They Can’t Bury You while You’re Still Moving: Update on Pulmonary Rehabilitation

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Disclosures: None relevant to this presentation
Today’s presentation

• Definition and concept of pulmonary rehabilitation
• Areas of scholarly activity in pulmonary rehab
• Physical inactivity is bad in the individual with chronic respiratory disease
• How we can measure physical activity
• How effective is pulmonary rehabilitation in increasing physical activity?
What’s old and new in pulmonary rehabilitation

• Less active scholarly activity: global outcomes, exercise training
• Areas of more intense interest:
  – PR in non-COPD patient
  – PR in the post-exacerbation period
  – Sustaining effects of PR in the long-term
  – Self management in PR and in respiratory disease in general
  – Expanding the access of pulmonary rehabilitation
  – Physical activity: Translating “can do” into “do do”

Why I decided to do pulmonary rehabilitation

Why I decided to do pulmonary rehabilitation


EDITORIAL

On pulmonary rehabilitation and the flight of the bumblebee: the ATS/ERS Statement on Pulmonary Rehabilitation

L. Nicl^, R. ZuWallack^, R. Wouters^ and C.F. Donner^
Why Pulmonary Rehab Works

Becomes more sedentary to avoid dyspnea-producing activity (decreases activity)

Deconditioning aggravates dyspnea; patient adjusts by reducing activity further

Going down the tubes

Dyspnea with activities
Pulmonary Rehabilitation 2006

- Pulmonary rehabilitation is a specialized, evidence-based, multidisciplinary, and patient-centered intervention for patients with chronic respiratory diseases
- As a component of integrated care, its goals include reduced symptoms, maximized functional status, increased participation, and reduced health care costs
- These goals are generally achieved through stabilizing or reversing the systemic manifestations of the respiratory disease and co-morbidities

Nici L, Donner C, Wouters EFM, ZuWallack R et al. ATS-ERS Statement on Pulmonary Rehabilitation 2006

Pulmonary Rehabilitation 2013

- Pulmonary rehabilitation is a comprehensive intervention
- It is based on a thorough patient assessment followed by patient tailored therapies that include, but are not limited to:
  - exercise training, education, and behavior change
- It is designed to:
  - Improve the physical and psychological condition of people with chronic respiratory disease
  - Promote the long-term adherence to health-enhancing behaviors.

Pulmonary Rehabilitation Team

Core team
• Program Coordinator (Nurse, physical therapist, respiratory therapist)
• Pulmonary Rehabilitation Specialist (optional)
• Medical Director
• Other resource professionals
  • PT, nurse, NP, RT, exercise physiologist, administrative assistant, clinical psychologist, dietician, social worker, OT, pharmacist, physiatrist, physician extender, recreational therapist, pastoral care, speech therapist

Pulmonary Rehabilitation: Science

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Source</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost-effectiveness</td>
<td>ACOP/AACVPR®</td>
<td>Weak to very weak evidence; weak recommendation</td>
</tr>
<tr>
<td>Dyspnea relief</td>
<td>ACOP/AACVPR®</td>
<td>Strong evidence; strong recommendation</td>
</tr>
<tr>
<td></td>
<td>ACP®</td>
<td>Average effect on dyspnea subscale of the Chronic Respiratory Questionnaire was clinically significant</td>
</tr>
<tr>
<td></td>
<td>Cochrane review¹</td>
<td>Effect on dyspnea subscale of the Chronic Respiratory Questionnaire was greater than minimum clinically important difference; strong support</td>
</tr>
<tr>
<td></td>
<td>GOLD®</td>
<td>Evidence grade A₁</td>
</tr>
<tr>
<td>Improved exercise</td>
<td>ACOP/AACVPR®</td>
<td>Strong evidence; strong recommendation</td>
</tr>
<tr>
<td>performance</td>
<td>ACP®</td>
<td>Clinically insignificant improvement in six-minute walk distance</td>
</tr>
<tr>
<td></td>
<td>Cochrane review¹</td>
<td>Clinically insignificant improvement in six-minute walk distance</td>
</tr>
<tr>
<td></td>
<td>GOLD®</td>
<td>Evidence grade A₁</td>
</tr>
<tr>
<td>Improved health-related</td>
<td>ACOP/AACVPR®</td>
<td>Strong evidence; strong recommendation</td>
</tr>
<tr>
<td>quality of life</td>
<td>ACP®</td>
<td>No difference in health status scores on the St. George’s Respiratory Questionnaire was less than minimum clinically important difference; strong support</td>
</tr>
<tr>
<td></td>
<td>Cochrane review¹</td>
<td>Effect on all subscales of the Chronic Respiratory Questionnaire was greater than minimum clinically important difference; strong support</td>
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<tr>
<td></td>
<td>GOLD®</td>
<td>Evidence grade A₁</td>
</tr>
<tr>
<td>Psychosocial benefits</td>
<td>ACOP/AACVPR®</td>
<td>Moderate evidence; weak recommendation</td>
</tr>
<tr>
<td></td>
<td>GOLD®</td>
<td>Reduced anxiety and depression; evidence grade A₁</td>
</tr>
<tr>
<td></td>
<td>Meta-analysis³</td>
<td>Small to moderate improvements in anxiety and depression compared with usual care</td>
</tr>
<tr>
<td>Reduced health care</td>
<td>ACOP/AACVPR®</td>
<td>Moderate evidence; weak recommendation</td>
</tr>
<tr>
<td>utilization</td>
<td>ACP®</td>
<td>Equivalency for health care utilization outcomes</td>
</tr>
<tr>
<td></td>
<td>GOLD®</td>
<td>Evidence grade A₁</td>
</tr>
<tr>
<td>Survival</td>
<td>ACOP/AACVPR®</td>
<td>Insufficient evidence; no recommendation provided</td>
</tr>
<tr>
<td></td>
<td>GOLD®</td>
<td>Evidence grade A₁</td>
</tr>
</tbody>
</table>

Systematic review of PR following exacerbations of COPD; Puhan Cochrane 2011

6MWD

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Mean Difference</th>
<th>SE</th>
<th>95% CI</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Behrens 2009</td>
<td>215.00</td>
<td>16.6%</td>
<td>190.12, 249.88</td>
<td>28</td>
</tr>
<tr>
<td>Carr 2009</td>
<td>-25.00</td>
<td>16.6%</td>
<td>-60.58, 20.58</td>
<td>22</td>
</tr>
<tr>
<td>Eshoa 2009</td>
<td>8.50</td>
<td>17.4%</td>
<td>-19.38, 36.38</td>
<td>16</td>
</tr>
<tr>
<td>Kiriakos 1998</td>
<td>150.00</td>
<td>17.0%</td>
<td>116.12, 183.88</td>
<td>28</td>
</tr>
<tr>
<td>Nava 1998</td>
<td>60.00</td>
<td>17.1%</td>
<td>36.75, 185.24</td>
<td>16</td>
</tr>
<tr>
<td>Taironis 2006</td>
<td>64.00</td>
<td>17.9%</td>
<td>22.74, 195.16</td>
<td>21</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>190.00</td>
<td>17.7%</td>
<td>112.24, 263.24</td>
<td>24</td>
</tr>
</tbody>
</table>

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

Mortality

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Experimental</th>
<th>Control</th>
<th>Total</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trusina 2003</td>
<td>16</td>
<td>24</td>
<td>12</td>
<td>47.7%</td>
</tr>
<tr>
<td>War 2014</td>
<td>10</td>
<td>14</td>
<td>21</td>
<td>68.0%</td>
</tr>
<tr>
<td>Ezhova 2016</td>
<td>1</td>
<td>14</td>
<td>1</td>
<td>120.0%</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>38</td>
<td>52</td>
<td>100.0%</td>
<td>6.28 [0.50, 10.00]</td>
</tr>
</tbody>
</table>

Test for overall effect Z = 2.74 (P = 0.006)

How exercise training in pulm rehab works

Central desensitization to dyspnea
Decreased anxiety and depression
Reduction in dynamic hyperinflation
Improved skeletal-muscle function

Treadmill endurance time following pulmonary rehabilitation

Adapted from Ries AL et al. (Table 2, pp 826-827) Effects of pulmonary rehabilitation on physiologic and psychosocial outcomes in pts with COPD. AIM 1995; 122:823-832

* = p < 0.05

BL 2 6 12 18 24 48 72

Months

Functional status in chronic lung disease


Physical activity and positive outcomes in COPD

Higher levels of physical activity in COPD are associated with:

- Better quality of life
- Decreased rate of re-admission for exacerbations of COPD (Garcia-Aymerich Thorax 2003)
- Fewer hospitalizations (Garcia-Aymerich Thorax 2006)
- Decreased all-cause mortality (Garcia-Aymerich Thorax 2006)
- Lower risk of developing COPD in active smokers (Garcia-Aymerich AJRCCM 2006)
- Rate of decline of lung function in active smokers (Garcia-Aymerich AJRCCM 2006)

Reduced physical activity in the individual with COPD

Adapted (improved and made more colorful) from Pitta F et al. Characteristics of physical activities in daily life in COPD. Am J Respir Crit Care Med 2005; 171:972-977
Physical activity measured using armband sensor; ~ 6-days' analysis
Significant limitations of physical activity were present in GOLD II and BODE 1


Longitudinal changes in dyspnea and activity in COPD

• 34 male patients with COPD followed for ~ 5 years in a clinic setting
• Followed with spirometry and the PFSDQ
• FEV1 decreased by 230 mL over this period (-46 mL/year)
• Dyspnea (not linked to activity) did not change
• Patients eliminated on average 5.5 activities over the five years; these included mowing the lawn, ironing, going to bars, gardening, auto and home repair, and walking one mile
• You cannot have exertional dyspnea without exertion

Lareau SC, Meek PM, Press D, Anholm JD, PJ. Roos Heart & Lung 1999; 28:65-73
Functional exercise capacity and functional status in OPR patients

Bowen et al. Chest 2000; 118:697-703

They can’t bury you if you’re still moving

Copenhagen City Heart Study
n = 6790, mean 11 years follow-up

Activity:
Low: < 2/h/week low intensity physical activity
Very low: Mainly sitting work, no physical activity in leisure time

Slide lifted from Thierry Troosters; originally from Garcia-Aymerich Thorax 2006
Quote from Lee Cote, my dance instructor
Physical activity levels and risk of re-admission for AECOPD

*activity promotion vs. pharmacology*


Inactivity predicts hospitalization in COPD

- Baseline evaluation (in 2008)
  - Clinical information: age, gender, body mass index (BMI), FEV1, six minute walk distance (6MWD).
- Physical activity was assessed over 7 consecutive days using a tri-axial accelerometer (RT-3)
  - This was worn on a lateral position on the waist
  - Patients were instructed to wear this device throughout their awake time
  - The sum of movements over each minute in the three axes (vector magnitude units, VMU) was recorded

### Predictors of Hospitalization (univariate analyses)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hazard ratio (95% CI)</th>
<th>p.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6MWD &lt; 350 m.</td>
<td>3.6 (1.5 – 8.3)</td>
<td>0.003</td>
</tr>
<tr>
<td>VMU &lt; 150 counts</td>
<td>2.2 (1.1 – 4.4)</td>
<td>0.02</td>
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</table>

### Predictors of Hospitalization (multivariate analysis)

#### All-cause hospitalizations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Hazard ratio (95% CI)</th>
<th>p.</th>
</tr>
</thead>
<tbody>
<tr>
<td>6MWD &lt; 350 m.</td>
<td>6.5 (1.5 – 28.4)</td>
<td>0.01</td>
</tr>
<tr>
<td>VMU &lt; 150 counts</td>
<td>3.4 (1.3 – 9.0)</td>
<td>0.01</td>
</tr>
</tbody>
</table>

#### Respiratory-related hospitalizations
Assessing physical activity in COPD

VMU data from an accelerometer
The WAW Study:
Site of monitoring and type of exercise
during 2 hours of PR exercise

<table>
<thead>
<tr>
<th></th>
<th>Directly observed</th>
<th>Device worn at:</th>
<th></th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Wrist</td>
<td>Ankle</td>
<td>Waist</td>
</tr>
<tr>
<td>Bike</td>
<td>178</td>
<td>162</td>
<td>190</td>
<td>88</td>
</tr>
<tr>
<td>Classroom</td>
<td>157</td>
<td>168</td>
<td>81</td>
<td>67</td>
</tr>
<tr>
<td>Treadmill</td>
<td>171</td>
<td>120</td>
<td>312</td>
<td>201</td>
</tr>
<tr>
<td>Total activity</td>
<td>150</td>
<td>134</td>
<td>167</td>
<td>111</td>
</tr>
</tbody>
</table>

Estimated mean Kcal/hr

How can we increase the “Do do”?

Activity Promotion: A Paradigm Shift for Chronic Obstructive Pulmonary Disease Therapeutics

<table>
<thead>
<tr>
<th>First Author</th>
<th>Year Published</th>
<th>No. of Subjects</th>
<th>Monitoring Duration</th>
<th>Device</th>
<th>Activity Increased?</th>
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</thead>
<tbody>
<tr>
<td>Coronado (28)</td>
<td>2003</td>
<td>15</td>
<td>1 day</td>
<td>Uniaxial</td>
<td>No</td>
</tr>
<tr>
<td>Steele (29)</td>
<td>2003</td>
<td>41</td>
<td>3 days</td>
<td>Triraxial</td>
<td>No</td>
</tr>
<tr>
<td>Sewell (30)</td>
<td>2005</td>
<td>120</td>
<td>2 days</td>
<td>Uniaxial</td>
<td>Yes</td>
</tr>
<tr>
<td>Mercken (31)</td>
<td>2005</td>
<td>11</td>
<td>9 days</td>
<td>Uniaxial</td>
<td>Yes</td>
</tr>
<tr>
<td>Pitsch (32)</td>
<td>2008</td>
<td>29</td>
<td>2–5 days</td>
<td>Dynaport</td>
<td>Yes</td>
</tr>
<tr>
<td>Walker (33)</td>
<td>2008</td>
<td>33</td>
<td>2–3 days</td>
<td>Uniaxial</td>
<td>Yes</td>
</tr>
<tr>
<td>Steele (34)</td>
<td>2008</td>
<td>50</td>
<td>6 days</td>
<td>Triraxial</td>
<td>No</td>
</tr>
<tr>
<td>Dallas (35)</td>
<td>2009</td>
<td>43</td>
<td>7 days</td>
<td>Pedometer</td>
<td>No</td>
</tr>
<tr>
<td>Mador (36)</td>
<td>2010</td>
<td>24</td>
<td>7 days</td>
<td>Triraxial</td>
<td>No</td>
</tr>
</tbody>
</table>

Definition of abbreviations: Dynaport, two-axi meter device (39); triraxial, three-axi meter device; uniaxial, single-axi meter device.

Casaburi R. Activity Promotion: A Paradigm Shift for Chronic Obstructive Pulmonary Disease Therapeutics, PATS 2008; 8: 334-337
Changes in pedometer counts following pulmonary rehabilitation

\[ n = 55 \]

\[
\begin{align*}
\Delta \text{ six minute walk (m)} & : 45 \quad < 0.0001 \\
\Delta \text{ MRC dyspnea (0-4)} & : -0.54 \quad 0.001 \\
\Delta \text{ CRQ total (units)} & : 10.1 \quad < 0.0001 \\
\Delta \text{ pedometer counts / hr} & : 30 \quad 0.11
\end{align*}
\]

Data from Northeast Pulmonary Rehabilitation Consortium

Outcome trajectory over 6 months

Promoting self-efficacy

- The present acute care model for the delivery of PR is generally insufficient for maintaining long-term exercise benefits. On the basis of the integrated care model, we recommend development and implementation of self-management strategies in PR to promote long-term health behavior change in this area. These strategies will specifically target patient self-efficacy and barriers to exercise.
- Behaviors:
  - Incorporating exercise into the home setting early on in the course of pulmonary rehabilitation

Nici L et al. Pulmonary Rehabilitation: WHAT WE KNOW AND WHAT WE NEED TO KNOW. J Cardiopulm Rehab and Prev 2009; 29:141–151

Weekly endurance activity duration after PR: three trajectories

Soicher et al. Trajectories of endurance activity following PR in COPD pts. ERJ 2012 39:272
Decline in weekly physical activity

- **LOW GROUP**: was characterized by severe disease, a lower 6MWD, poor past exercise habits, worse self-efficacy for exercise, were more prone to exacerbations, and more likely to cite a medical reason for not exercising *(bad habits, bad protoplasm)*

- **HIGH-DECLINE GROUP**: was characterized by less-severe disease, less dyspnea, were more likely to report perceived barriers to exercise, were more likely to report a life event at 8 months, and were more likely to report a co-morbid condition at 12 months *(practical barriers, life events, general health issues)*

Soicher et al. Trajectories of endurance activity following PR in COPD pts. ERJ 2012 39:272

Translating increases in exercise capacity realized in the laboratory setting into increased physical activity in the home and community settings

- Provide longer duration pulmonary rehabilitation, if possible; encourage maintenance program attendance
- Promote self efficacy through self management strategies in pulmonary rehabilitation
- Focus on activity not just exercise in the home setting
- Consider feedback on activity
- Consider novel behavior modification strategies
- Explore barriers to regular physical activity
What we are up against

I just can't figure it out. The 6 weeks' course of lisinopril I gave you last year controlled your BP beautifully at the time. Now that darn BP is up again!

Conclusion: The Enemy