
6MWD	6 minute walk distance
12MWD	12 minute walk distance
12MWT	12 minute walk test
ABG	Arterial blood gases
ADL	Activities of daily living
AQ20	Airways questionnaire 20
ATS	American Thoracic Society
BDI	Baseline dyspnoea index
BiPAP	Bilevel positive airway pressure
BMI	Body mass index
BPQ	Breathing problems questionnaire
BTS	British Thoracic Society
CBT	Cognitive behavioural therapy
CES-D	Centre for epidemiologic studies depression scale
CET	Cycle ergometry training
CHF	Chronic heart failure
COPD	Chronic obstructive pulmonary disease
CPE	Cardiopulmonary exercise
CPEX	Cardiopulmonary exercise testing
CRDQ	Chronic respiratory disease questionnaire
CRF	Chronic respiratory failure
CRP	C reactive protein
CSES-D	Center for Epidemiologic Studies Depression Scale
CSES	COPD self efficacy scale
CT	Combined training
DHA	Docosahexaenoic acid
DNA	Did not attend
EAA	Essential amino acids
EPA	Eicosapentaenoic acid
EPAP	Expiratory pressure levels
ERS	European Respiratory Society
ESWT	Endurance shuttle walk test
ET	Endurance training
$ETCO_2$	End tidal CO2
ETA	Exercise training alone
ETLS	Exercise training plus lecture series
ETAT	Exercise training plus activity training
FEV_1	Forced expiratory volume in 1 second
FFM	Fat free mass
FFMI	Fat free mass index
FM	Fat mass
FVC	Forced vital capacity
GEP	Generalised exercise programme
GER	General exercise reconditioning
GOLD	Global initiative for chronic obstructive lung disease
HADS	Hospital anxiety and depression score

HAM-A	Hamilton anxiety rating scale
HAM-D	Hamilton depression rating scale
HRCT	High resolution computed tomography
HRQOL	Health related quality of life
ICS	Inhaled corticosteroids
IHD	Ischaemic heart disease
ILD	Interstitial lung disease
IL6	Inter leukin 6
IM	Intermuscular
IMT	Inspiratory muscle training
IPAP	Inspiratory pressure levels
IPF	Idiopathic pulmonary fibrosis
IPS10	Inspiratory pressure support 10
IQR	Interquartile range
ISWT	Incremental shuttle walk test
ITEP	Individually targeted exercise programme
ITT	Intention to treat
IVC	Inspiratory vital capacity
LABA	Long acting beta agonist
LAP	Lifestyle activity programme
LCADL	London chest activity of daily living scale
LGT	Low intensity general training group
LTOT	Long term oxygen therapy
MIP	Maximum inspiratory pressure
MRC	Medical research council scale
Mw	Weighed mean
MRF28	Maugeri respiratory failure questionnaire
ND	Nandrolone decanoate
NIV	Non invasive ventilation
NIVS	Noninvasive ventilator support
NMES	Neuromuscular electrical stimulation
NNT	Number needed to treat
NS	Non significant
O_2	Oxygen
PAIS-SR	Psychosocial adjustment to illness scale-self report
$PaCO_2$	Partical pressure of carbon dioxide
$Pa0_2$	Partial pressure of oxygen
PFSDQ	Pulmonary functional status and dsypnoea questionnaire
PeMax	Maximal expiratory mouth pressure
PiMAX	Maximal inspiratory mouth pressure
PRAISE	Pulmonary rehabilitation adapted index of self efficacy
PUFA	Polyunsaturated fatty acid
RM	Repitition maximum test
MVC	Maximal voluntary contraction
QOL	Quality of life
RCT	Randomised controlled trial
SCL-90R	Symptom checklist 90R
SF-36	Short form 36
SGRQ	St Georges respiratory questionnaire
SMD	Standardised mean difference
SOB	Shortness of breath
$Sp0_2$	Saturation of peripheral oxygen
SPPB	Short physical performance battery
ST	Strength training group

STAI	State trait anxiety inventory
SWT	Shuttle walk test
TDI	Transition dyspnoea index
TET	Traditional exercise training
TNF	Tumour necrosis factor
VAS	Visual analogue scale
VO_2max	Maximal oxygen consumption