NON-PHARMACOLOGICAL MANAGEMENT OF COPD

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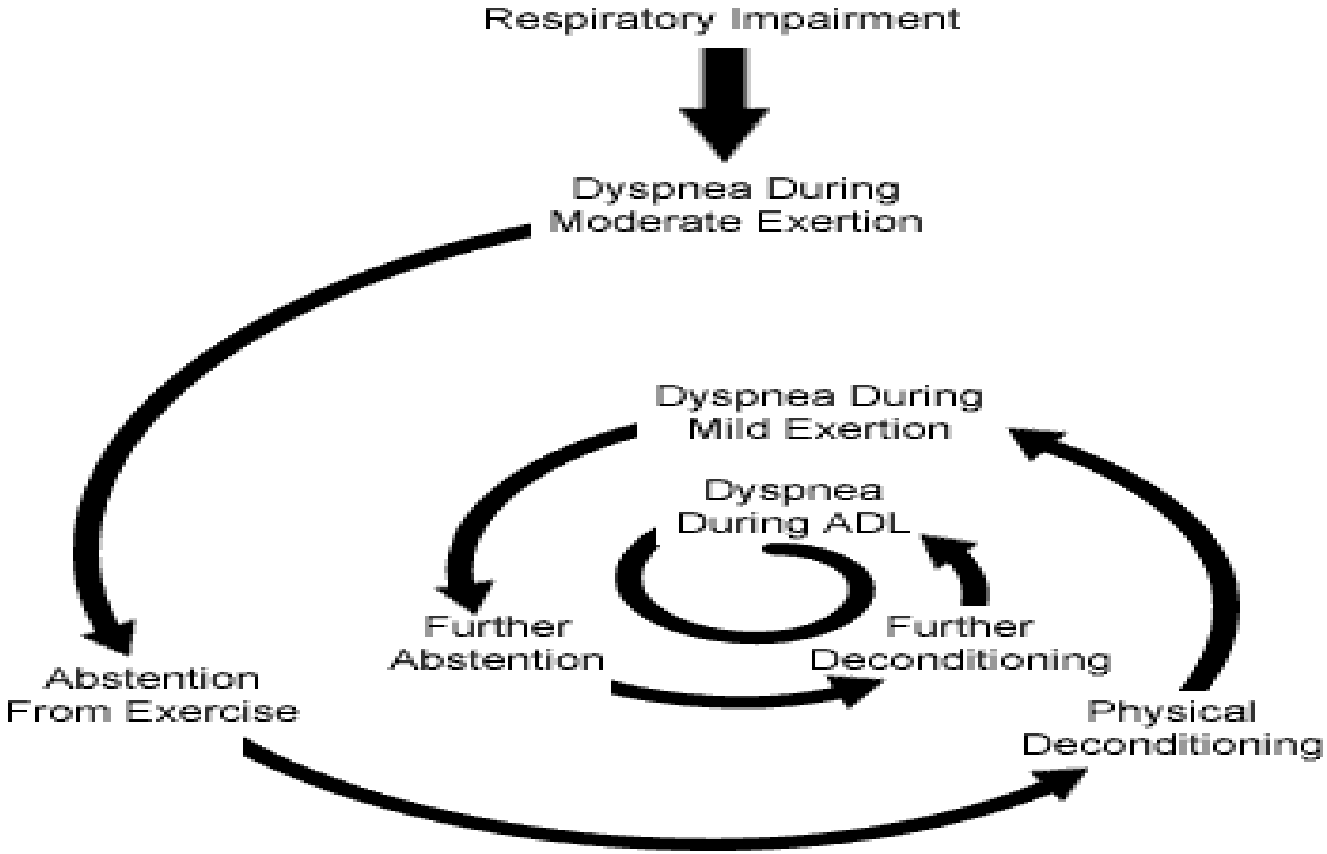
LEARNING OBJECTIVES

- Review concept of pulmonary rehabilitation and its measurable benefits
- Review indications for Long-Term Oxygen Therapy
- Discuss options for delivery of LTOT
- Discuss Role of NIPPV in management of stable COPD
- Understand when referral to hospice is appropriate

WHAT IS PULMONARY REHABILITATION?

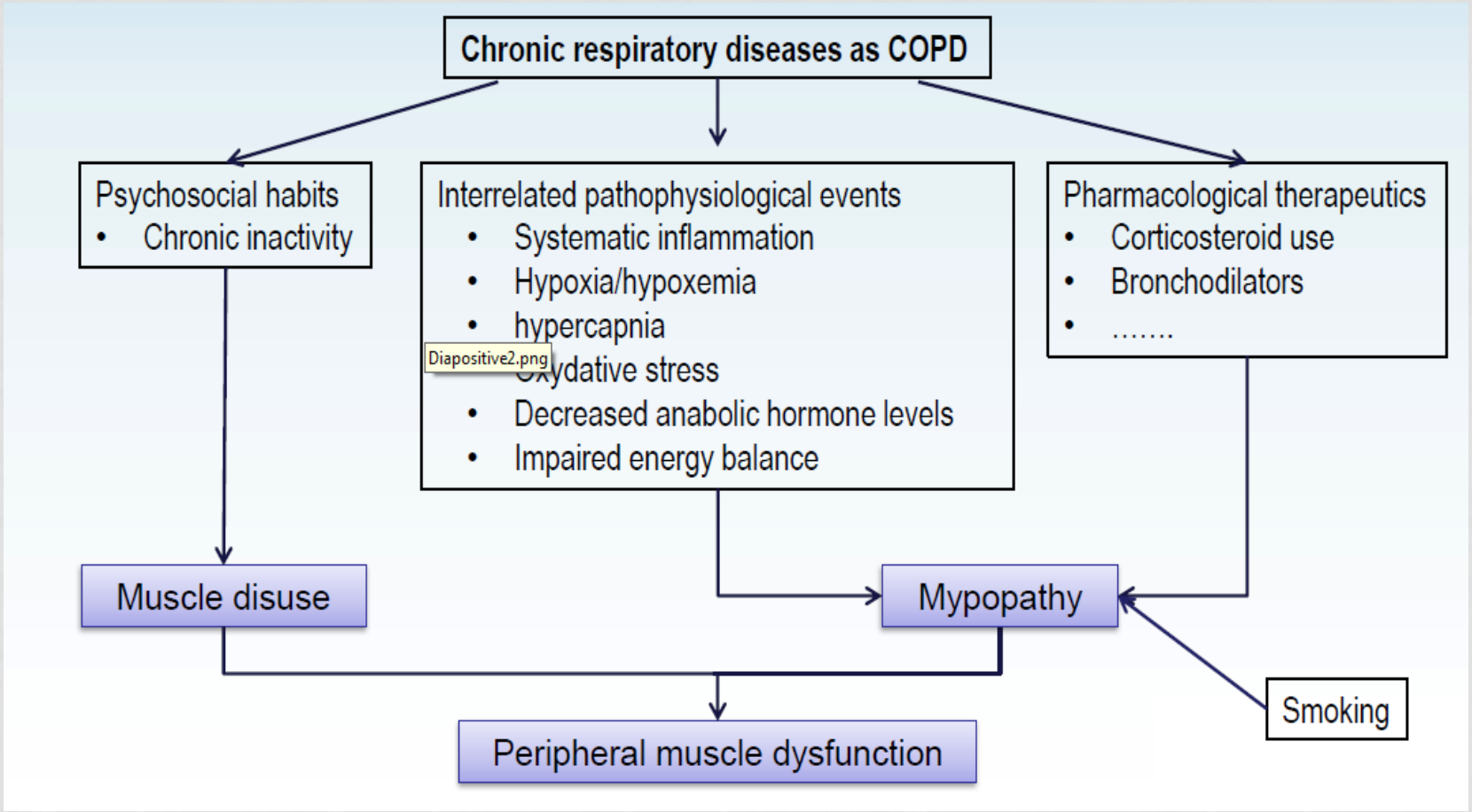
- "…a multidisciplinary programme of care for patients with chronic respiratory impairment that is individually tailored and designed to optimise each patient's physical and social performance and autonomy."
- Pulmonary rehabilitation program include:
  - exercise training
  - education
  - psychosocial/behavioural intervention
  - nutritional therapy
  - outcome assessment
  - promotion of long-term adherence to the rehabilitation recommendations

SPIRAL OF DISABILITY



ADL = activities of daily living

FACTORS INVOLVED IN SKELETAL MUSCLE DYSFUNCTION



Adapted from Gea, J. Expert Review of Respiratory Medicine

WHO IS IT FOR?

- **All disease severities** (but may not benefit if unable to walk)
- …where SYMPTOMS AND DISABILITY are present (usually MRC grade 3)
- No justification for selection on basis of age, impairment, disability, smoking status or oxygen use
- Continuing smokers may not be eligible and less likely to complete
- Contraindicated if recent MI/ unstable angina

WHAT IS PULMONARY REHABILITATION?

- Three supervised 3 to 4 hr sessions/weekly
  - 6 to 12 weeks (longer may be better)
- Clinical Assessment
  - Cardiopulmonary Exercise Testing?
- Exercise Program
  - Endurance Exercise of Leg muscles
  - High intensity regimens (initial targets 60% max)
  - Resistance Training of Upper Arms
- Education
  - Smoking Cessation, incorporation of activity with daily activity, nutrition, Psychosocial support (anxiety/depression), action plan for COPD exac

LOWER EXTREMITY EXERCISE

- Foundation of pulmonary rehabilitation
  - Multiple controlled studies show:
    - Increased exercise tolerance
    - Walking distance
    - Dyspnea scores
    - QOL scores

UPPER EXTREMITY EXERCISE

- Less data regarding exercise conditioning
- Some muscle groups serve dual function
  - Respiratory and postural
  - Upper Extremity training results in decreased ability for these muscles to participate in ventilation
- Evidence to support improvement in task specific performance

TYPES OF TRAINING

- Continuous vs Interval Exercise
  - Traditionally: continuous, high intensity
  - Similar results with interval training
    - Improved Adherence
- Breathing Retraining
  - Yoga, Pursued Lips
    - Improvement in TLC, dyspnea and saturations
- Ventilatory Muscle Training
  - Mixed results, low quality studies

Interval versus continuous high-intensity exercise in chronic obstructive pulmonary disease: a randomized trialAnn Intern Med. 2006;145(11):816.

PULMONARY REHABILITATION AND MORTALITY

- Mixed results
- Heterogenous populations in study groups

PULMONARY REHABILITATION EFFECT ON EXERCISE CAPACITY

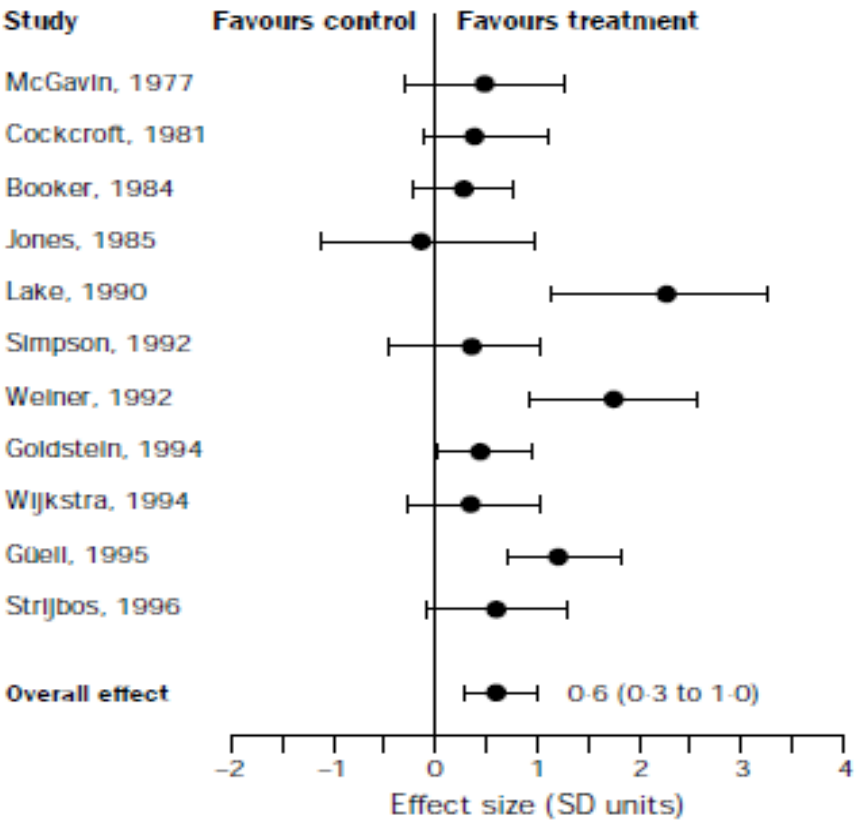


Figure: **Effect of respiratory rehabilitation on functional exercise capacity**

Lacasse,Y et.al. Lancet 1996; 348:1115

PULMONARY REHABILITATION EXERCISE EFFECT

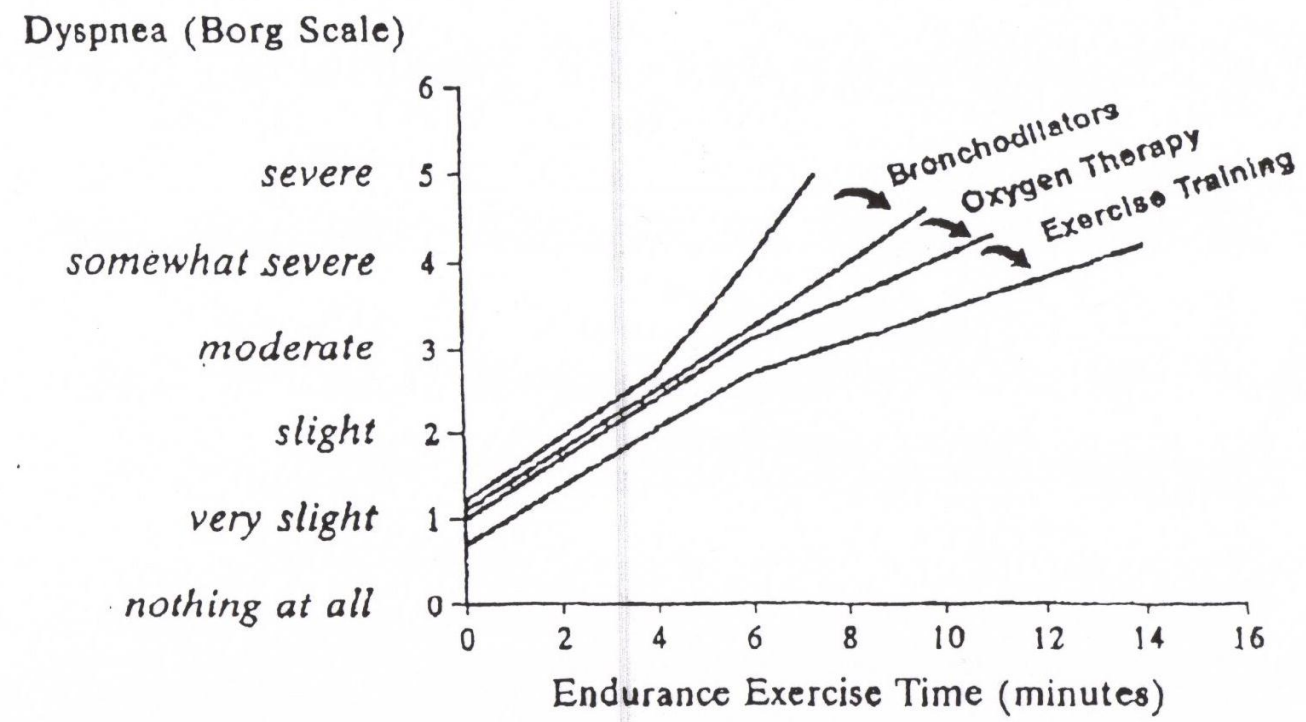


Figure 2. Effect of exercise training on dyspnea compared with bronchodilators and oxygen. Reprinted with permission from Reference 17.

Am J Respir Crit Care Med 1999; 159;321

EFFECT OF THERAPY:
DOES NOT IMPROVE LUNG MECHANICS OR GAS EXCHANGE, BUT OPTIMIZES OTHER BODY SYSTEMS

- Muscle biochemistry
  - higher work rates with less lactic acidosis leading to decreased ventilatory demand
- Reduced dynamic hyperinflation through reduced ventilatory demand
- Desensitization to dyspnea:
  - antidepressant effect, social interaction, self management, and adaptive behaviors

Casaburi, R and Z W allack. Pulmonary Rehabilitation for Management of Chronic Obstructive Pulmonary Disease. N Engl J Med 2009; 360:1329-1335.

DURATION OF BENEFITS

- 48 patients participating in five sucessive hospital based PR programs over 7 yrs
  - At the end of each program subjects showed improvement in:
    - Exercise capacity, health status, dyspnea, BODE index
    - Degree of improvement decreased with successive programs
  - Exercise tolerance, Dyspnea, and HRQOL did not worsen despite progressive drop in FEV_1

Foglio et al.Respir Med. 2007;101(9):1961.

COST AND COVERAGE

- Cost estimated $2200 8 weeks (NETT Trial)
  - Hospital outpatient: copayment
  - Community or Physician's office: 20% of Medicare reimbursement
- Medicare coverage
  - Moderate to Very Severe COPD as defined by the Gold Classification
  - CPT Code for PR in COPD – 2010
  - 36 sessions per prescription
  - 72 session lifetime maximum

HEALTHCARE UTILIZATION IN **STABLE STATE**

- Early uncontrolled studies suggest that pulmonary rehab decreases:
  - Hospital stay
  - Recurrent hospitalization rates
    - Avg 23 days/yr/pt
- Modest results in larger controlled studies
  - Lancet. 2000;355(9201):362.
    - Controlled: 200 PTS
    - No difference in hospitalization rates
    - LOS: 10 vs 20 days

PULMONARY REHABILITATION FOLLOWING EXACERBATION

- Rationale
  - Skeletal muscle dysfunction
    - Quadricep strength drops 5% at day 3
      - Continues to drop up to 3 months post-discharge
  - Hospitalized patient spend < 10 min walking/day
  - Inactive up to 1 month post-discharge compared to stable COPD

Puhan MA, Gimeno-Santos E, Scharplatz M, Troosters T, Walters EH, Steurer J. Pulmonary rehabilitation following exacerbations of chronic obstructive pulmonary disease. Cochrane Database of Systematic Reviews 2009

PULMONARY REHABILITATION FOLLOWING EXACERBATION

- Cochrane systematic review of five RCT's
  - Reduction in hospital admissions (OR 0.22)
  - One in four patients needed to prevent one re-admission
  - Overall reduction in Mortality (OR 0.28)
- Seymour et al. Thorax 2010
  - 60 pts, controlled study, 3 month PE
    - Hospitalization
      - 33% UC group vs 7% PEPR group
    - Hospital Attendance
      - 57% UC group vs 27% PEPR group

PULMONARY REHABILITATION BENEFITS IN COPD

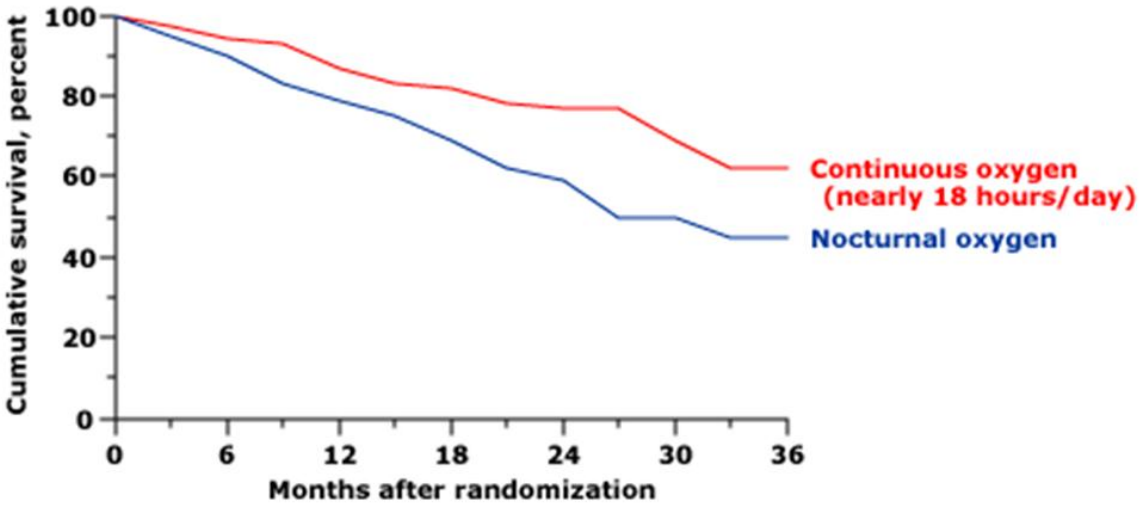
- **Improves exercise capacity - Evidence A**
- **Improves perceived breathlessness - Evidence A**
- **Improves quality of life – Evidence A**
- **Reduces hospitalizations and LOS – Evidence A**
- **Reduces anxiety and depression – Evidence A**
- UBE improves arm function – Evidence B
- Benefits extend beyond training period – Evidence B
- Improves survival – Evidence B

LONG TERM OXYGEN THERAPY

- Evidence:
  - Nocturnal Oxygen Therapy Trial (NOTT)
  - Medical Research Council (MRC) study
    - Relationship between survival and the average daily duration of oxygen use.
    - Median survival in those using O2 for 18 hours/day was approximately two-fold longer than in those receiving no O2 .
    - Survival curves for O2-treated subjects in subsequent uncontrolled studies have generally produced results that are consistent with the data from similarly treated groups of the NOTT and MRC studies

NOTT TRIAL AND SURVIVAL

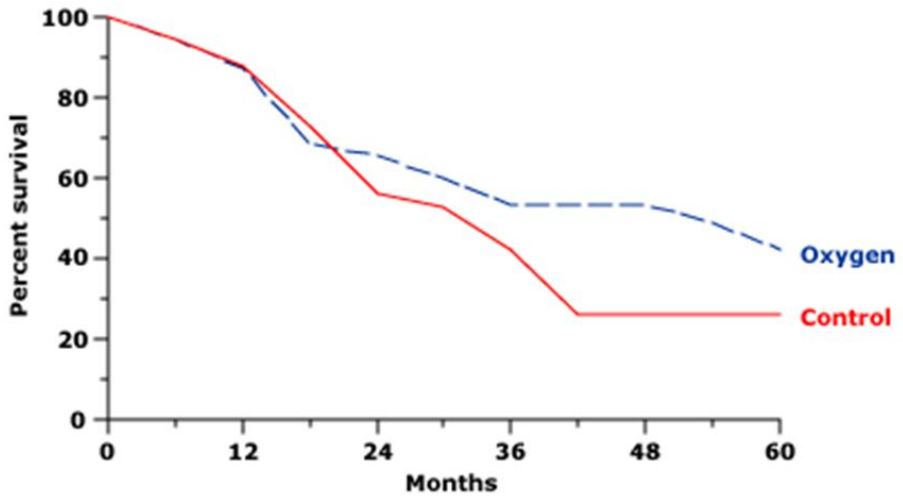
Survival benefit of continuous long-term oxygen therapy in COPD



The Nocturnal Oxygen Therapy Trial randomly assigned 203 patients with chronic obstructive pulmonary disease complicated by hypoxemia to treatment with nearly continuous oxygen therapy (red line) or nocturnal oxygen alone (blue line). Continuous oxygen therapy was associated with a significant survival benefit ($p = 0.01$).
Redrawn from Nocturnal Oxygen Trial Therapy Group, Ann Intern Med 1980; 93:391.

MRC TRIAL SURVIVAL BENEFIT

Survival benefit of long-term oxygen therapy in COPD



Medical Research Council Trial in which 87 patients with chronic obstructive pulmonary disease, severe hypoxemia, hypercapnia, and a history of heart failure were randomized to treatment with oxygen therapy for at least 15 h/day (blue dashed line) or no oxygen (red line). Continuous oxygen therapy led to a significant survival benefit.

Report of the Medical Research Council Working Party, Lancet 1981; 1:681.

LTOT WITH EXERCISE ONLY

- No mortality data
- Improved:
  - Dyspnea scores
  - Walking distances
  - Shorter recovery time after exertion.

LONG-TERM OXYGEN THERAPY WHO QUALIFIES?

- Stable disease on a full medical regimen
  - PaO2 < 55 mmHg (corresponding to an SaO2 <88%)
  - PaO2 is 55-59 mmHg (SaO2 89%) and who exhibits signs of tissue hypoxia:
    - pulmonary hypertension
    - cor pulmonale
    - erythrocytosis,
    - edema from right heart failure
    - impaired mental status
  - Desaturation only during exercise or sleep suggests consideration of oxygen therapy specifically under those conditions.

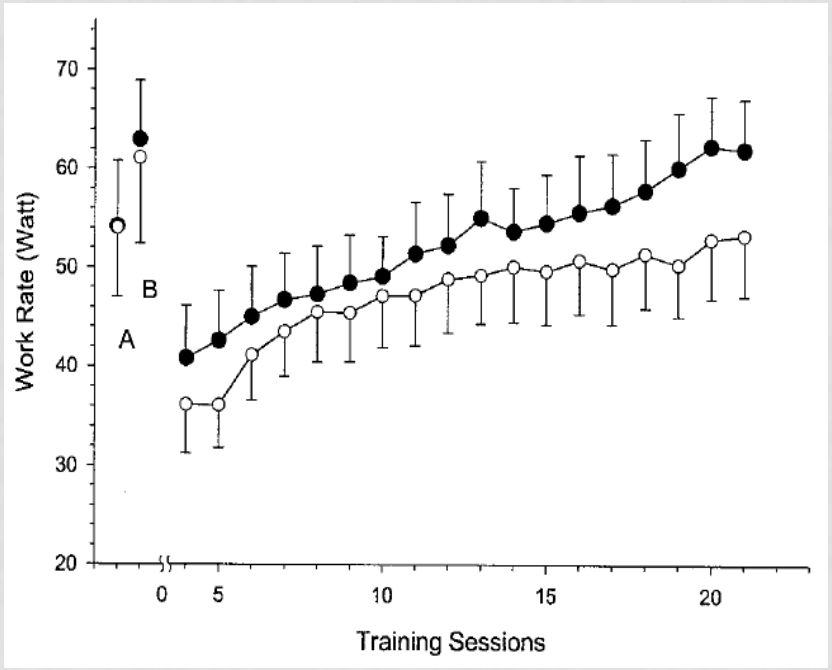
LONG TERM OXYGEN THERAPY

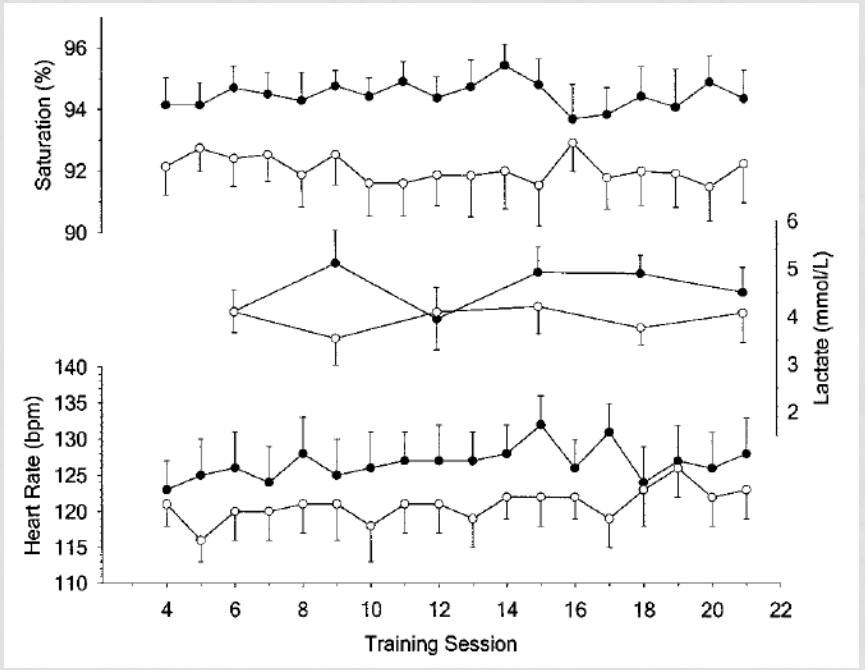
- Over-reliance on the NOTT and MRC trial for defining eligibility for LTOT
  - Arterial oxygen concentration in the MRC trial and the NOTT were chosen arbitrarily during design of the trials and did not originate from the analysis of data from these trials.
  - Small study groups, few women
- Gray areas:
  - Patient with adequate PaO2 who have severe dyspnea relieved by low-flow oxygen
  - Patients who are limited in their exertional capacity but improve their exercise performance with supplemental oxygen.

BENEFITS OF SUPPLEMENTAL OXYGEN IN EXERCISE TRAINING IN NONHYPOXEMIC CHRONIC OBSTRUCTIVE PULMONARY DISEASE PATIENTS

AJRCCM 2003 NOV 1;168(9):1034-42

- Double Blinded Trial
- 29 non-hypoxic patients with COPD (FEV1 36%)
- Cycle Egrometers, 45min, 3/wk, 7wks
- During exercise 3 L/min oxygen vs compressed air





ADDITIONAL EVIDENCE

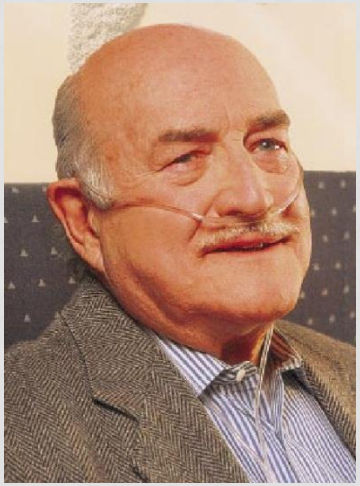
- Improved Dyspnea Scores and Endurance

- Dean NC, Brown JK, Himelman RB, Doherty JJ, Gold WM, Stulbarg MS. Oxygen may improve dyspnea and endurance in patients with chronic obstructive pulmonary disease and only mild hypoxemia. *Am Rev Respir Dis.* 1992;1464:941-945.
- Jolly EC, Di Boscio V, Aguirre L, Luna CM, Berensztein S, Gené RJ. Effects of supplemental oxygen during activity in patients with advanced COPD without severe resting hypoxemia. *Chest.* 2001;1202:437-443.

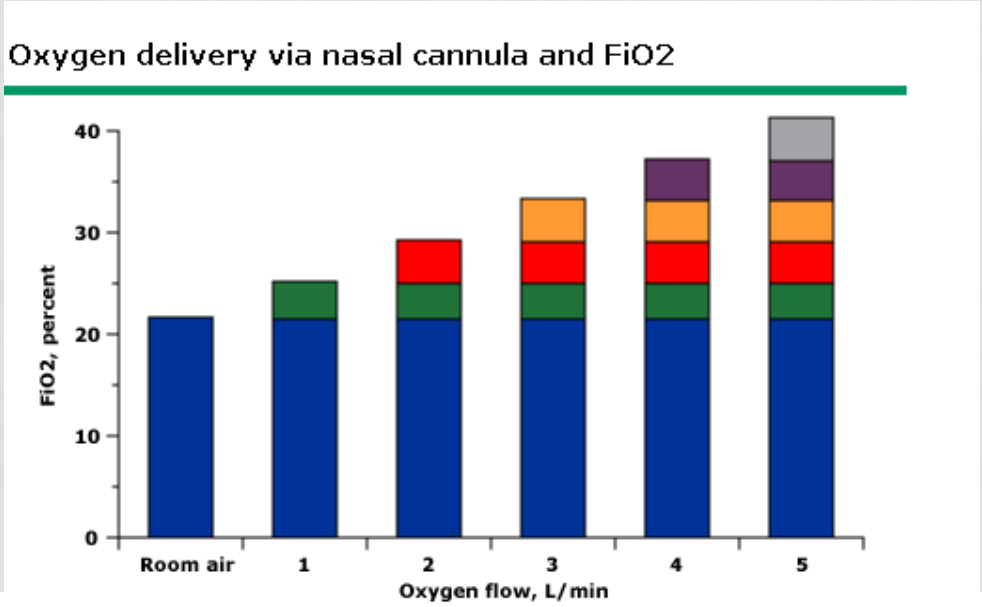
TYPES OF OXYGEN CONSERVING DEVICES

- Reservoir Cannulas
- Demand oxygen pulsing devices
- Transtracheal Catheters

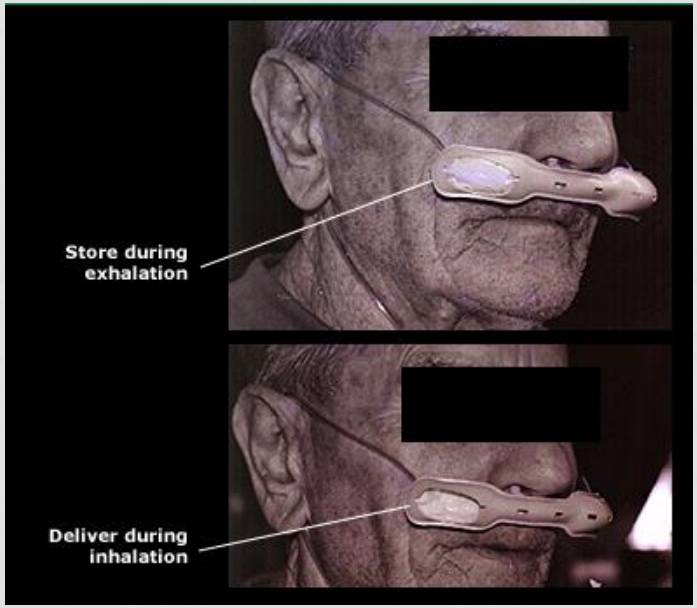
NASAL CANNULA



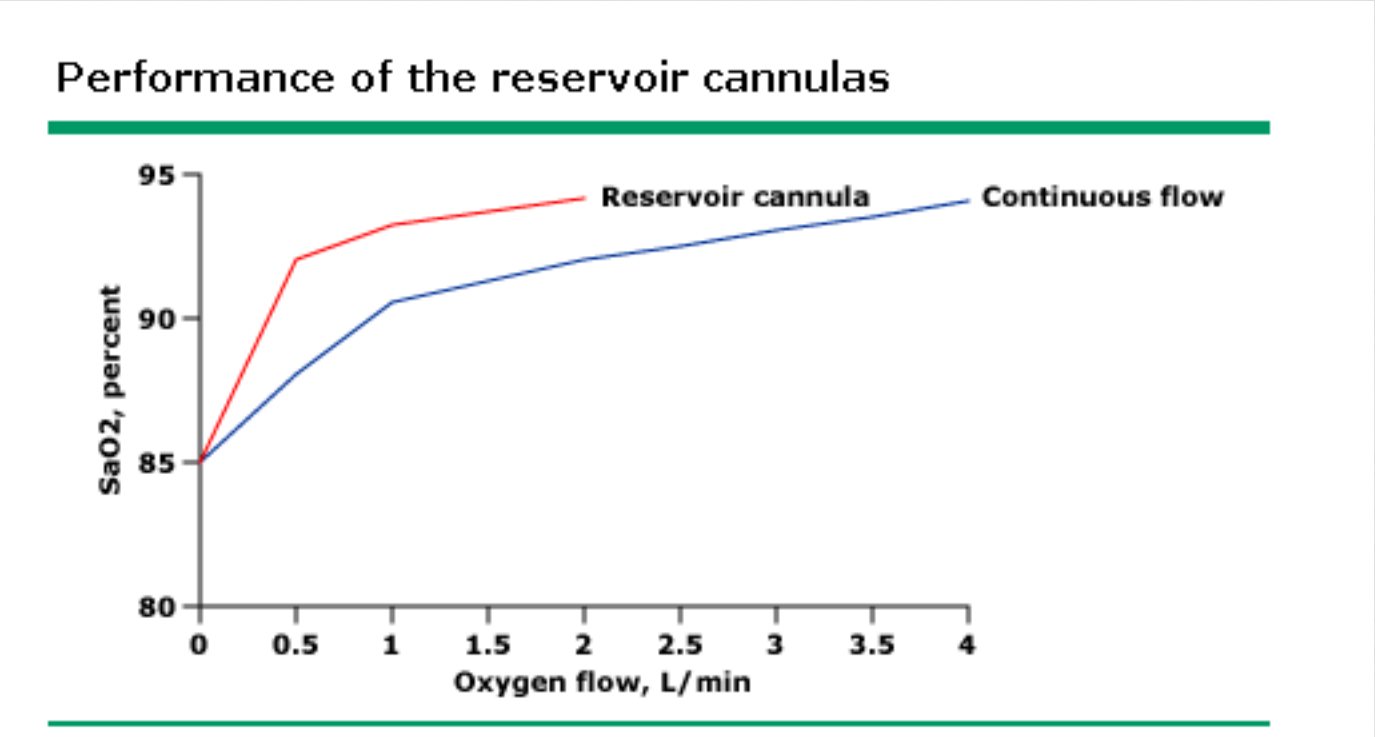
- Advantages
  - Accepted
  - Less obtrusive
  - No impediment to speech or eating



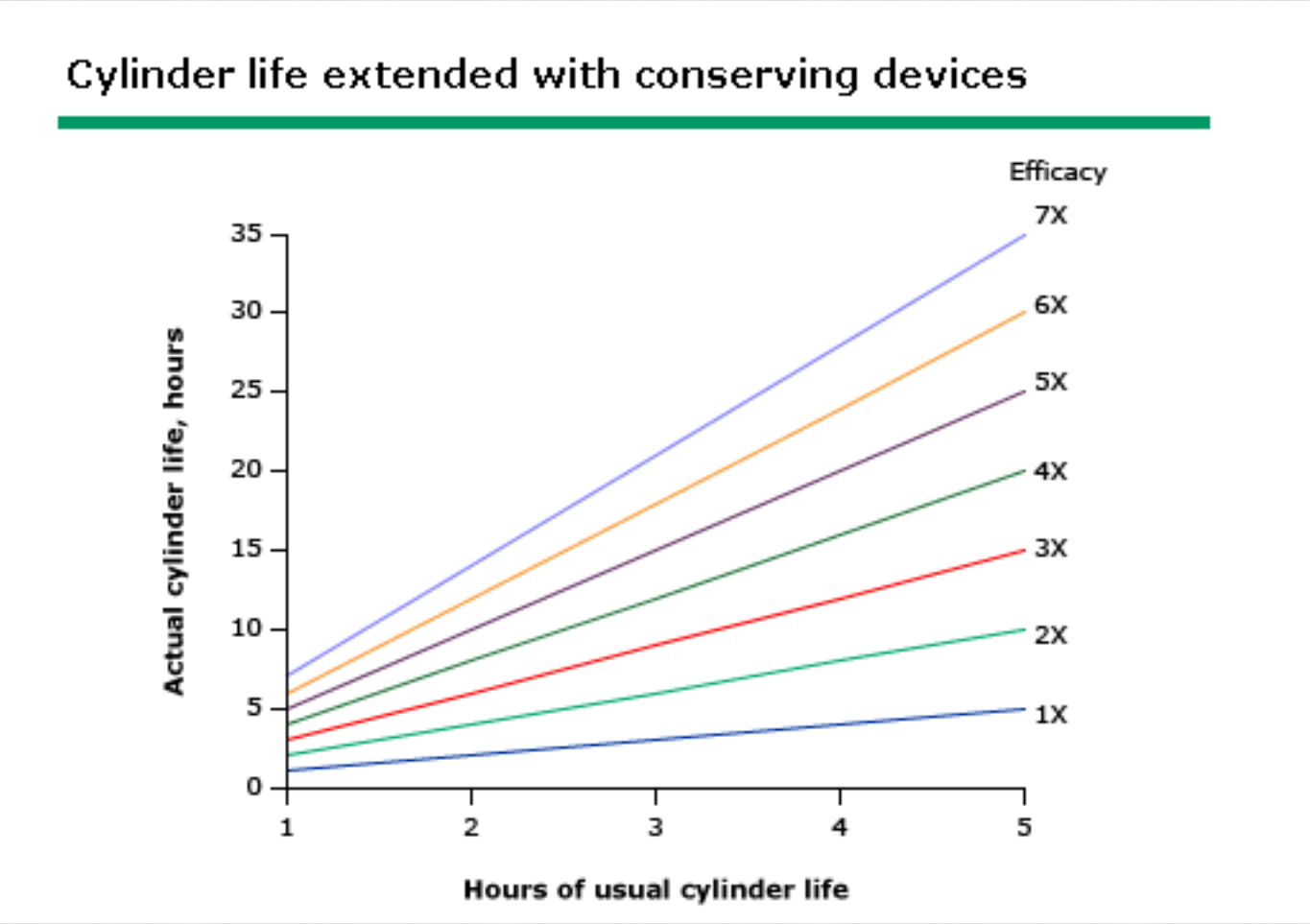
RESERVOIR CANNULAS



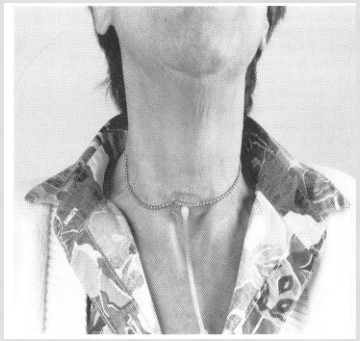
RESERVOIR CANNULAS



CYLINDER LIFE



TRANSTRACHEAL



Potential benefits of transtracheal oxygen

Physiologic benefit	Mechanism
Decrease in dead space	O2 from catheter enters the trachea lower in the airways, decreasing dead space.
Decrease in total inspired minute ventilation	Due to flow from the catheter, less gas is inspired at the mouth, reducing work of breathing.
Increase in CO2 elimination efficiency	Fresh gas flowing from the catheter flushes the area proximal to the catheter tip during expiration, reducing the amount of CO2 that returns to the alveoli with the next inspiratory cycle. In addition, gas exiting the catheter tip at high velocity generates turbulence that enhances gas mixing distal to the catheter tip, increasing CO2 washout. As a consequence, PaCO2 remains unchanged despite a decrease in total inspired minute ventilation.

PORTABLE OXYGEN

- Medicare Reimbursement:
  - Patient must be mobile in the home and regularly ambulate more than **50 feet**
  - **Medicare does not dictate what type of oxygen equipment is provided to the patient.**
    - Determined by patient and physician preference.
  - Certificate of Medical Necessity form needed every 12 months.
  - For highly active and mobile patients:
    - liquid oxygen
    - lightweight aluminum fiber-wrapped ambulatory cylinder
    - portable oxygen concentrator.
    - < 10lbs

A

Respironics

B

Invacare

C

Inogen

D

AirSep

Eclipse

	FreeStyle	LifeStyle	Inogen	Eclipse	EverGo
Weight (lbs.)	4.5*	9.75	9.7	17.9	10
Dimension (in.)	8.6x6.1x3.6	6x7x16	12x11x6	19x12x7	12x6x8.5
Volume ($in.^3$)	189	672	792	1,596	612
AC/DC	YES	YES	YES	YES	YES
Battery Life** (hrs.)	2***	< 1	3	2.4	4
Cont. Settings (Lpm)	N/A	N/A	N/A	0.5 - 3	N/A
Pulse Settings	1 - 3	1- 5	1 - 5	1 - 6	1 - 6
Pulse Output* (cc/min.)	350	350	300	320	300
Max Pulse Output* (cc/min.)	500	500	750	960	900
Noise (dBs)	<55	<55	51	40 - 48	< 55

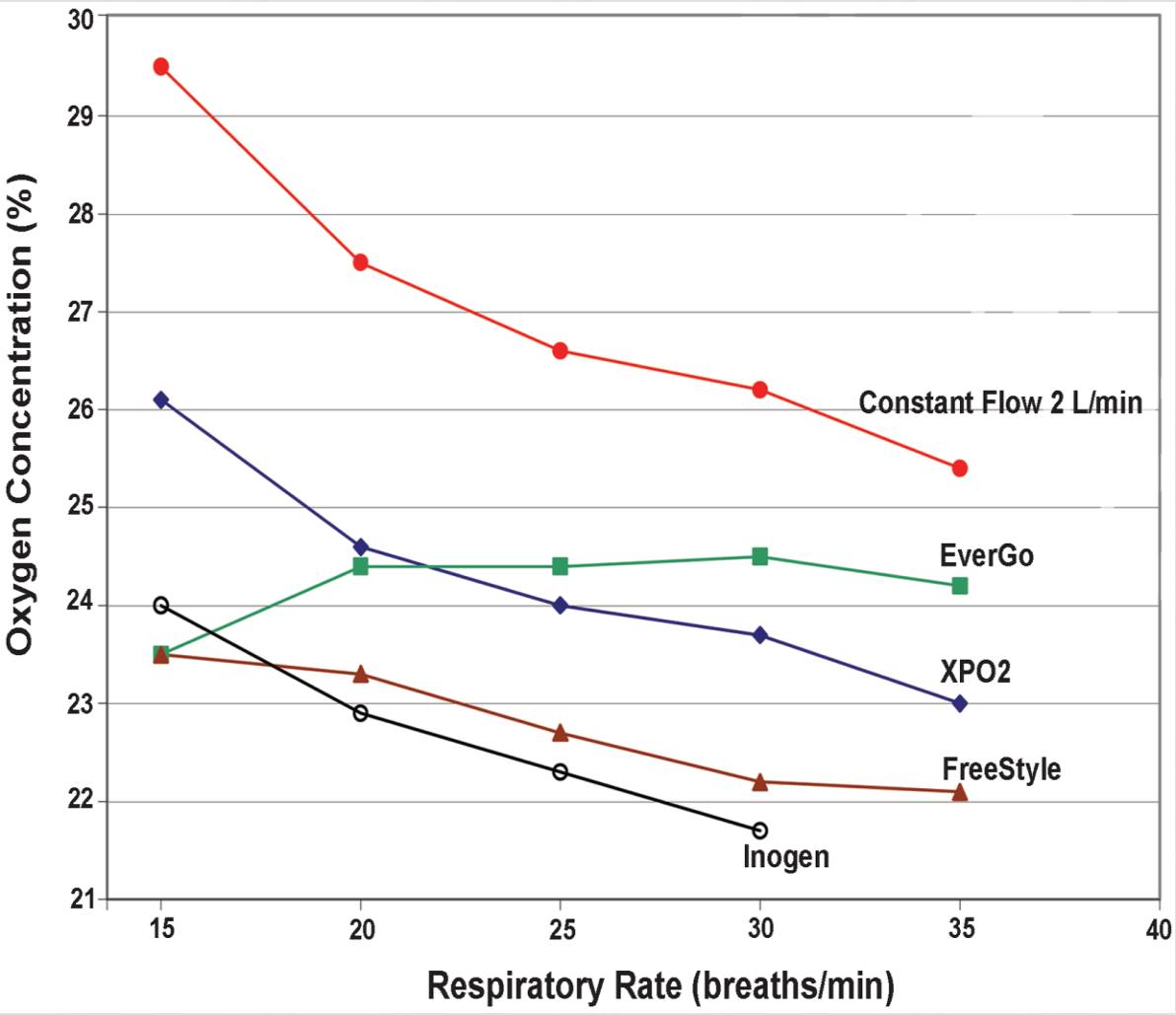
*At setting 2
**Add 1.8 lbs. for optional Airbelt
***Add 4 hrs. with optional Airbelt

Typical Product Parameters

Oxygen flow	Pulse Dose Delivery, Settings 1-5
Oxygen concentration	87% - 95.6% at all settings
Weight	6 pounds concentrator, 1.3 pounds supplemental battery
Dimensions	10" H x 7" W x 4" D
Battery duration	2.5 hours at setting 2, internal battery 2.5 hours at setting 2, supplemantal battery
Battery recharge time	3 hours*
AC power	100-240 VAC 50/60 Hz, 1.0 amps at 120 VAC
DC power	12-16 VDC, 3.3 amps at 18 VDC
Operating altitude	Up to 10,000 ft (3046 m) above sea level
Maximum oxygen capacity	900 ml per minute
Limited warranty - Concentrator	5 years
Limited warranty - Battery and accessories	1 year

* recharge time increases if unit is running while charging

OXYGEN CONCENTRATION AND RR



OXYGEN SUPPLEMENTATION IN SETTING OF HYPERCAPNIA

- Multifactorial
  - Decreased Minute Ventilation
    - Hypoxic drive and blunted CO2 sensitivity
    - ~ 20%
  - Haldane Effect
    - Decreased hemoglobin affinity for CO2
    - ~ 30%
  - Increased Dead Space Ventilation
    - Worsening of V/Q matching due to a loss of hypoxic pulmonary vasoconstriction
    - ~50%

NIPPV AND COPD

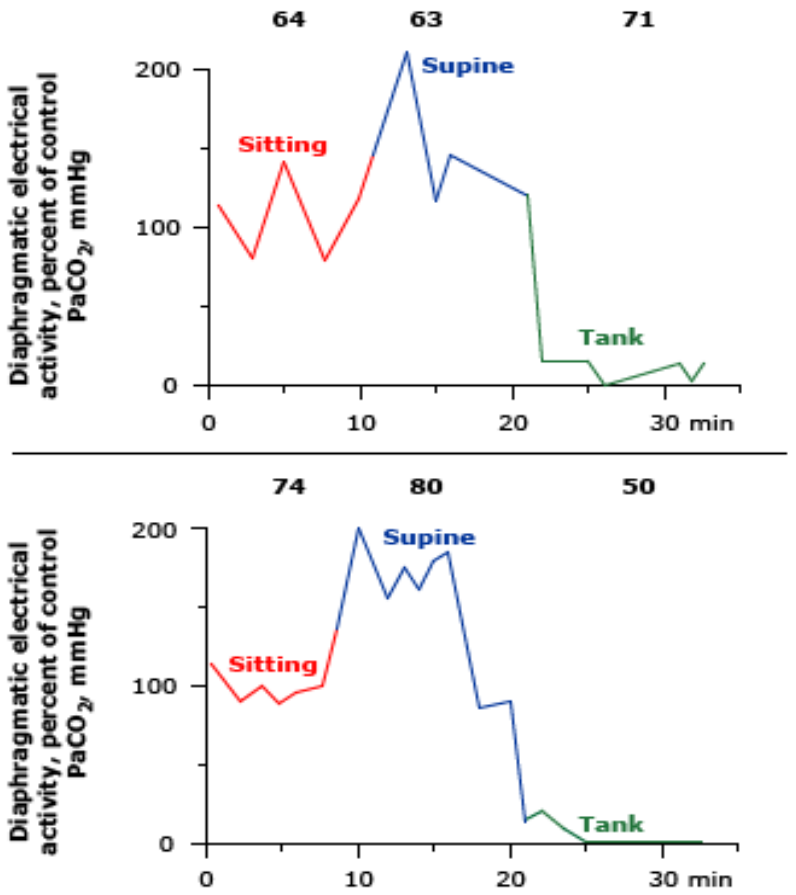
- Acute Exacerbations
  - Meta-analysis (14 randomized trials, 758 patients)
  - Hypercapneic Respiratory Failure PCO2 > 45 secondary to COPD exacerbation
  - NIPPV decreased:
    - Mortality (11 versus 21 percent)
    - Intubation rate (16 versus 33 percent)
    - Treatment failure (20 versus 42 percent).
  - Severity associated with benefit from NIPPV

Ram FS. Cochrane Database Syst Rev. 2004

NOCTURNAL NIPPV AND STABLE COPD

- Rationale
  - Provide rest for weakened respiratory muscles

Diaphragmatic electrical activity



Rochester DF, Braun NM, Laine S. Diaphragmatic energy expenditure in chronic respiratory failure. The effect of assisted ventilation with body respirators. Am J Med 1977; 63:223

NIPPV AND COPD

- An E0470 device is covered if:
  - **PaCO2 > 45 mmHg** , done while awake and breathing the patient's prescribed FIO2
  - Sleep oximetry demonstrates oxygen saturation ≤ 88% for ≥ 5 minutes of nocturnal recording time done while breathing oxygen **at 2 LPM or higher**
  - **Obstructive Sleep Apnea** (OSA) and treatment with a continuous positive airway pressure device (CPAP) **has been considered and ruled out**.

NOCTURNAL NIPPV

- Uncontrolled Trials
  - Benefits:
    - Dyspnea
    - Improvement of Hypersomnolence
    - Daytime CO_2
  - Quality of studies questionable
  - Variable compliance complicates interpretation

NOCTURNAL NIPPV

- Cochrane Airways Group 7 RCT (245 pts)
  - 3 and 12 month follow-up
  - **No significant difference:**
    - PaCO2 (2.5 mmHg) or PaO2
    - 6 min walk distance
    - Health related QOL
    - FEV1/FVC, Max Inspiratory Pressures
  - Subgroups with benefit at 3 months
    - IPAP > 18cmH20
    - Used NIPPV > 5 hrs nightly
    - Baseline PaCO2 > 55 mmHg

Cochrane Airways Group, Respiratory Medicine 2013

NOCTURNAL NIPPV

- Survival
  - AVCAL Study
    - 145 pts controlled trial, LTOT vs LTOT/NPPV
    - Mean f/u 2.2yrs, compliance 4.5 hrs/night
    - **Improved survival out to 36 months, beyond which survival curves converged**
- Hospitalization
  - Italian MCT, 122 Stable COPD(LTOT vs LTOT/NPPV)
  - **After 2 yrs, no difference in Mortality or Hospital Admissions**

Australian trial of non-invasive Ventilation in Chronic Airflow Limitation (AVCAL) Study Group
Thorax. 2009;64(7):561
Italian Association of Hospital Pulmonologists (AIPO)
Eur Respir J. 2002;20(3):529

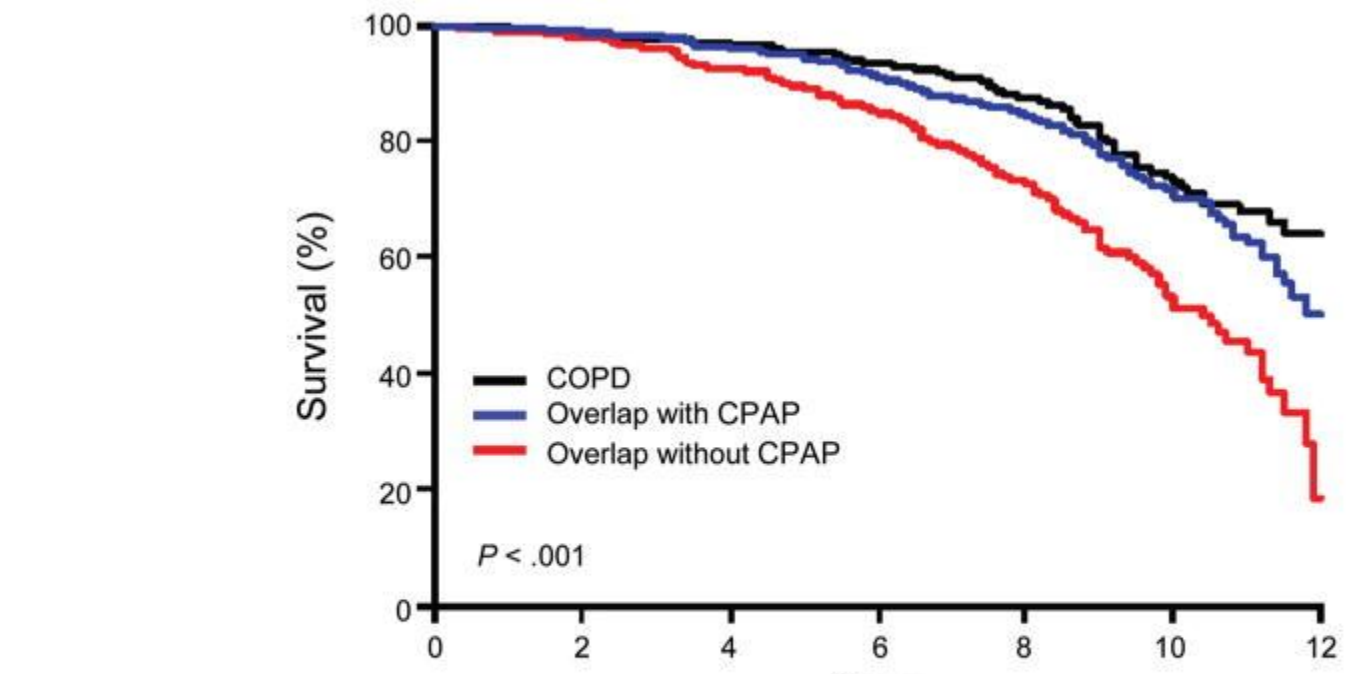
SLEEP AND COPD

- OSA prevalence in COPD as in a general population of similar age
  - Oxygen desaturation during sleep is more pronounced
    - Hypoventilation
    - Ventilation/Perfusion Mismatching

SLEEP AND COPD

- Screen for **nocturnal hypoxemia**:
  - Hypercapnia during wakefulness
  - Moderate to severe daytime hypoxemia
  - Pulmonary and systemic hypertension
  - Heart failure
- Screen for **coexisting SBD**:
  - Progressive hypoventilation (worsening hypercapnia)
  - Suspected upper airway obstruction, ie, coexisting OSA (EDS, Apneic Events)
  - Continued clinical deterioration despite the use of oxygen therapy

COPD AND OSA OVERLAP SYNDROME



Number at risk							
COPD	210	203	196	184	144	89	10
Overlap with CPAP	228	223	215	201	167	97	8
Overlap without CPAP	213	204	186	161	121	57	3

Marin AJRCCM Vol 182. pp 325–331, 2010

NUTRITION AND COPD

- Barriers:
  - Fatigue and dyspnea (interfere with food preparation and consumption)
  - Chronic sputum production (alters the taste of food)
  - Flattening of the diaphragm (causes early satiety)
  - Depression
  - Side effects of medications (eg, nausea, indigestion)

NUTRITION AND COPD

- **Adequate calories** to meet or slightly exceed their basal energy expenditure
  - Consultation with a registered dietician to develop a nutritional prescription for food intake is often helpful
- **Small, frequent meals** with proportionately **more fat and protein** (eg, eggs) and less carbohydrate
- Meals requiring **little preparation** (eg, microwaveable, liquid supplements)
- **Rest before meals**
- Daily multivitamin

PALLIATIVE OR END OF LIFE CARE

- Palliative Care vs. Hospice Care
  - Palliative
    - Focuses on **preventing and relieving suffering** and on supporting the best possible **quality of life** for patients and their families
  - Hospice
    - Model of palliative care offered to patients at the end of life **when curative or life-prolonging therapy is no longer indicated**.

WHEN TO REFER?

- Medicare hospice coverage depends on certification by two physicians that a patient's **prognosis is six months or less** if the terminal illness runs its normal course
- BODE Index
- Hospitalized patients
  - PaCO2 > 50mm Hg
    - 33% will die within 6 months, 43% 1 year
  - Mechanical Ventilation
    - In hospital mortality ~ 25%, 1 year morality ~ 50%

Celli BR, Cote CG, Marin JM, et al. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Eng J Med. 2004; 350(10):1005-12.
Connors AF Jr, Dawson NV, Thomas C, et al. Outcomes following acute exacerbation of severe chronic obstructive lung disease. Am J Respir Crit Care Med. 1996; 154:959-967.

NATIONAL HOSPICE AND PALLIATIVE CARE ORGANIZATION CRITERIA

- Cor pulmonale
- pO2 <55 mmHg while on oxygen
- Albumin < 2.5 gm/dl
- Weight loss of > 10%,
- Progression of disease
- Poor functional status.
- **When using these factors, 50% of the patients were still alive at six months**

SMOKING CESSATION: BEHAVIORAL COUNCILING

- Ask:
  - Implement an officewide system that ensures that, for every patient at every clinic visit, tobacco-use status is queried and documented
- Advise:
  - Strongly urge all tobacco users to quit in a clear, strong, personalized manner.
- Assess:
  - Determine the patient's willingness to quit smoking within the next 30 days
- Assist:
  - Provide aid for the patient to quit
- Arrange:
  - Schedule follow-up contact, either in person or by telephone.
  - 1 wk and 1 month

Fiore MC, Jaen C, Baker T, et al. Treating tobacco use and dependence: 2008 update. Clinical Practice Guideline. Rockville, MD: US Department of Health and Human Services. Public Health Service. 2008

SMOKING CESSATION: ALTERNATIVES

- Acupuncture
  - Acupuncture is included in some commercially available smoking cessation programs.
  - Less effective than nicotine replacement
- Aversive therapy
  - Aversive therapy for smoking cessation involves increasing the amount and rate of cigarette smoking over a short period of time with the goal of inducing a sense of displeasure with smoking.
- Financial incentives
  - A randomized trial among 878 smokers employed at a company in the US found that a substantial financial incentive (as much as $750) increased smoking cessation rates at 9 or 12 months (15 versus 5 percent) and at 15 or 18 months (9 versus 4 percent), compared to an information-only control
- Hypnosis

A randomized, controlled trial of financial incentives for smoking cessationN Engl J Med. 2009;360(7):699.

TAKE HOME POINTS

- Pulmonary Rehabilitation should be considered for all patients with COPD and respiratory symptoms, regardless of severity
- PR following exacerbation should be recommended
- Oxygen conserving devices and portable concentrators may make LTOT more appealing to patients
- Not enough evidence to support regular use of nocturnal NIPPV in hypercapneic COPD patients
- Screen for COPD/OSA Overlap Syndrome
- Palliative care referral

QUESTIONS?