Management of Severe COPD

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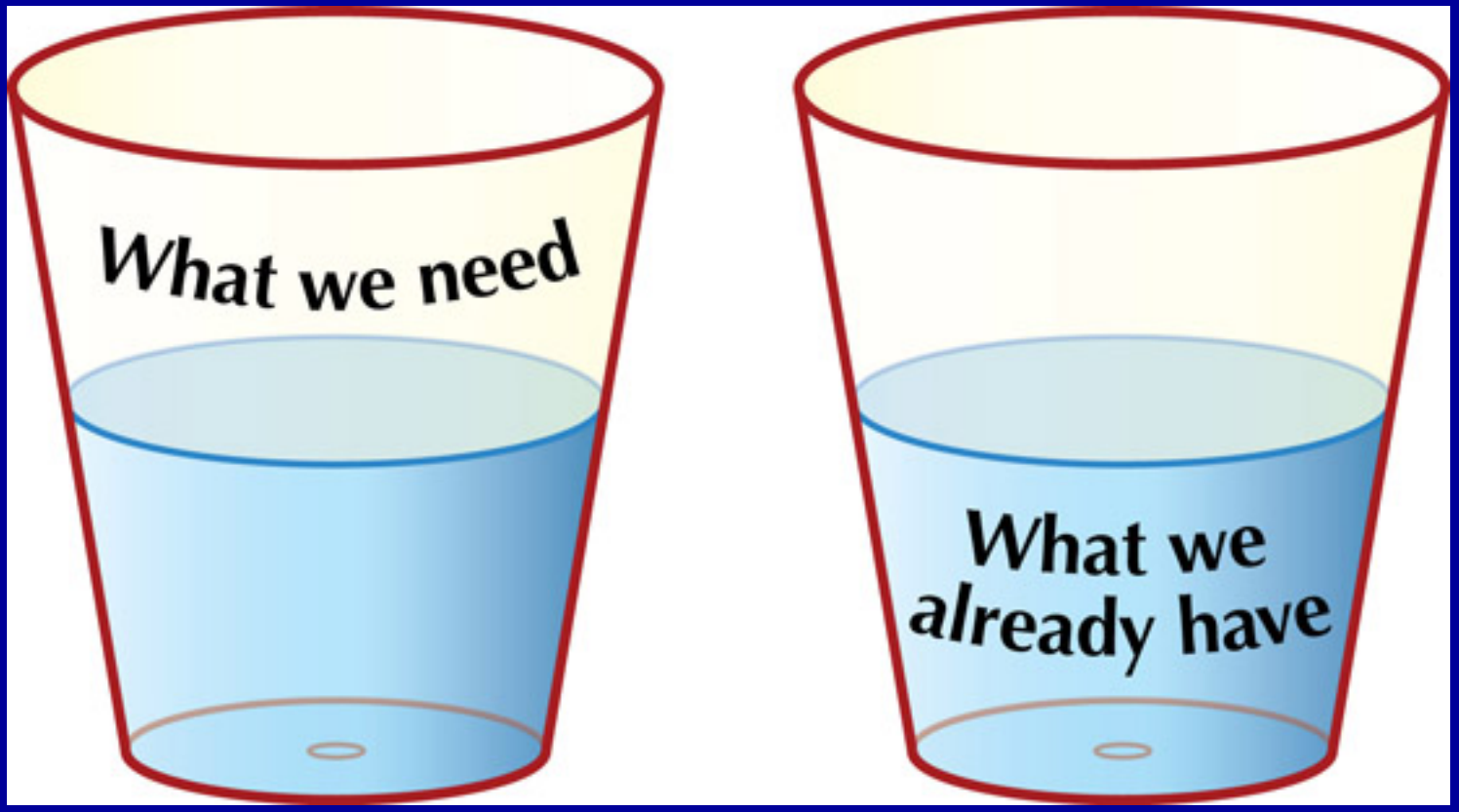
Relationship Disclosures

No financial relationships to disclose

Potpourri

- COPD definition and physiology
- Standard therapies for COPD
- Nocturnal Ventilation
- Perioperative Considerations
- Invasive treatment options

Half Empty/Half Full

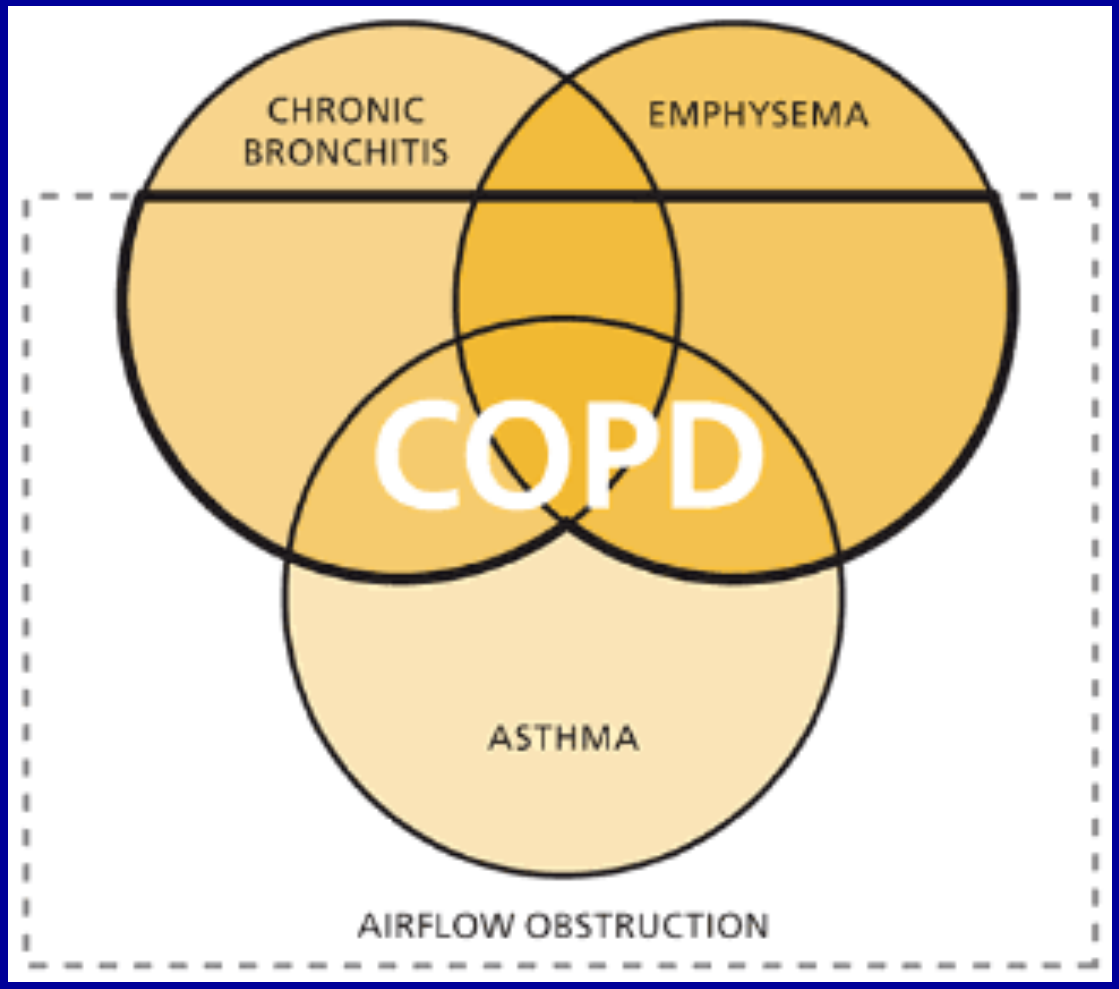


Half Empty/Half Full

COPD Facts

- About 13.5% adults 20 – 79 have reduced airflows
- 4th leading cause of death in USA
  - 120,000 annually

What is Obstructive Lung Dz



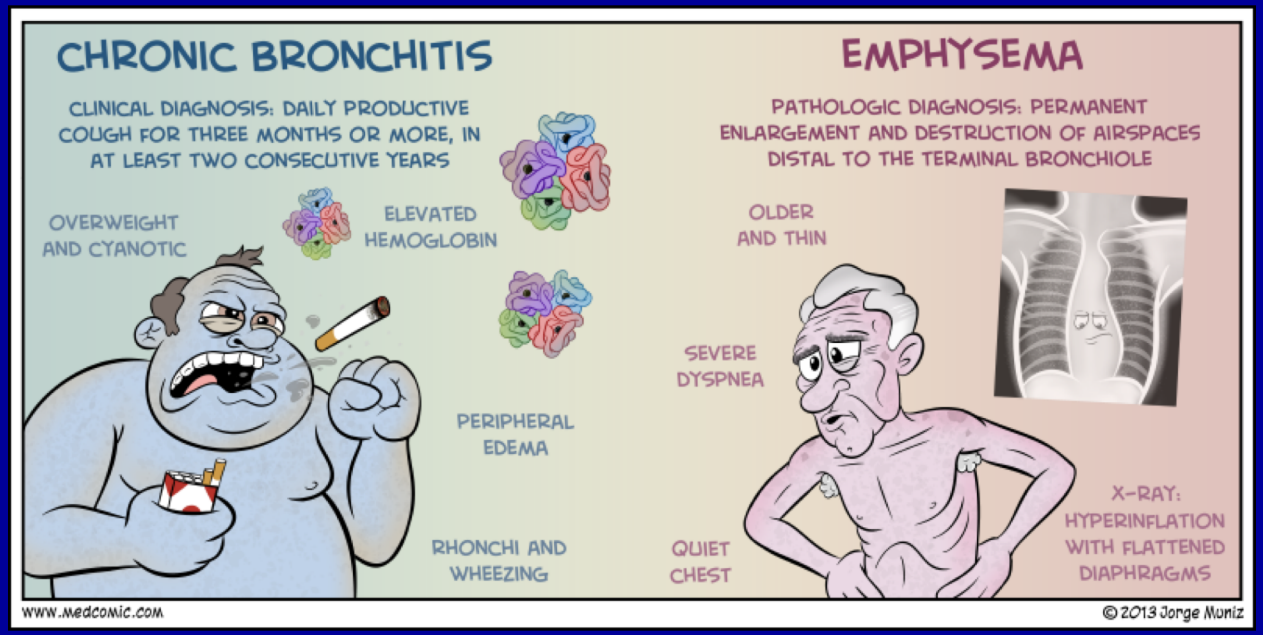
Global Initiative for Chronic Obstructive Lung Disease

POCKET GUIDE TO COPD DIAGNOSIS, MANAGEMENT, AND PREVENTION

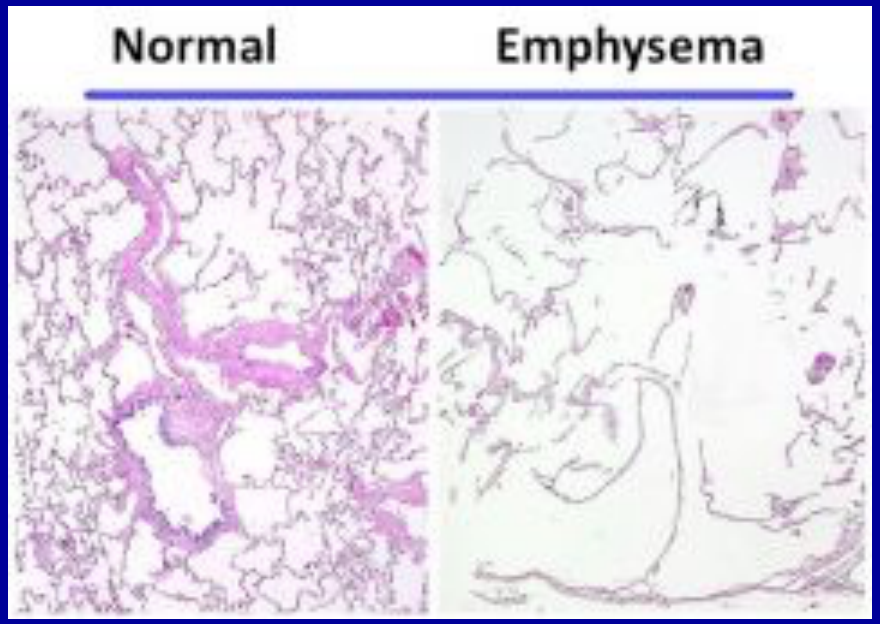
A Guide for Health Care Professionals

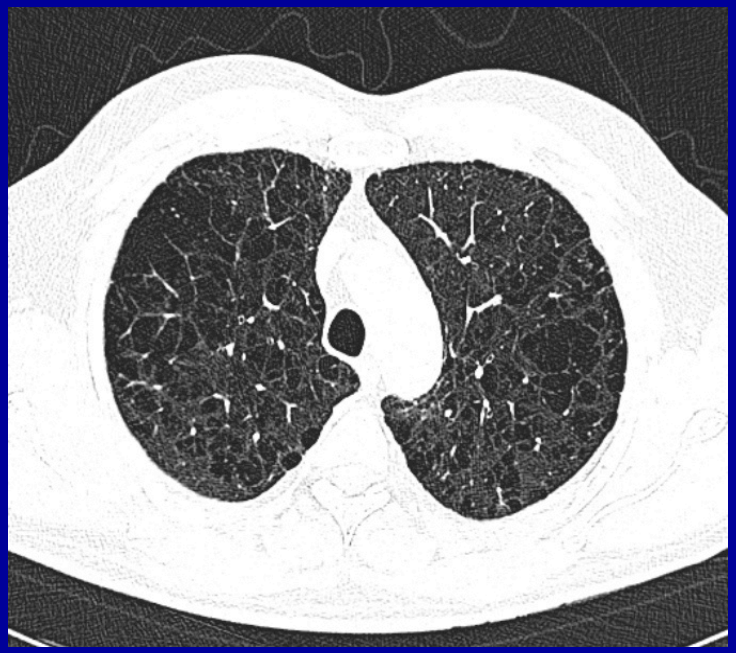
Chronic Bronchitis

- Chronic cough x 3 months for 2 consecutive years
- Other etiologies excluded
- Airflow obstruction



Emphysema





- Pathologic finding
- Airspace/terminal bronchial destruction
- Exclusion of fibrosis
- Moderate to severe airflow obstruction

Asthma

- Chronic airway inflammation
- Airway responsiveness/hyper-responsive
- Recurrent episodes of wheezing/breathlessness
- Highly variable, reversible airflow obstruction

Differential Diagnosis of COPD

- COPD
  - Mid-life onset
  - Slowly progressive symptoms
  - History of tobacco or other smoke exposure
- Asthma
  - Early life onset
  - Widely variable symptoms from day to day
  - Allergy, Rhinitis, Eczema
  - Worsening early am and night
  - Reversible airflow obstruction?

Differential Diagnosis of COPD

- CHF
  - Pulmonary edema on x-ray
  - Pulmonary restriction, not obstruction on PFT

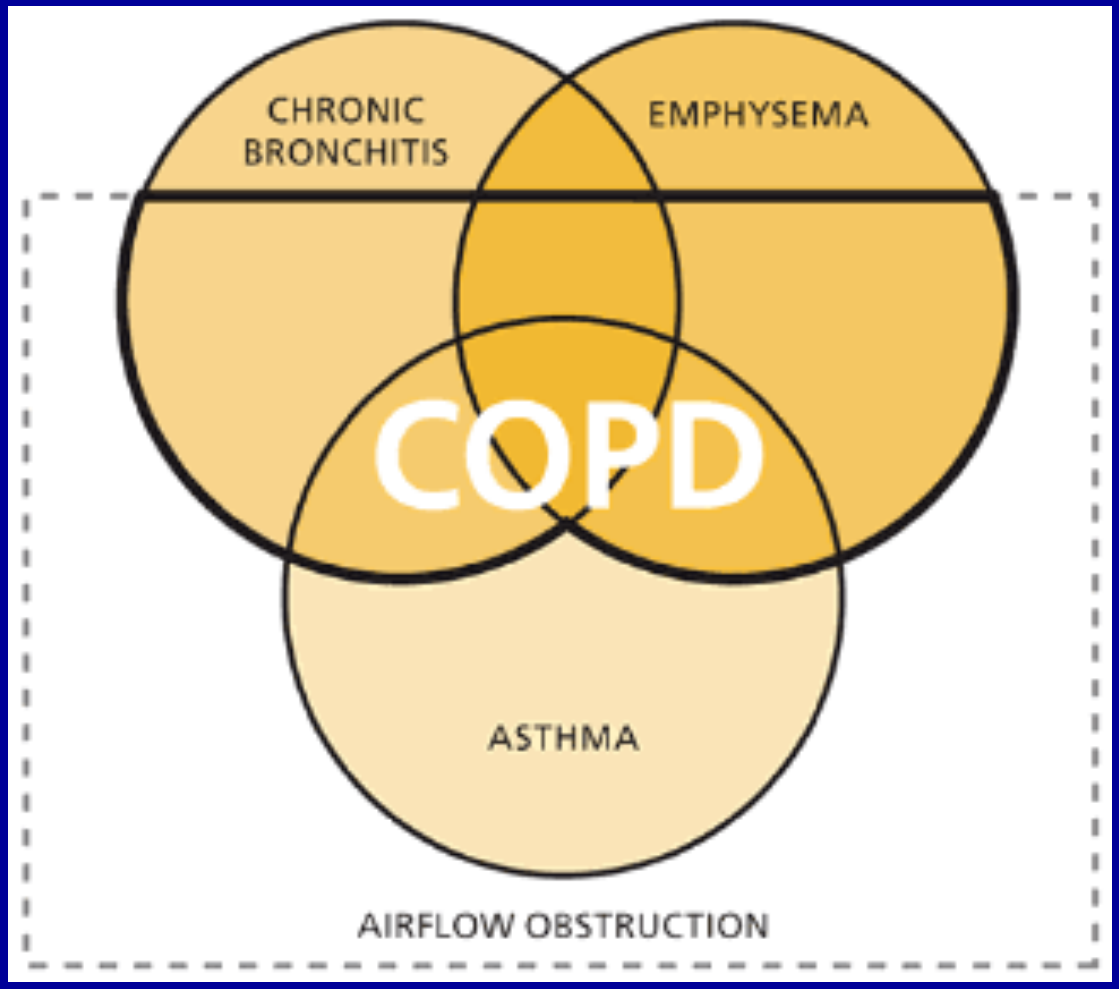
Differential Diagnosis of COPD

- Bronchiectasis
  - Large volume purulent sputum
  - Frequent bacterial exacerbations
  - Bronchial wall thickening/Dilation on imaging

Differential Diagnosis of COPD

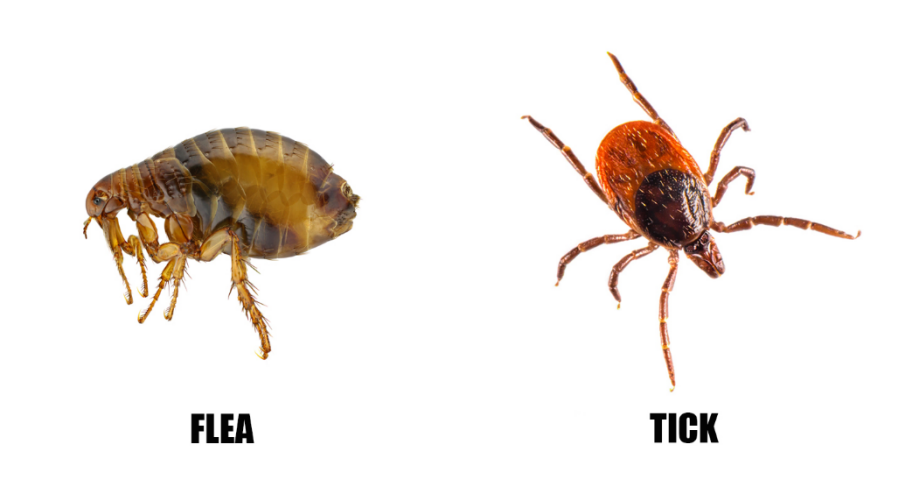
- Obliterative Bronchiolitis
  - Associated with connective tissue disease
  - Non-smokers
  - Post-bone marrow transplants
  - Inhalational injury

What is COPD


CHRONIC
BRONCHITIS
EMPHYSEMA
COPD
ASTHMA
AIRFLOW OBSTRUCTION

COPD/Asthma Overlap Syndrome

- Chronic bronchitis and emphysema often overlap
- Asthmatic bronchitis if chronic productive cough with complete reversibility
- Airflow reversibility suggests asthma
  - Complete reversibility, no COPD
  - Incomplete reversibility, overlap



Asthma

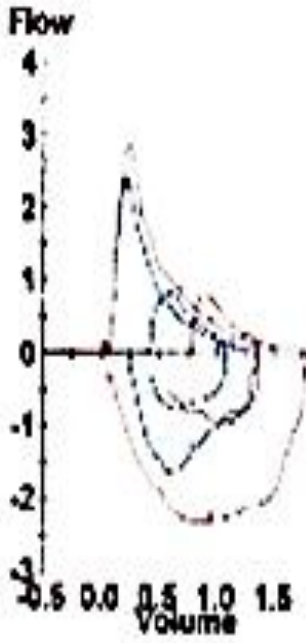
- Management is different
  - More responsive to inhaled/systemic steroids
  - Elevated Eosinophils or IgE
  - Subsets that may benefit from anti-IL5 therapy or anti-IgE treatment


Respiratory Inhalers

Pulmonary Function Report

Spirometry		Ref	Pre Meas	Pre % Ref	Post Meas	Post % Ref	Post % Chg
FVC	Liters	2.21	1.36	61	1.79	81	32
FEV1	Liters	1.52	0.81	53	0.98	64	21
FEV1/FVC	%	81	60	74	54	68	-9
FEF25-75%	L/sec	1.14	0.39	34	0.36	32	-6
PEF	L/sec	4.85	2.40	50	2.86	59	19

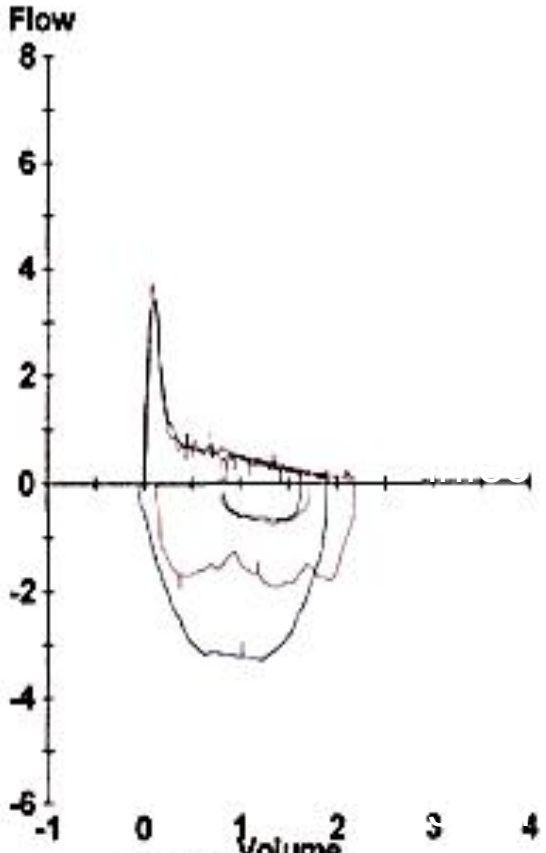
Lung Volumes				
TLC	Liters	4.29	4.71	110
VC	Liters	2.21	1.42	64
RV	Liters	1.91	(3.29)	(172)
FRC PL	Liters	2.28	(3.58)	(157)
ERV	Liters	0.75	(0.34)	(45)
IC	Liters	1.51	1.13	75
RV/TLC	%	44	(70)	(158)

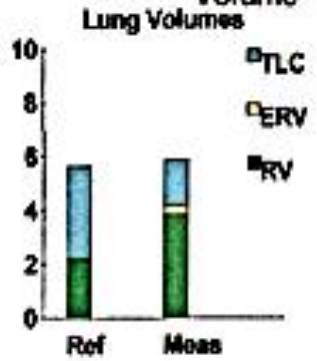


Pulmonary Function Report

Referring Physician: DR PEGANY

Age: 66 Height(in): 66.0 Weight(lb): 135 Gender: Male Race: Caucasian
Diagnosis: Medication:
Dyspnea Rest: No Dyspnea Exercise: Yes
Cough: Yes Persistent: No Productive (cc):
Smoker: Yes How Long(pk/yrs): Stopped(yrs): Cigarettes: Yes
Technician: Ann Heinrich Temp: 22 PBar: 745





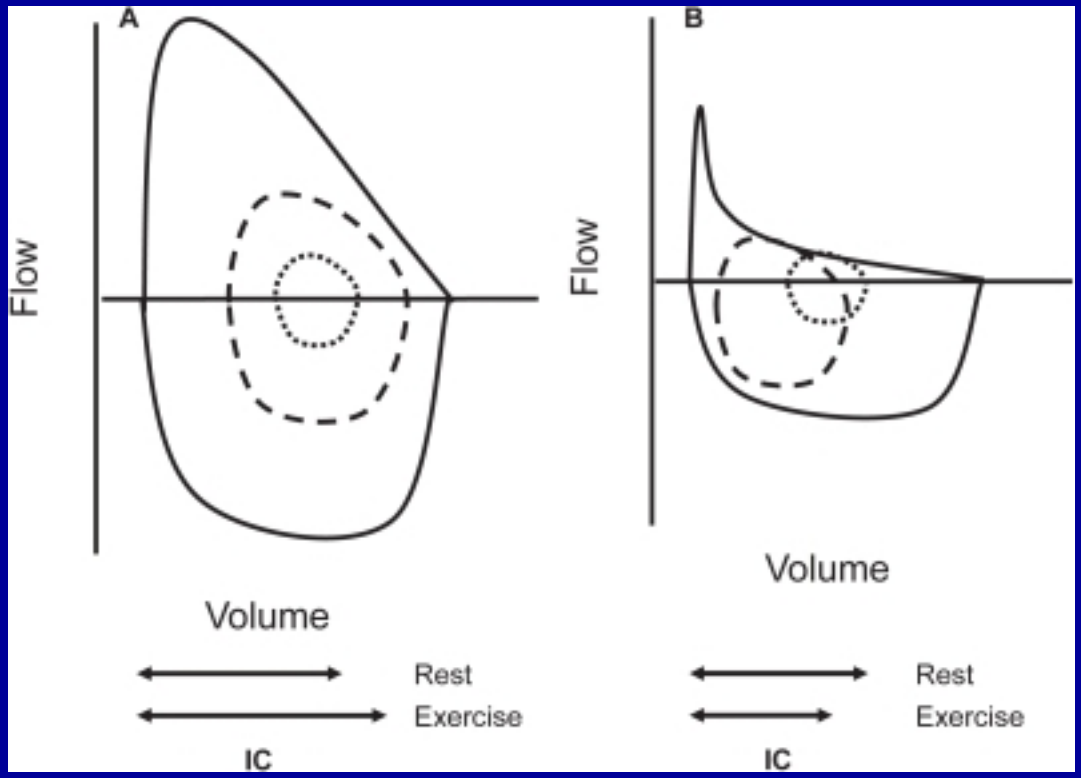
Spirometry

		Ref	Pre Meas	Pre % Ref	Post Meas	Post % Ref	Post % Chg
FVC	Liters	3.43	1.91	56	2.20	64	15
FEV1	Liters	2.73	0.73	27	0.71	26	-2
FEV1/FVC	%	80	38	48	32	41	-15
FEF25-75%	L/sec	2.81	0.34	12	0.28	10	-18
PEF	L/sec	7.45	(3.44)	(46)	3.74	50	9
FET100%	Sec		7.19		10.27		43
FIVC	Liters	3.43	1.95	57	2.05	60	5
FIF50%	L/sec		3.20		1.65		-48

Lung Volumes

		Ref	Pre Meas	Pre % Ref	Post Meas	Post % Ref	Post % Chg
TLC	Liters	5.61	5.86	104	(7.57)	(135)	29
VC	Liters	3.43	2.04	59	2.20	64	8
RV	Liters	2.20	(3.82)	(174)	(5.38)	(244)	41
FRC PL	Liters	3.45	4.04	117	(6.60)	(191)	63
ERV	Liters		0.32				
IC	Liters		1.82		0.98		-46
RV/TLC	%	39	(65)	(166)	(71)	(181)	9

Dyspnea


A
Flow
Volume
Rest
Exercise
IC
B
Flow
Volume
Rest
Exercise
IC

Global Initiative for Chronic Obstructive Lung Disease

POCKET GUIDE TO COPD DIAGNOSIS, MANAGEMENT, AND PREVENTION

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GOLD CRITERIA

- STAGE I: *Mild* COPD
  - FEV_1 >=80%
- STAGE II: *Moderate* COPD
  - FEV_1 = 50 - 80%

GOLD CRITERIA

- STAGE III: *Severe* COPD
  - FEV_1 = 30 - 50%
  - Increasing Shortness of breath
  - Reduced exercise tolerance
  - Repeated Exacerbations
- STAGE IV: *Very Severe* COPD
  - FEV_1 < 30%
  - Chronic respiratory failure
  - Severe quality of life impairment

Your name:

Today's date:

CAT
COPD Assessment Test

How is your COPD? Take the COPD Assessment Test™ (CAT)

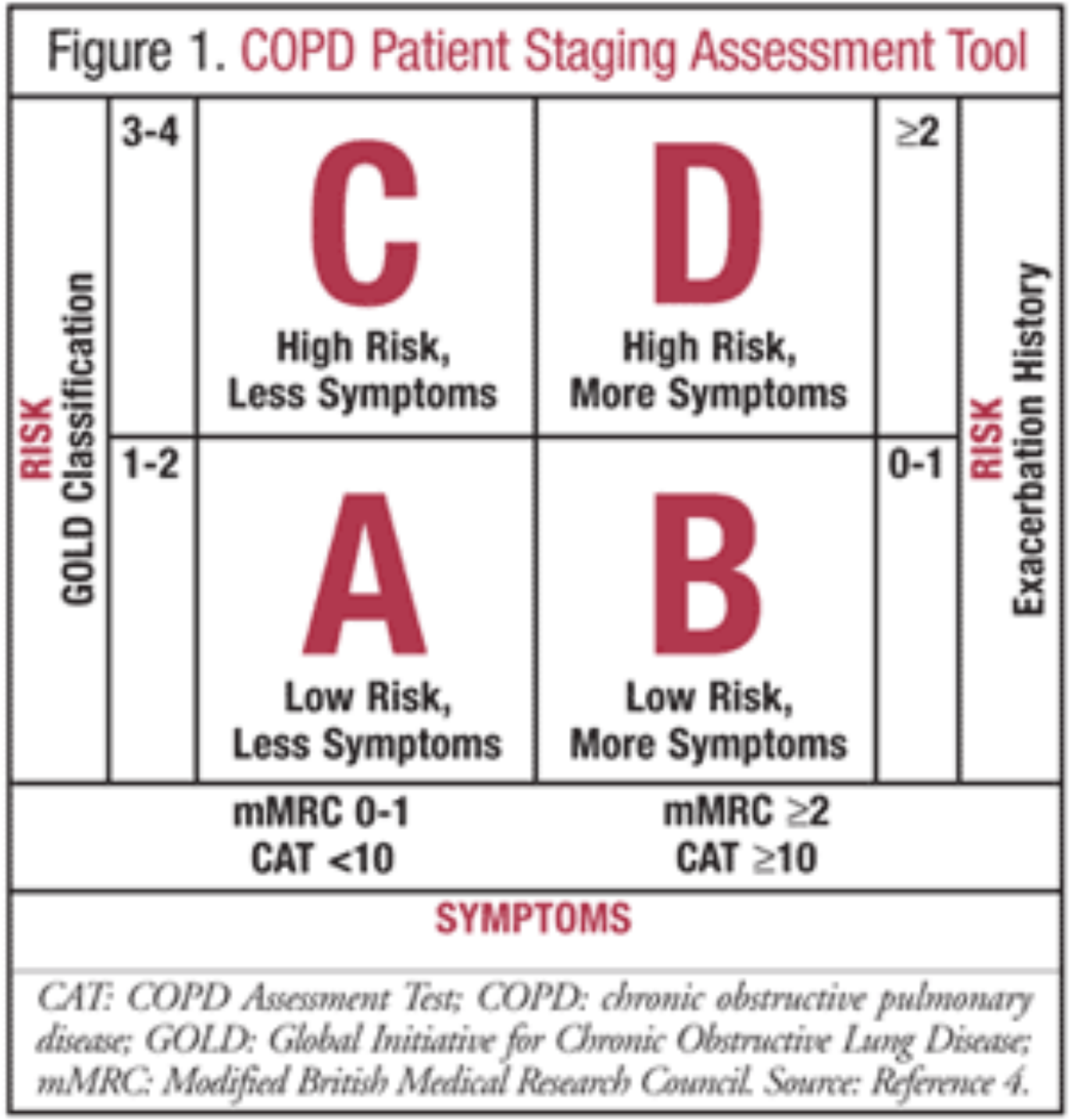
This questionnaire will help you and your healthcare professional measure the impact COPD (Chronic Obstructive Pulmonary Disease) is having on your wellbeing and daily life. Your answers, and test score, can be used by you and your healthcare professional to help improve the management of your COPD and get the greatest benefit from treatment.

For each item below, place a mark (X) in the box that best describes you currently. Be sure to only select one response for each question.

Example: I am very happy 0 X 2 3 4 5 I am very sad

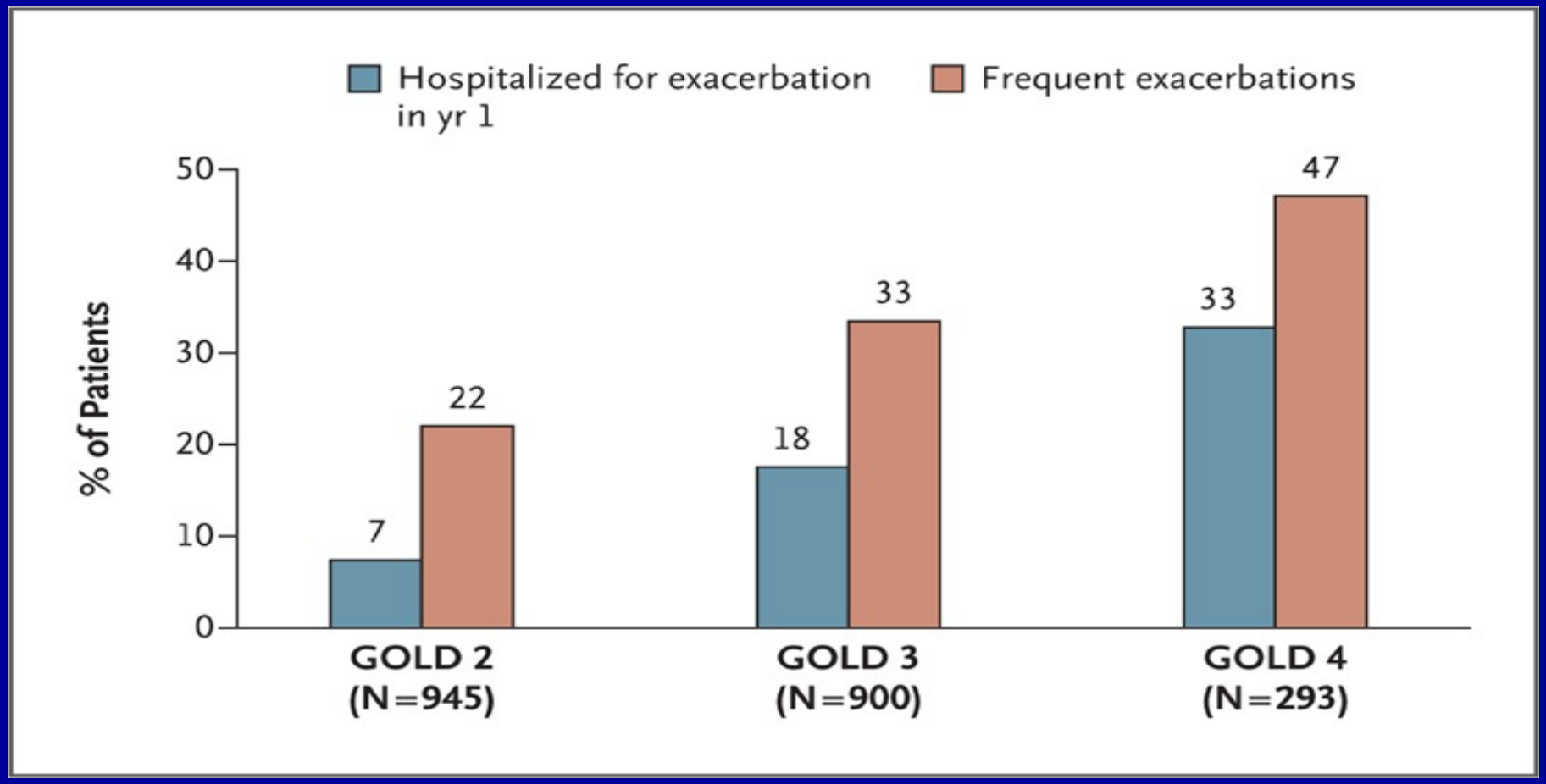
			SCORE
I never cough	0 1 2 3 4 5	**I cough all the time**	
I have no phlegm (mucus) in my chest at all	0 1 2 3 4 5	**My chest is completely full of phlegm (mucus)**	
My chest does not feel tight at all	0 1 2 3 4 5	**My chest feels very tight**	
When I walk up a hill or one flight of stairs I am not breathless	0 1 2 3 4 5	**When I walk up a hill or one flight of stairs I am very breathless**	
I am not limited doing any activities at home	0 1 2 3 4 5	**I am very limited doing activities at home**	
I am confident leaving my home despite my lung condition	0 1 2 3 4 5	**I am not at all confident leaving my home because of my lung condition**	
I sleep soundly	0 1 2 3 4 5	**I don't sleep soundly because of my lung condition**	
I have lots of energy	0 1 2 3 4 5	**I have no energy at all**	
		TOTAL SCORE	

Figure 1. COPD Patient Staging Assessment Tool



CAT: COPD Assessment Test; COPD: chronic obstructive pulmonary disease; GOLD: Global Initiative for Chronic Obstructive Lung Disease; mMRC: Modified British Medical Research Council. Source: Reference 4.

Exacerbation and GOLD stage



NEJM 2010; 363:1128-38

COPD Management

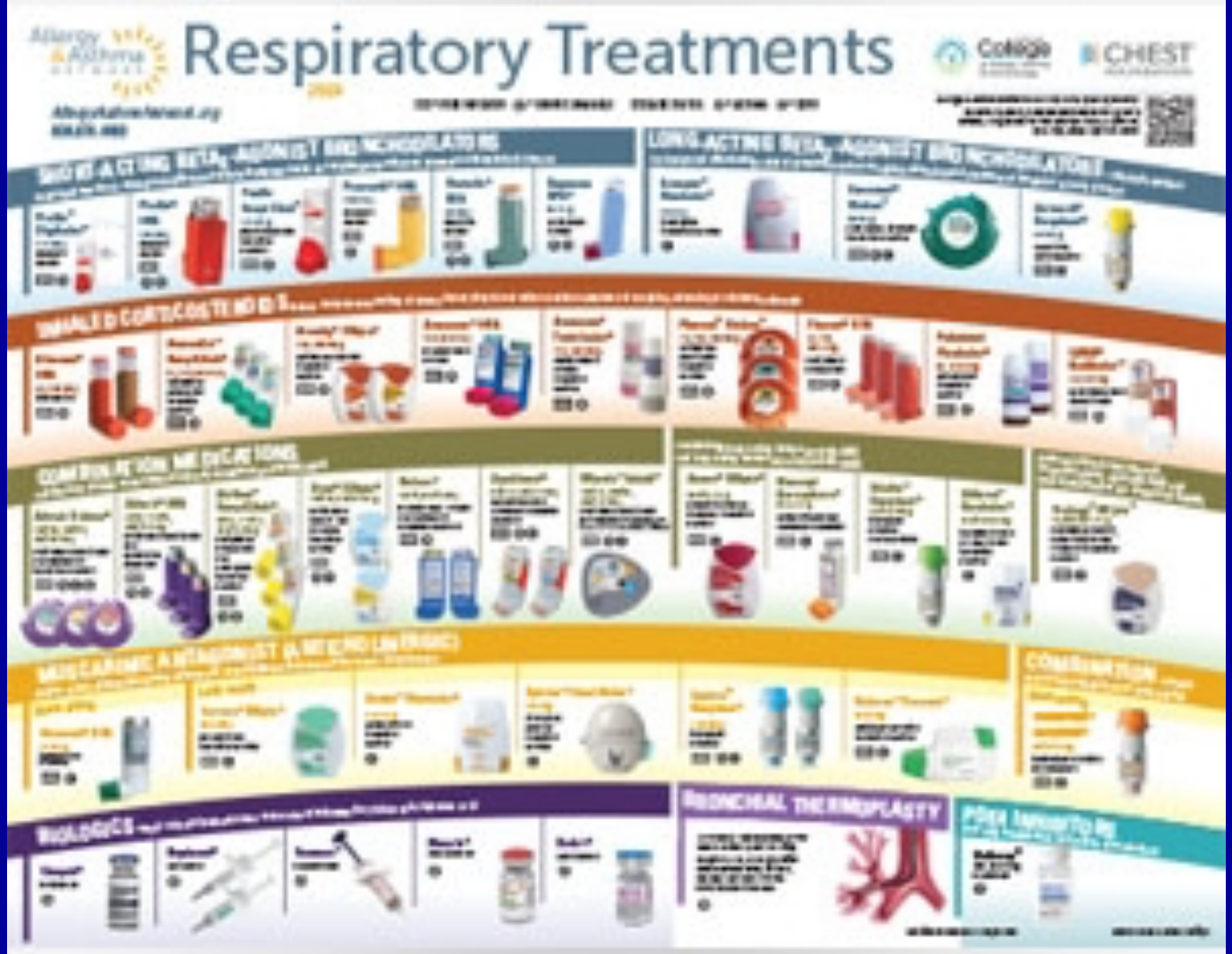
- Smoking Cessation
- Supplemental O2 if needed
  - Nocturnal Ventilation
- Exercise/Improve stamina
- Medications for symptom control

Pharmaceutical Management

- Reduce breathlessness by improving air flow
- Decrease symptoms of cough/sputum
- Improve quality of life
- Reduce frequency of exacerbations
- No significant mortality benefit/altering disease progression

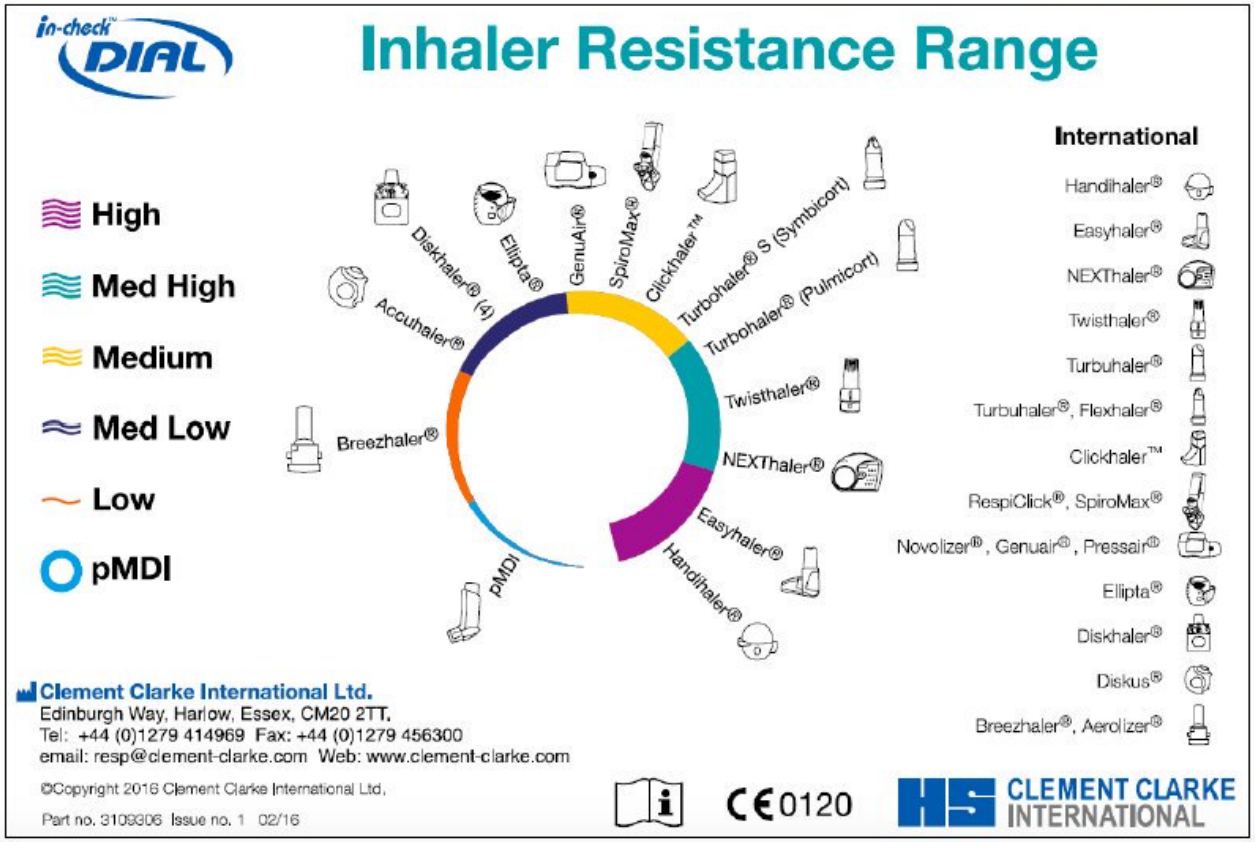
Pharmacologic Management

- Anticholinergics
- Beta-2 Agonists
- Theophylline
- Glucocorticosteroids
  - Inhaled
  - Systemic
- Combination
- Roflumilast (PDF-4)
- Azithromycin
- Alpha-1 Repacement

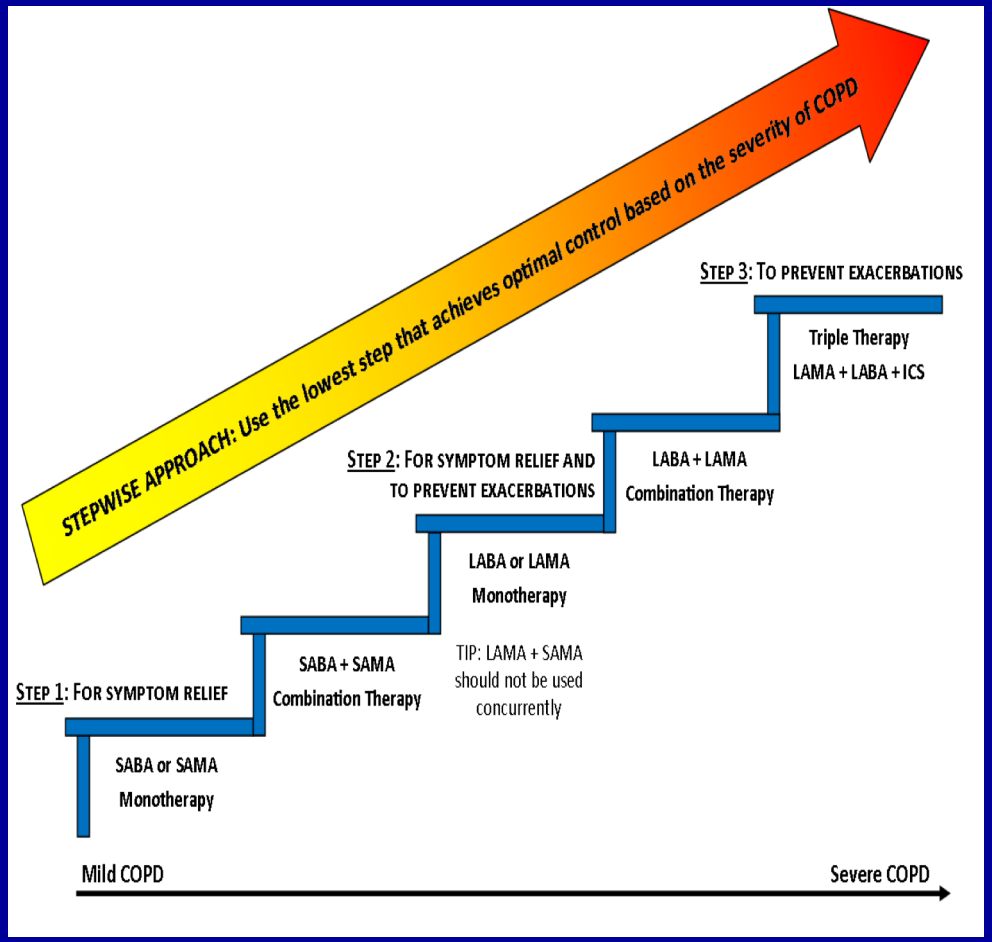

Respiratory Treatments
CHEST

Device Selection

Measuring Inspiratory Flow:
In-Check DIAL

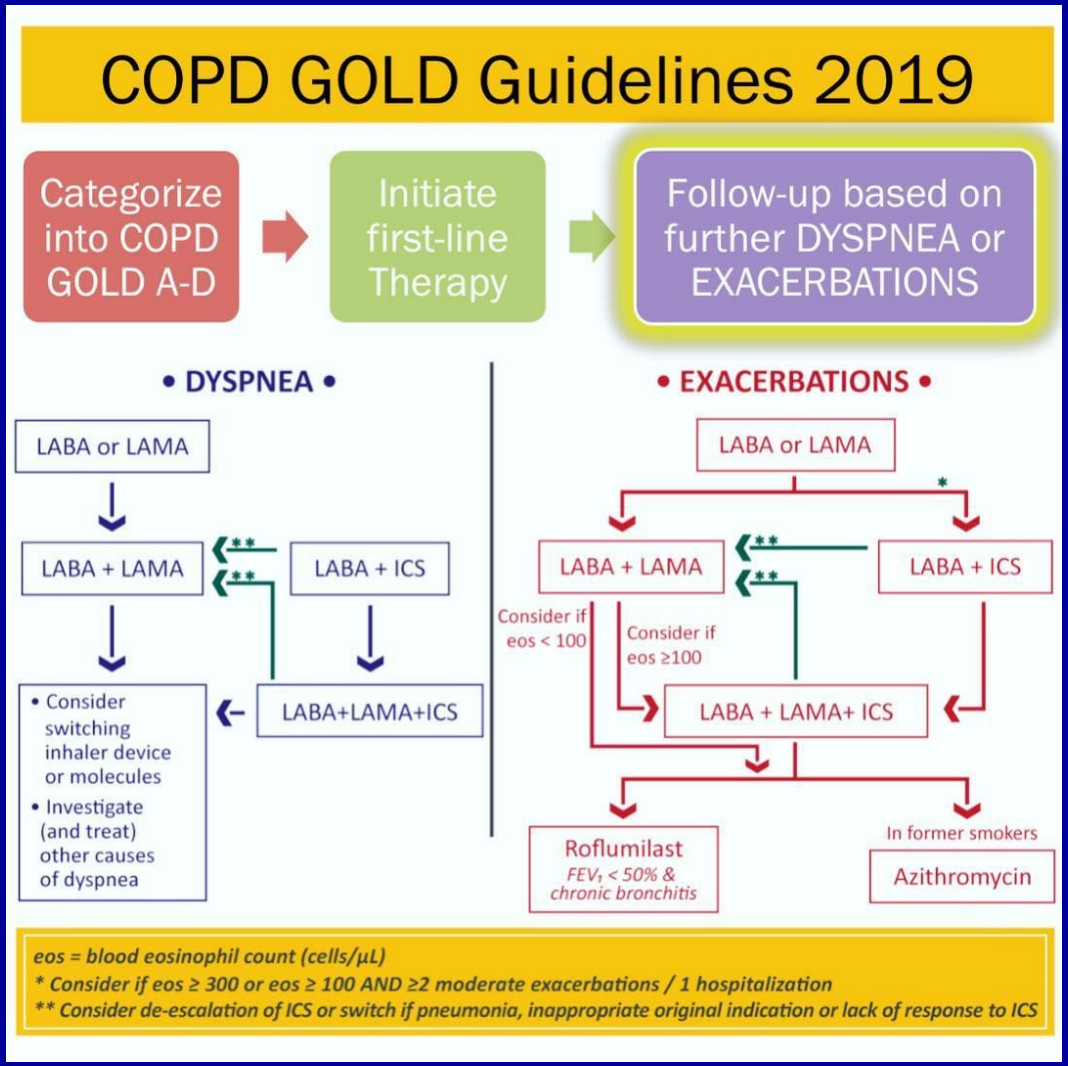


TREATMENT



Global Obstructive Lung Disease

Pharmacologic Management

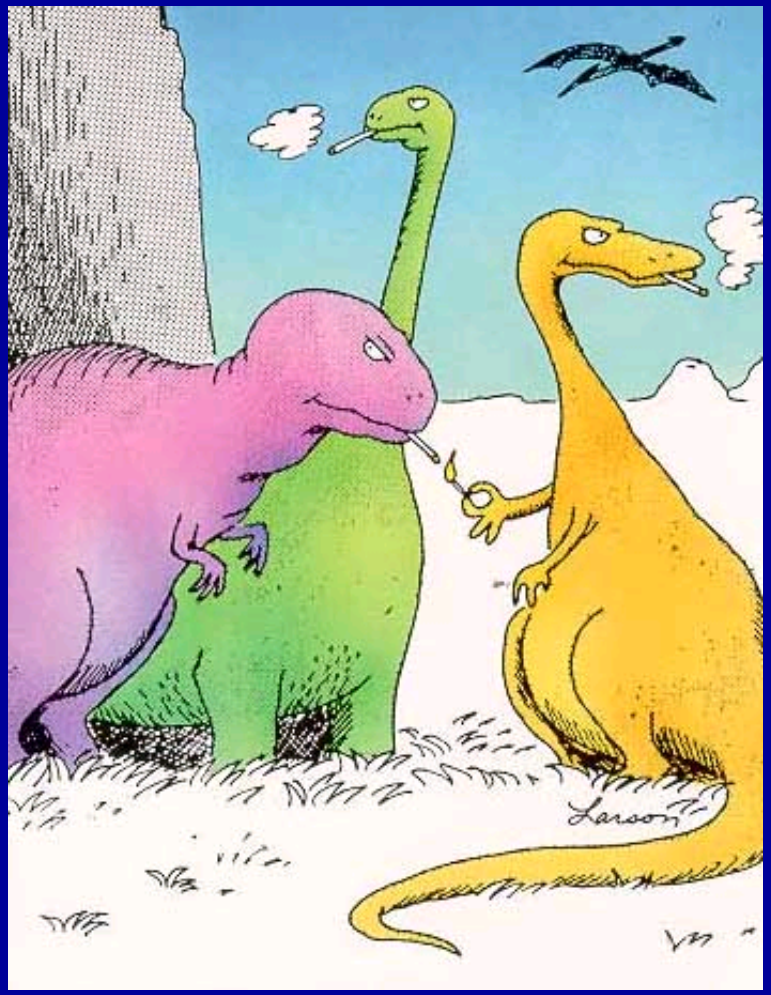


Alpha-1 Antitrypsin Deficiency

- Free test kits available
- Estimates 1% of COPD patients
- Lower lobe predominant emphysema
- May present with other lung disease
  - Bronchiectasis
  - Ashtma
- Specific treatment with replacement

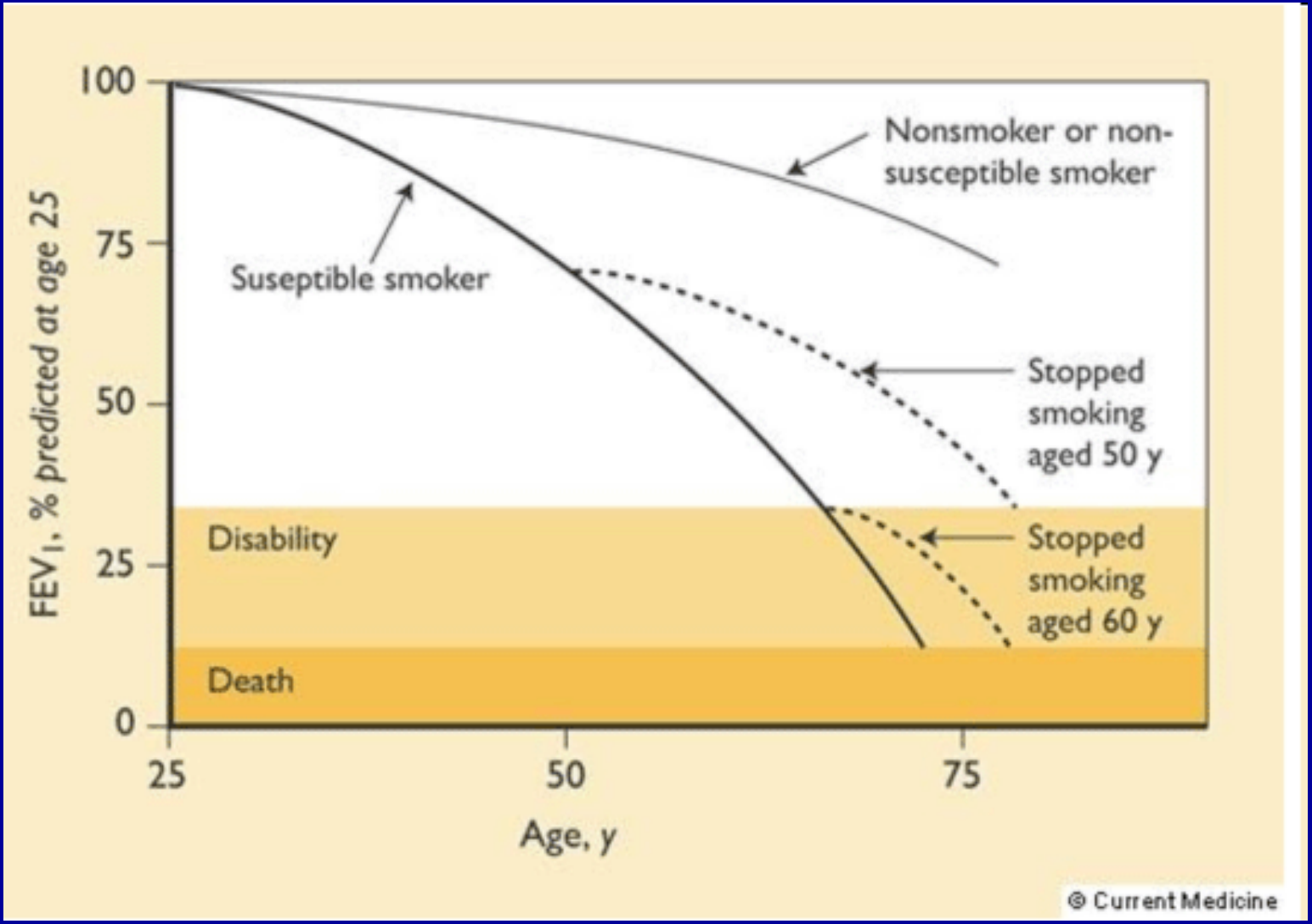
SMOKING CESSATION

How the Dinosaurs Really Died



Doctor Approved

FEV1 and Smoking



Smoking Cessation

- Reduces rate of decline
- May improve cough and sputum volume
- May improve mild disease
- Reduced risk of cancer
- Reduced risk of heart attacks
- Reduced risk of Peptic Ulcer disease
- Reverse osteoporosis risk of smoking
- Reduced risk of diabetes
- Improves lung cancer mortality

Smoking Cessation

- Behavioral Counseling
  - Live and/or phone
  - Referral to state program
- Pharmacologic
  - Varenicline
  - Nicotine Replacement
  - Bupropion
  - Combination?

Combination Treatments

- Bupropion/Varenicline -
  - no 52wk benefit[1]
  - Possible benefit non-NRT responding heavy smoking (> 1 PPD) Men[2]
    - 12 weeks 71%
- Bupropion/NRT Patch
  - 36% smoke free at 52 weeks[3]
  - Successful in schizophrenia[4]

1 JAMA 2014 311:155-63
2 Nicotine &tobacco research, 2017 19:999-1002
3 NEJM 1999 340:685-91
4 Biological Psych 2008 63:1092-96

LONG TERM OXYGEN THERAPY

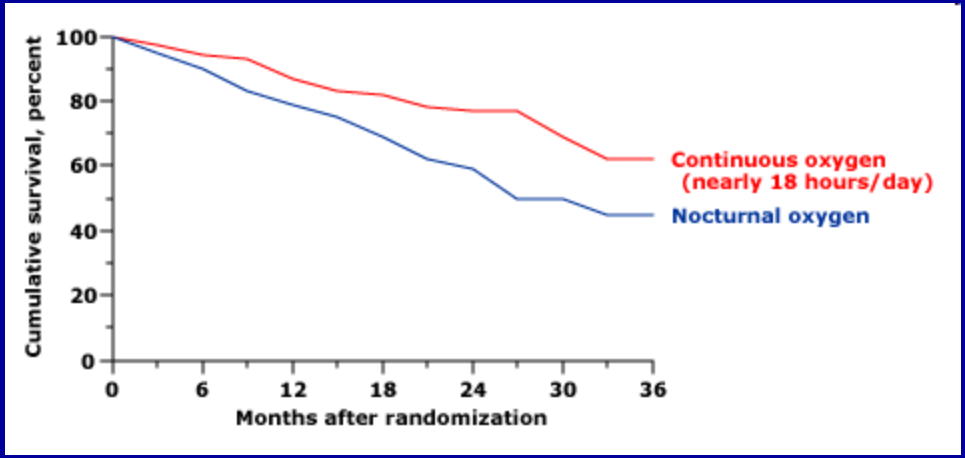
Continuous or Nocturnal O_2

- 203 Patients (low oxygen levels)
  - Nocturnal O_2 (102 patients) = Control
  - Continuous O_2 (101 patients) = Treatment

Annals of Internal Medicine 1980; 92: 391-398

Continuous or Nocturnal O_2

- Outcome measure: Death at 19 months
  - Nocturnal O_2 41/102 (40.2%)
  - Continuous O_2 23/101 (22.8%)
- Trend most striking in
  - High CO2
  - Lower nocturnal O2 sat
  - More severe brain/mood dysfunction



Annals of Internal Medicine 1980; 92: 391-398

Nocturnal Ventilation

Nocturnal Ventilation

- Rest muscles of breathing
- Improve poor ventilation with sleep
- Conflicting data / Knowledge gaps
  - Despite CMS guidelines allow for coverage

Nocturnal Ventilation

- Patients with nocturnal desaturation despite O2 should be evaluated for OSA
- PaCO2 > 51
- O2 sat < 88% for 5 or greater minutes
  - BiPAP no Backup Respiratory Rate (BURR)

CMS guidelines

Nocturnal Ventilation

- Burr if:
  - Desaturation or increased PaCO2 on BiPAP
  - No improvement in PaCO2 at 60 days
  - During hospital stay PaCO2 > 51 requiring BiPAP with backup rate to stabilize

CMS guidelines

Nocturnal Ventilation

- COPD exacerbations requiring Non-invasive or vent support (at 1 year):
  - 60% readmitted and 25% die
- HI-NIV (high IPAP) – (some studies 28!)
- Goal control $PaCO_2$
- Question improvement in QOL

HOT-HMV Trial

- UK study 64 patients – median O2 1 l/min
  - Admitted with COPD with hypercapnia
  - Baseline FEV1 < 50%
  - PaCo2 > 53 PaO2 < 55
  - 28 Home O2
  - 36 Home O2 + NIV
  - Mean BiPAP 24 / 4 BURR 14

JAMA 2017 317:2177-86

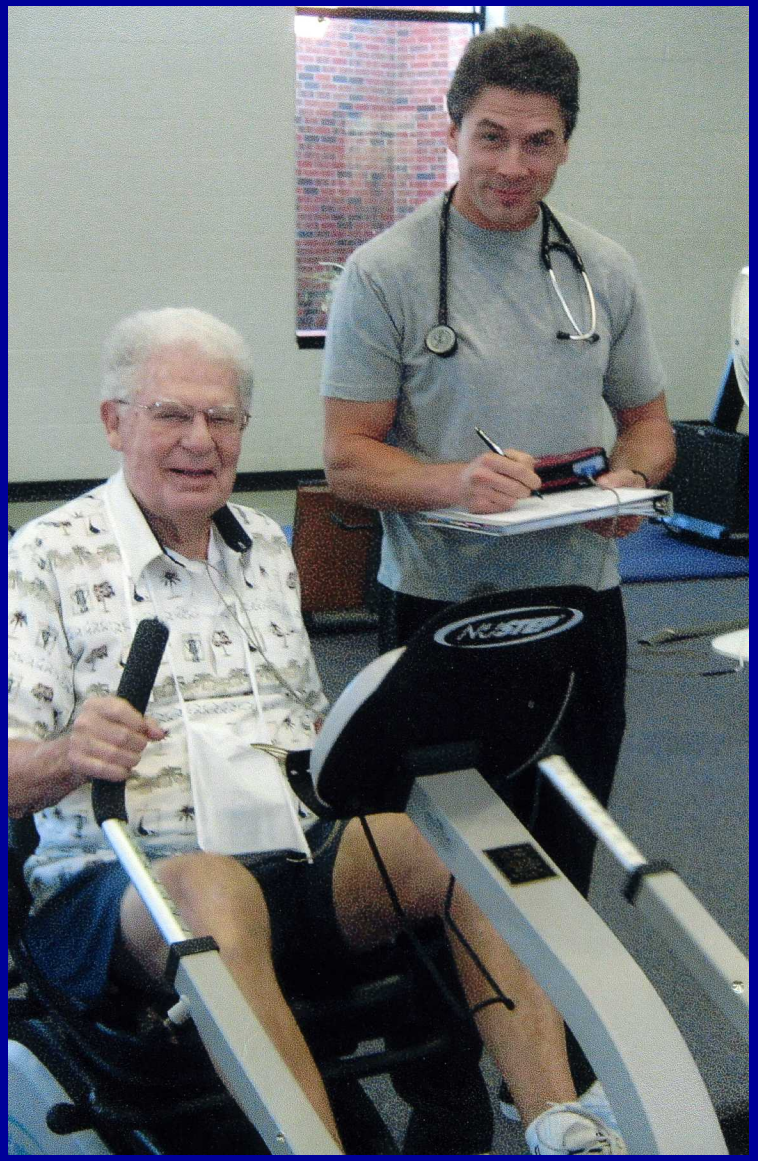
HOT-HMV Trial

- Outcome Readmission or Death 12 month
  - O2 group – 80.4% (median 1.4 months)
  - O2+NIV - 63.4% (median 4.3 months)
- NNT – 5

JAMA 2017 317:2177-86

EXERCISE

Pulmonary Rehab



Pulmonary Rehab

Pulmonary Rehab

- Comprehensive program including:
  - Smoking cessation
  - Education
    - Exercise
    - Disease process
    - Energy Conservation
  - Self management
    - Bronchial hygiene
    - Medications
    - O2
    - Exacerbation protocol

Pulmonary Rehab

- Exercise
  - Resolve deconditioning
  - Learn to deal with dyspnea
  - Aerobic training
  - Strength training
- Breathing retraining
  - Diaphragmatic
  - Pursed lip breathing

Pulmonary Rehab

- Nutritional education
- “daily activity” Training
- Family training
- Psychosocial well being

Pulmonary Rehab

- Benefits
  - Reduced health care utilization
  - Improved quality of life
  - Possible Mortality benefit
  - Improved BMI
- Drawbacks
  - Upfront costs (long-term gain)
  - Limited access
  - Diminished gains over time
    - Similar Gains accomplished with repeat rehab

Cochrane Meta-analysis

- 65 studies – 3822 participants
  - Study quality “Generally good”
- Improves Dyspnea and Fatigue
- Improved emotional function
- Increased sense of personal control of disease
- Improved Exercise capacity

Cochrane.org February 24, 2015

Indications

- Shortness of breath with rest or activity
- Decline in ability to perform daily activity
- Need for Lung volume reduction/transplant
- Increased utilization of health care
- GOLD stage II

Contra-indications

- Heart disease?
- Severe psychologic or cognitive disease
- Substance abuse
- Physical limitations
  - Poor vision
  - Orthopedic impairment
  - Neuropathies

Surgical Concerns

Be aggressive
Be more aggressive
Don’t get careless

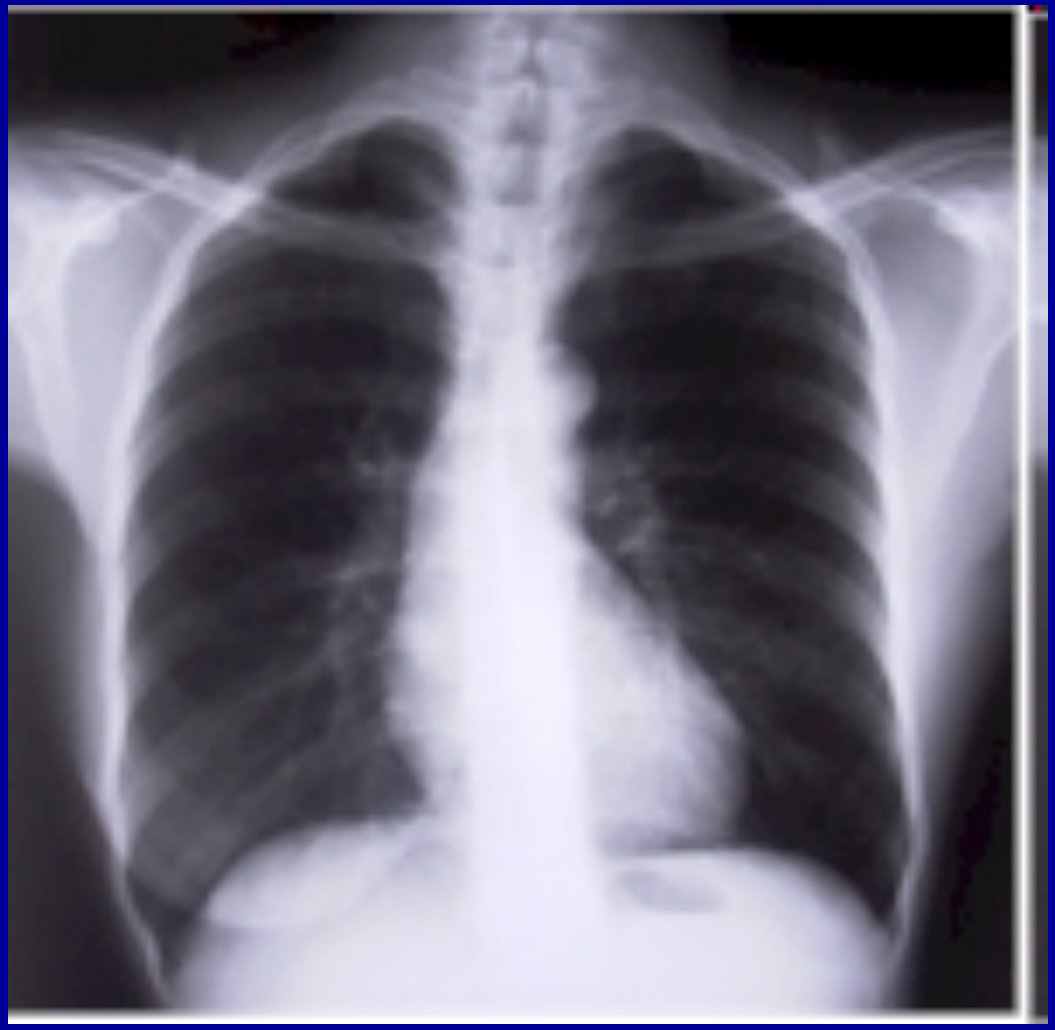
Surgical concerns

- COPD doubles likelihood of complications
  - Atelectasis/Hypoxia
  - Infection (Pneumonia/bronchitis)
  - Exacerbations
  - Respiratory failure
- More important if comorbidities
  - Age
  - CHF
  - Current smoker (quit 4 weeks pre-surgery)

Surgical concerns

- No level of FEV1/severity is prohibitive
  - Post lung resection 0.8 L ??
- Diaphragm dysfunction***
  - Cardiac surgery/Upper abdomen
- > 2 hours anesthesia
- What is the risk:benefit of surgery
- Is the patient “good enough”
  - “the enemy of good is better”

HYPERINFLATION



Hyperinflation

- Over inflation of the lungs/air trapping
- Places Respiratory muscles at mechanical disadvantage
- Increases work of breathing

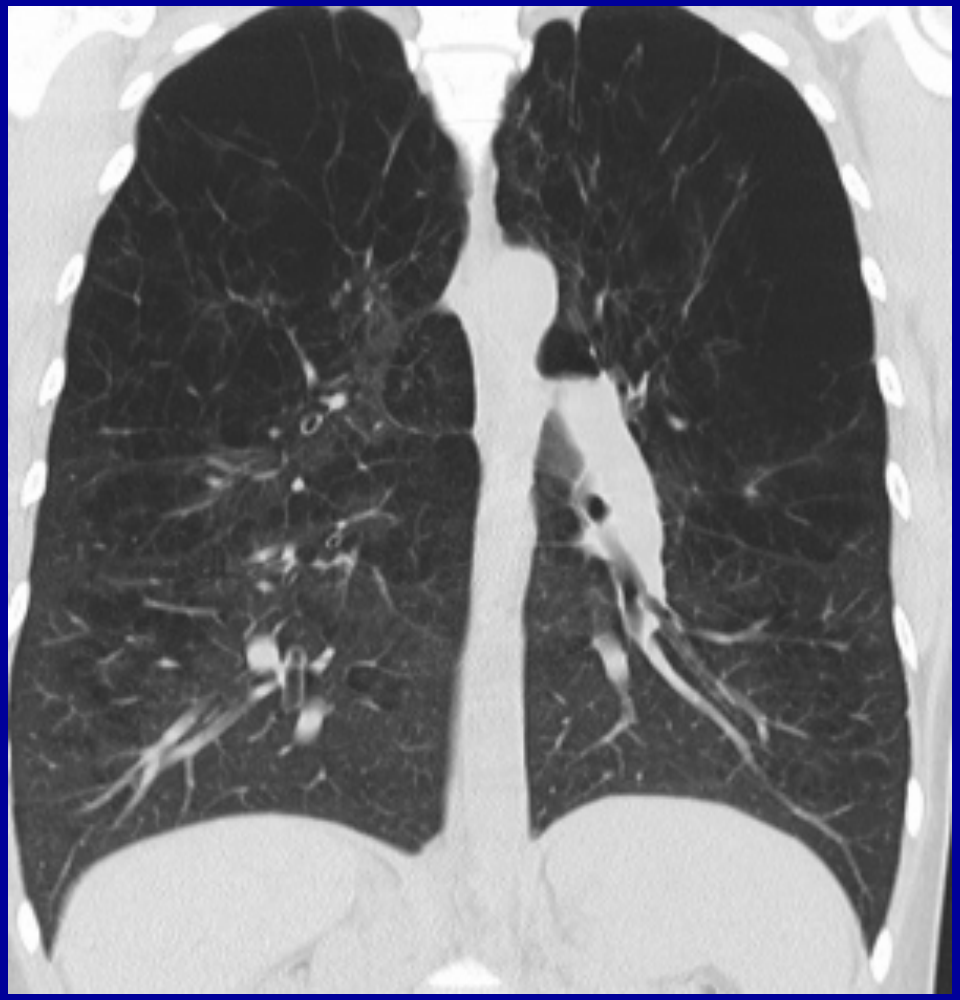
Lung Volume Reduction

Lung Volume Reduction

- Decrease Hyperinflation
  - Increase Elastic Recoil
  - Improving airflow

Improve diaphragm mechanics

Heterogenous Emphysema



LUNG VOLUME REDUCTION

Surgical

LVRS

- Criteria
  - Heterogenous and Upper lobe emphysema
    - CAT Scan
    - Ventilation and Perfusion Scanning
  - Mild to no mid/lower lung emphysema
    - Atelectasis (flattening) of lower lungs!
- Non-High risk patients:
  - Very severe disease
  - Homogeneous Emphysema

NETT

- 1218 Patients
- Baseline assessment then at 6 mos. Rehab
- Random assignment to Surgery/Medical
- High Risk
  - FEV1 < 20%
  - DLCO < 20%
  - Homogenous change on CT

**NEJM 2003 348;21:2059-2073*

NETT

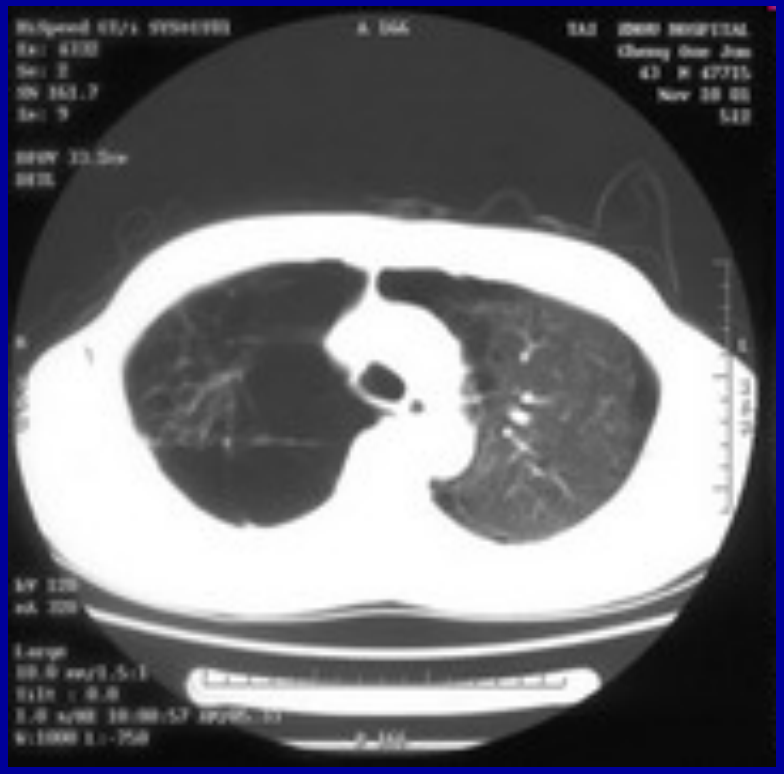
- Surgical High Risk
  - 16% 30 day mortality
  - 29% 90 day mortality
  - No mortality in medical arm
  - Further enrollment was excluded

**NEJM 2003 348;21:2059-2073*

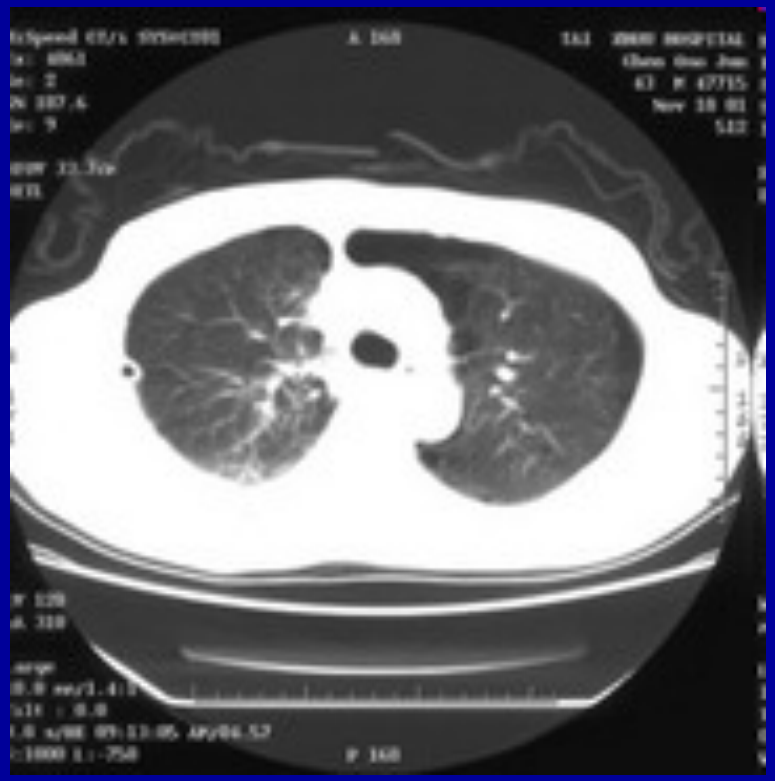
NETT

- Surgical Procedure
  - Bilateral
  - Sternotomy or VATS
  - Goal 20 to 30% lung volume each lung

**NEJM 2003 348;21:2059-2073*



PRE-LVRS



POST-LVRS

NETT

- Bottom Line
  - low exercise tolerance and Upper lobe
    - Improved long term survival
    - Improved exercise tolerance
  - High exercise and upper lobe
    - No mortality benefit
    - Improved, sustained exercise/QOL benefit
  - High exercise tolerance and lower lobe
    - No QOL/functional benefit
  - Low exercise lower lobe—
    - short lived exercise benefit

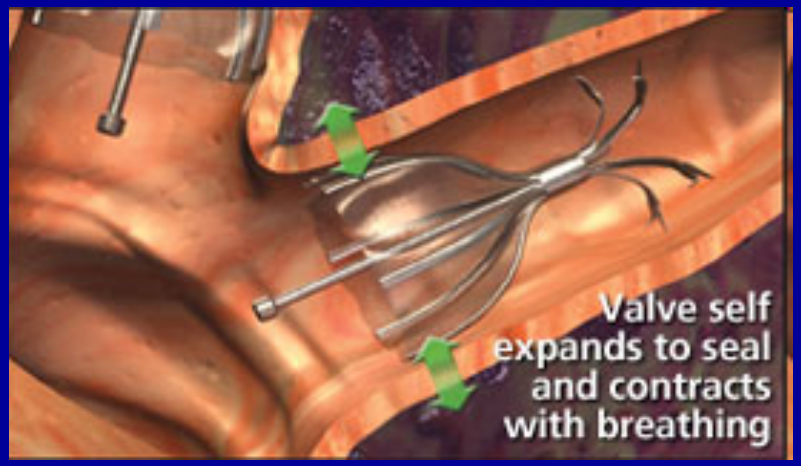
**NEJM 2003 348;21:2059-2073*

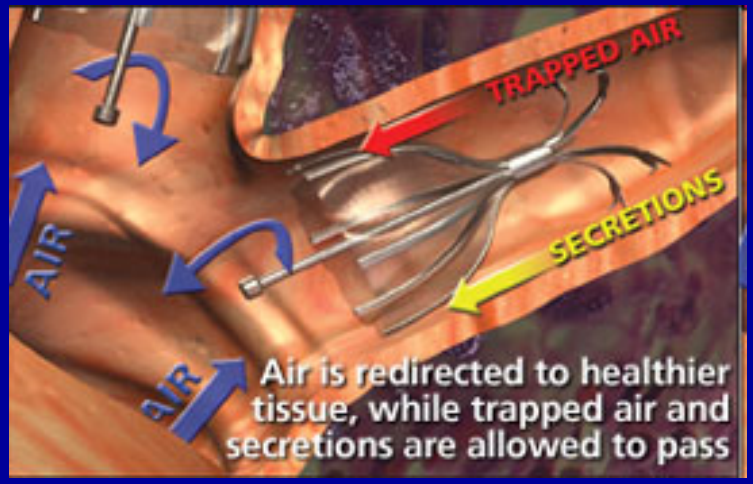
LUNG VOLUME REDUCTION

Endobronchial

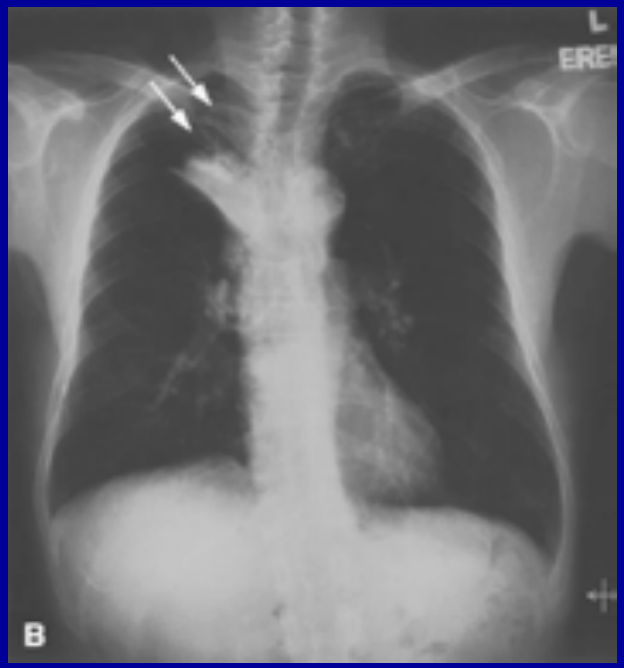
FDA Approved June 2018

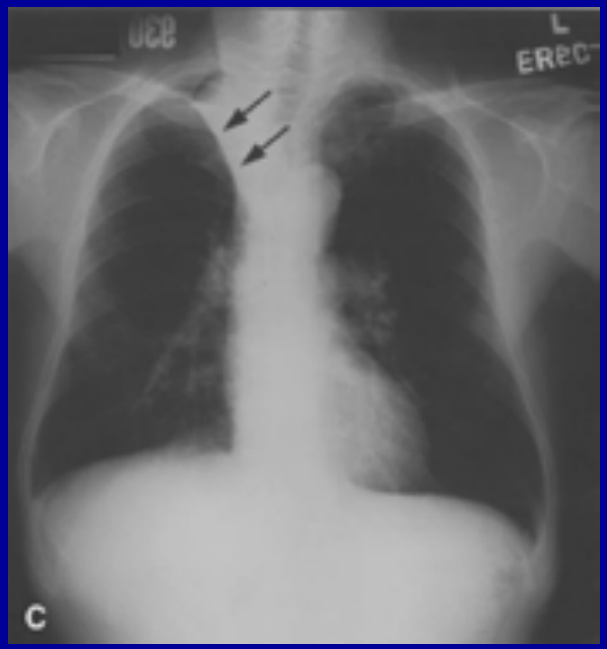
EBV Placement





EBV Theapy

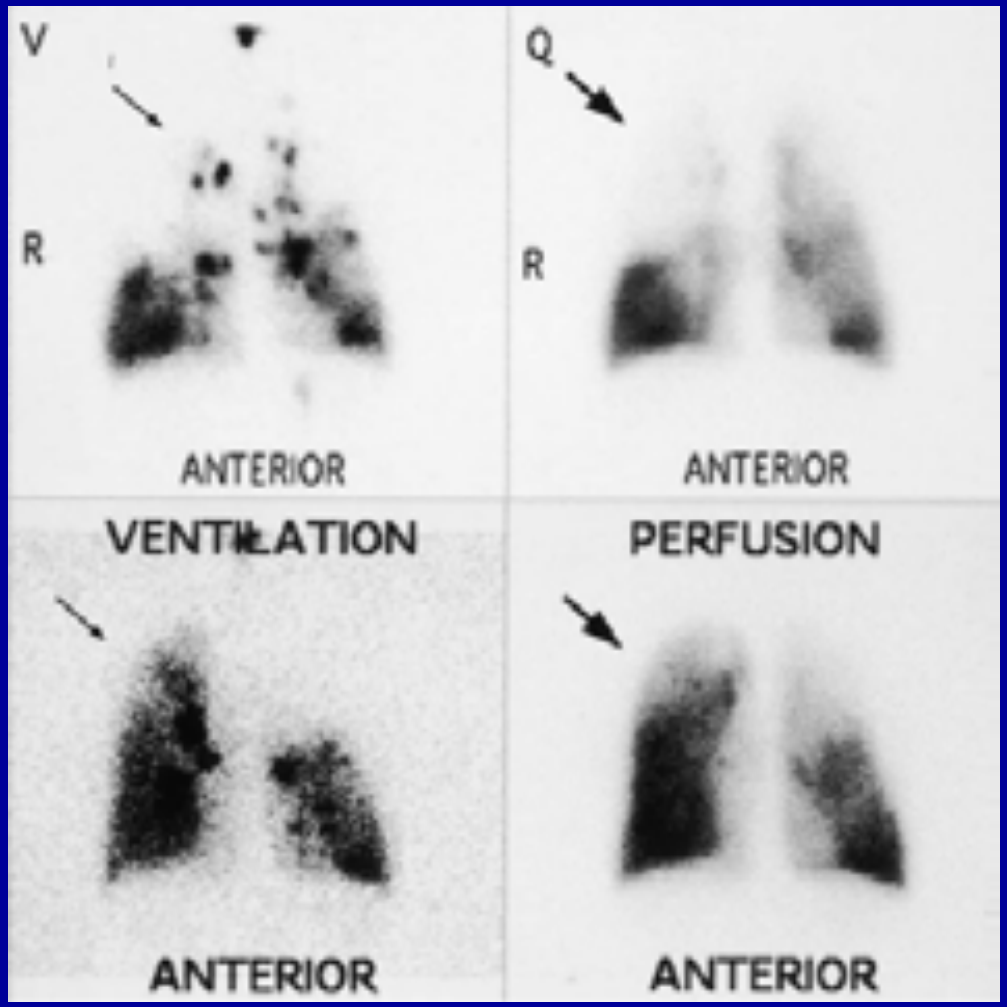




Pre-Valve 1 day 1 month

*J. Thor Cardiovasc Surg 2004;127:1564-1573

V/Q Changes



*J. Thor Cardiovasc Surg 2004;127:1564-1573

Endobronchial Valve

Emphasys Trial

- 98 patients
  - FEV_1 (30%)
  - HRCT and V/Q
  - Valve targeting and number left to investigator
- 396 valves placed (4 per pt)

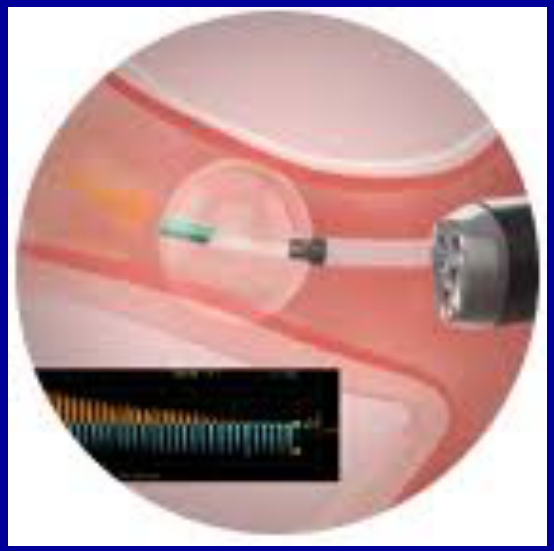
**Chest 2006;129:518-526*

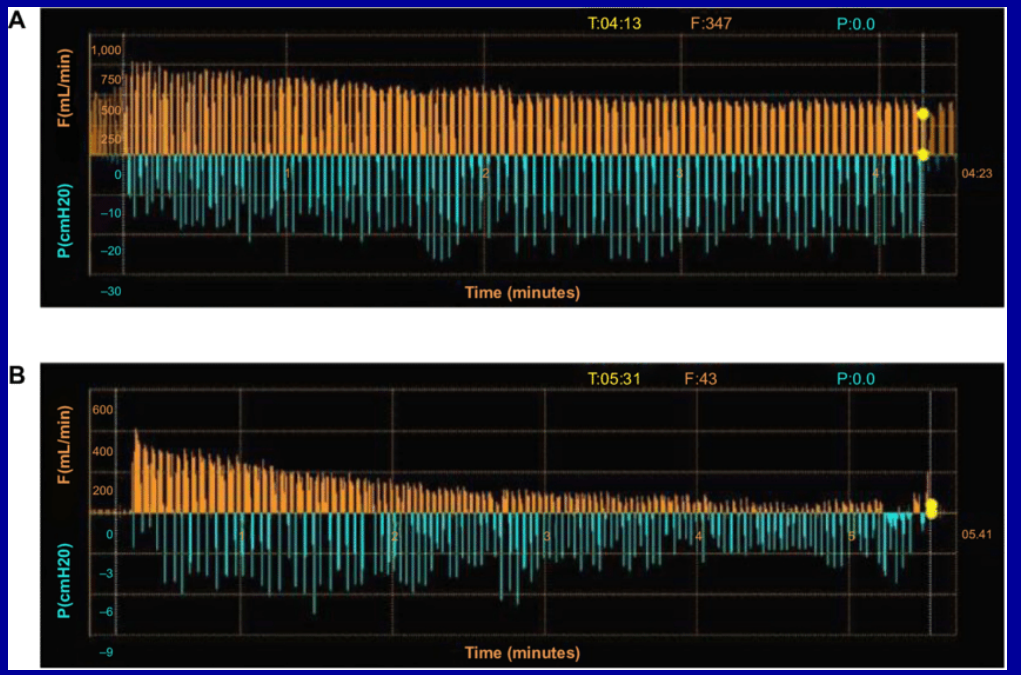
Average Changes

- FEV1 improved 10.7%
- 6MWT increased 23%
- *Typically not on pre-procedure or post-procedural rehab.
- Spiration (Olympus) Emphasys (Zephyr) met targets but not approved by FDA
- Complications pneumonia/bleeding

*Chest 2006;129:518-526

COLLATERAL VENTILATION





EBV without collateral ventilation

- Netherlands
- 68 patients
  - No collateral ventilation
  - Treated patients had increased exertional tolerance and pulmonary function

NEJM 2015;373:2325-2335 (12/10/2015)

Liberate Trial

- Multicenter and international
  - Emphysema patients
  - Age 40 - 75 former smoker
  - FEV1 15 – 45% predicted
  - Hyperinflation: TLC > 100% or RV > 175
  - 6MWT < 500 m after pulmonary rehab
  - 2:1 EBV vs. Standard care
- *160/909 enrolled met full inclusion

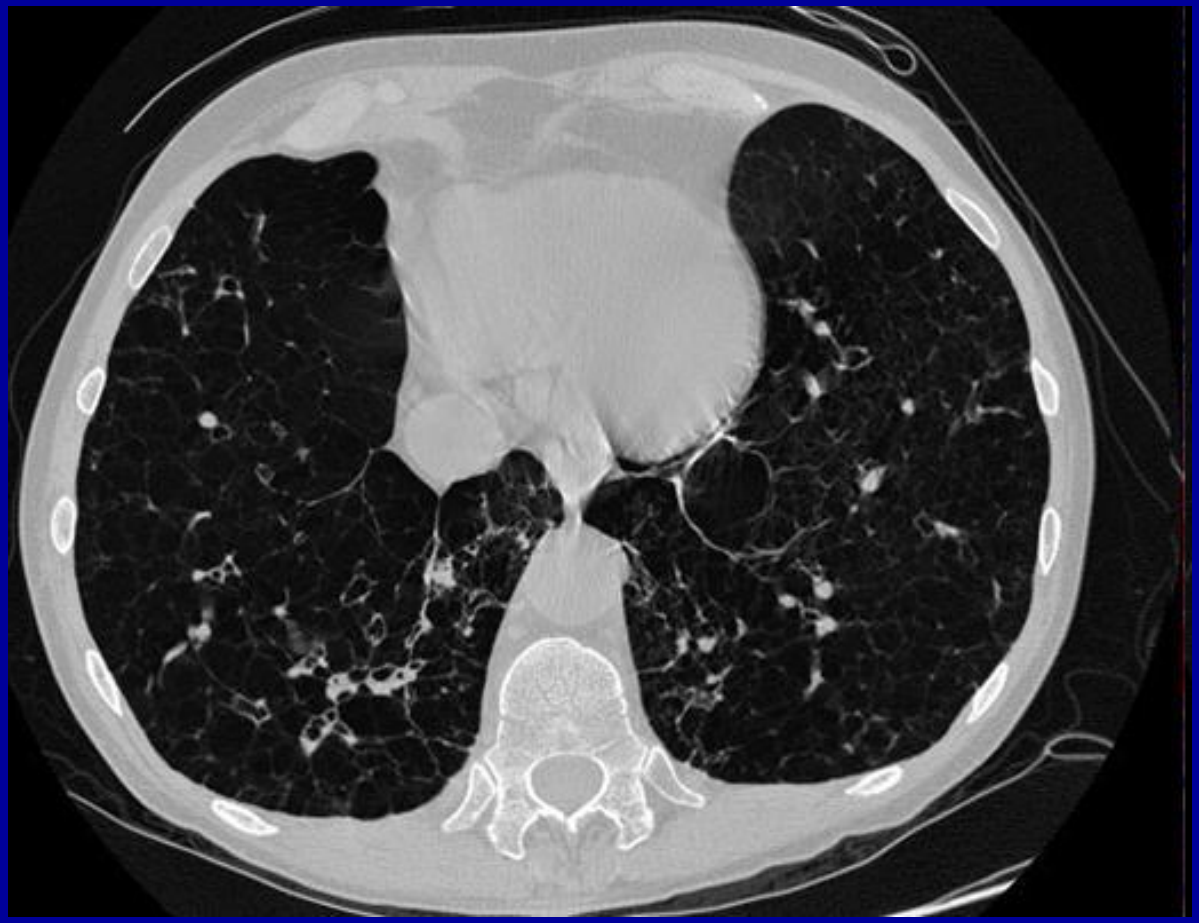
Am J Respir Crit Care Med 2018 198:1151-64

Liberate Trial

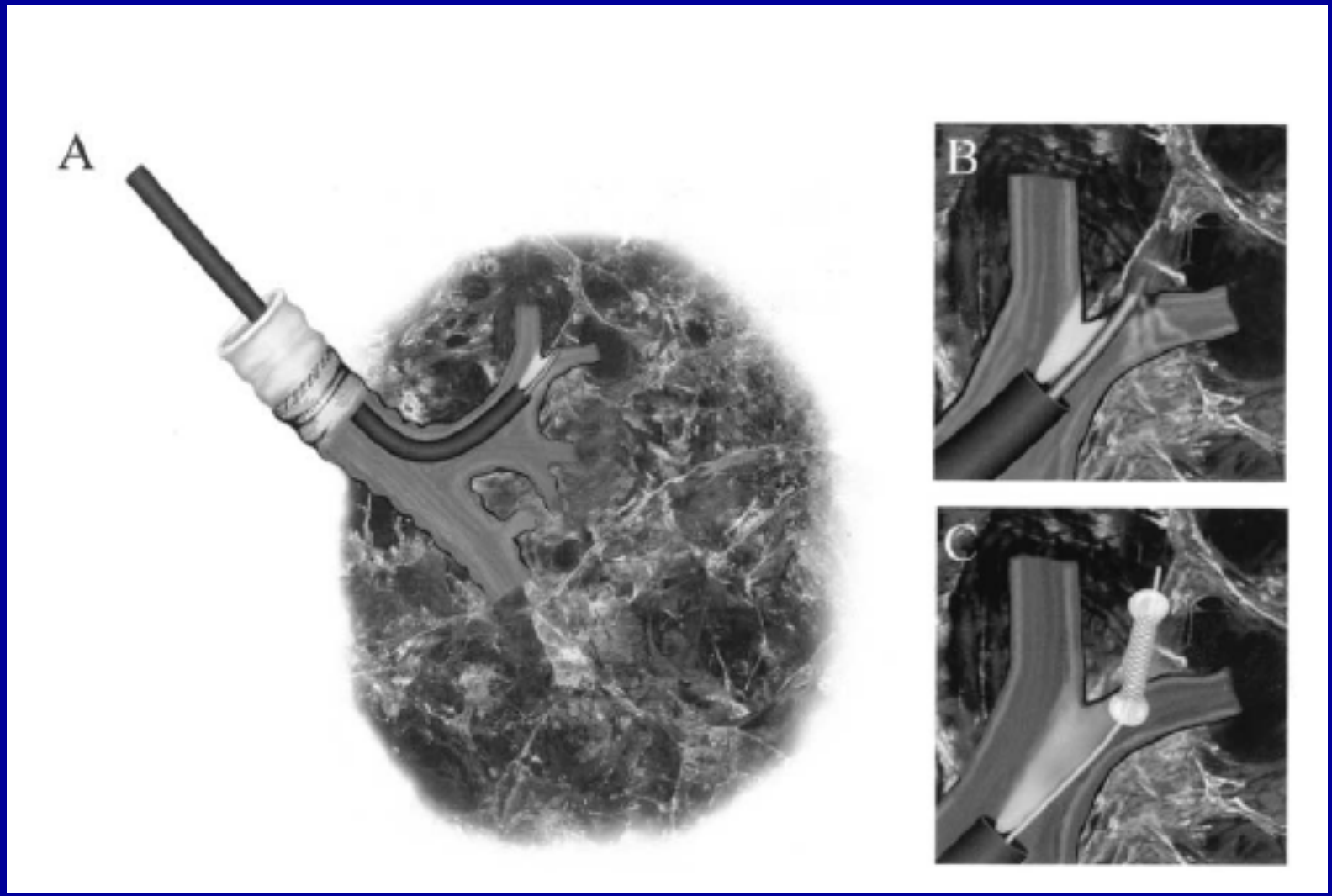
- 12 month follow-up
- >15% FEV1 improvement
  - 47.7% EBV vs. 16.8 Standard Care
- 6 MWT improved 39.31 m
- Improvement in symptom scores
- Pneumothorax up to 45d 26.6%
  - 4 deaths
- 1 death each group > 45 days

Am J Respir Crit Care Med 2018 198:1151-64

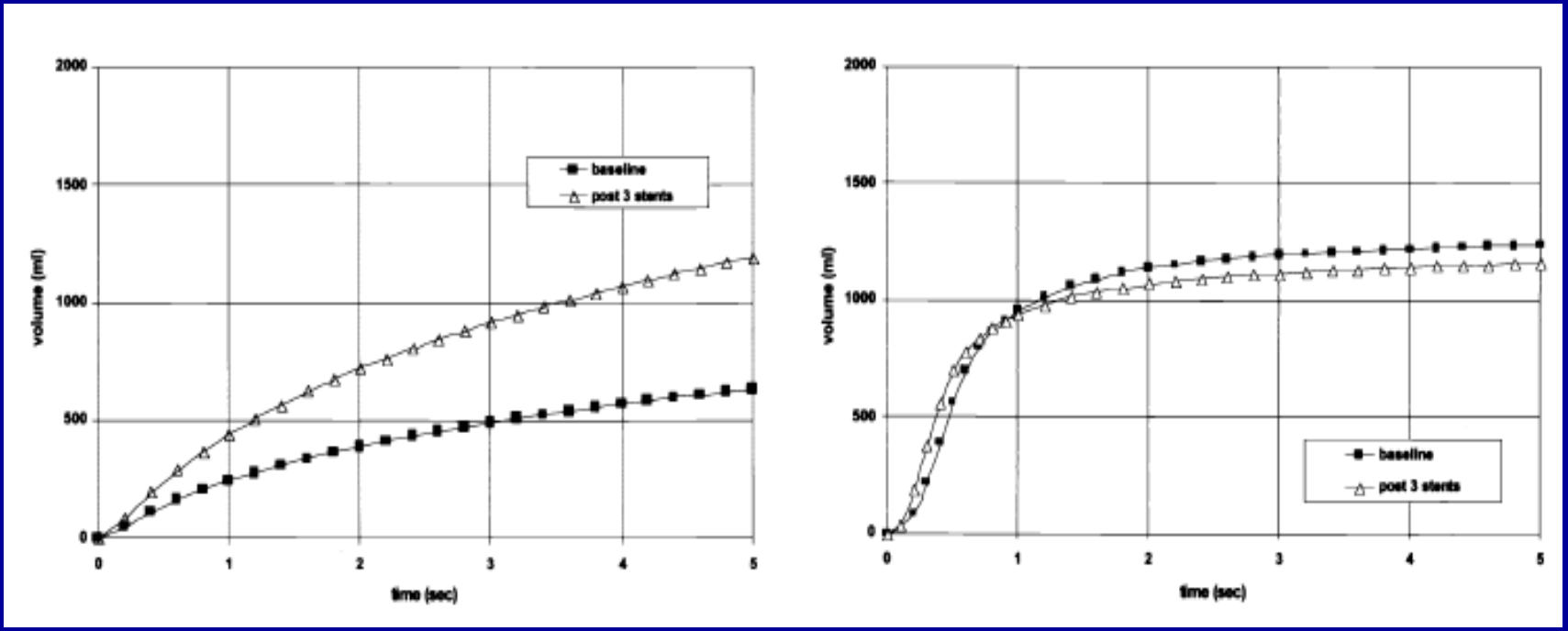
Homogenous Emphysema



Airway Bypass (Fenestration)



Airway Bypass

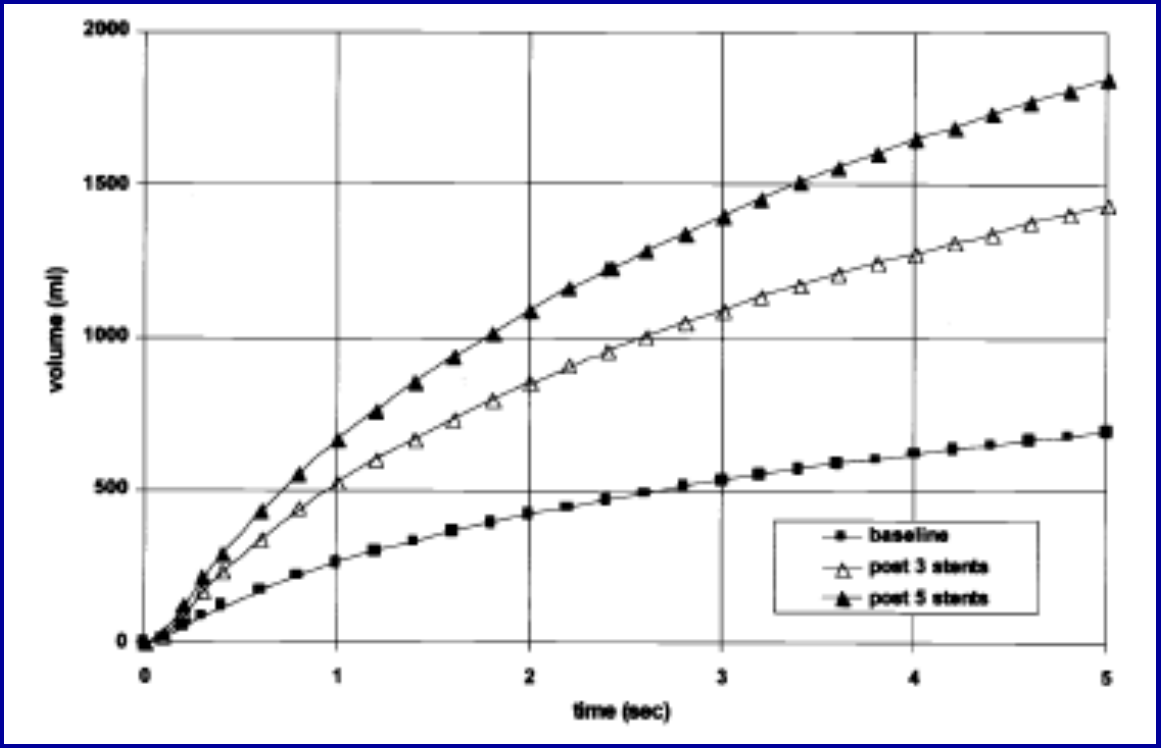


Emphysema

Normal

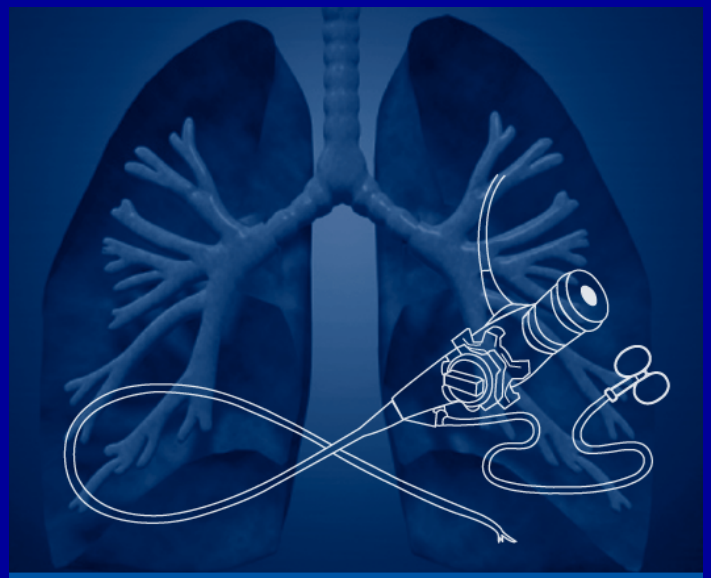
*Ann Thorac Surg 2003;75:393-398

Airway Bypass



Ann Thorac Surg 2003;75:393-398

EASE Trial



EASE Trial Referring Physician Booklet

INCLUDES:
Existing Treatments for Emphysema
Background on Airway Bypass
Airway Bypass Procedure Description
EASE Trial Protocol Revision 7 Summary

EASE Trial
Exhale Airway Stents for Emphysema

This document is intended only for physicians who might refer their patients for potential participation in the EASE Trial. It is not

EASE TRIAL

Exhale ***A***irway ***S***tents for ***E***mphysema

- 315 patients (208 treatment)
- Safe with some short term improvements
- No sustainable long term benefits

LANCET 378;9795: 997-1005 *9/10/2011*

Lung Transplant

Indications

- Difficult to predict who will do well
- All efforts to exclude asthma
- Must have Pulmonary Rehab
- Must be on supplemental O_2
- Severe disease
- $PaCO_2$ > 55 and/or Heart dysfunction from lung disease
- Preferably Hypercapneic and Hypoxemic

BODE Index

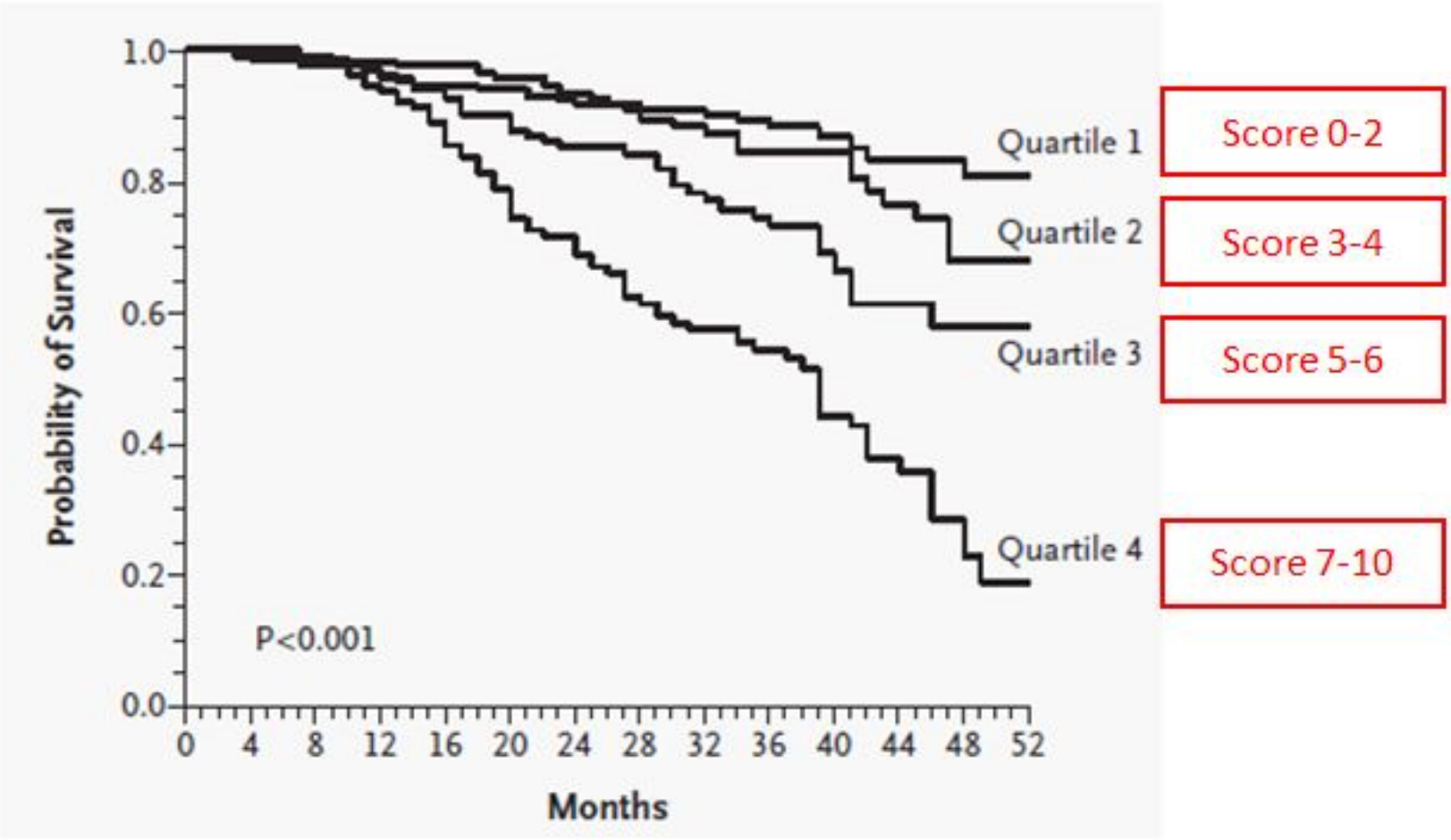
Table 2. Variables and Point Values Used for the Computation of the Body-Mass Index, Degree of Airflow Obstruction and Dyspnea, and Exercise Capacity (BODE) Index.*

Variable	Points on BODE Index			
	0	1	2	3
FEV_1 (% of predicted)†	≥65	50–64	36–49	≤35
Distance walked in 6 min (m)	≥350	250–349	150–249	≤149
MMRC dyspnea scale‡	0–1	2	3	4
Body-mass index§	>21	≤21		

* The cutoff values for the assignment of points are shown for each variable. The total possible values range from 0 to 10. FEV_1 denotes forced expiratory volume in one second.
† The FEV_1 categories are based on stages identified by the American Thoracic Society.
‡ Scores on the modified Medical Research Council (MMRC) dyspnea scale can range from 0 to 4, with a score of 4 indicating that the patient is too breathless to leave the house or becomes breathless when dressing or undressing.
§ The values for body-mass index were 0 or 1 because of the inflection point in the inverse relation between survival and body-mass index at a value of 21.

NEJM

BODE Index



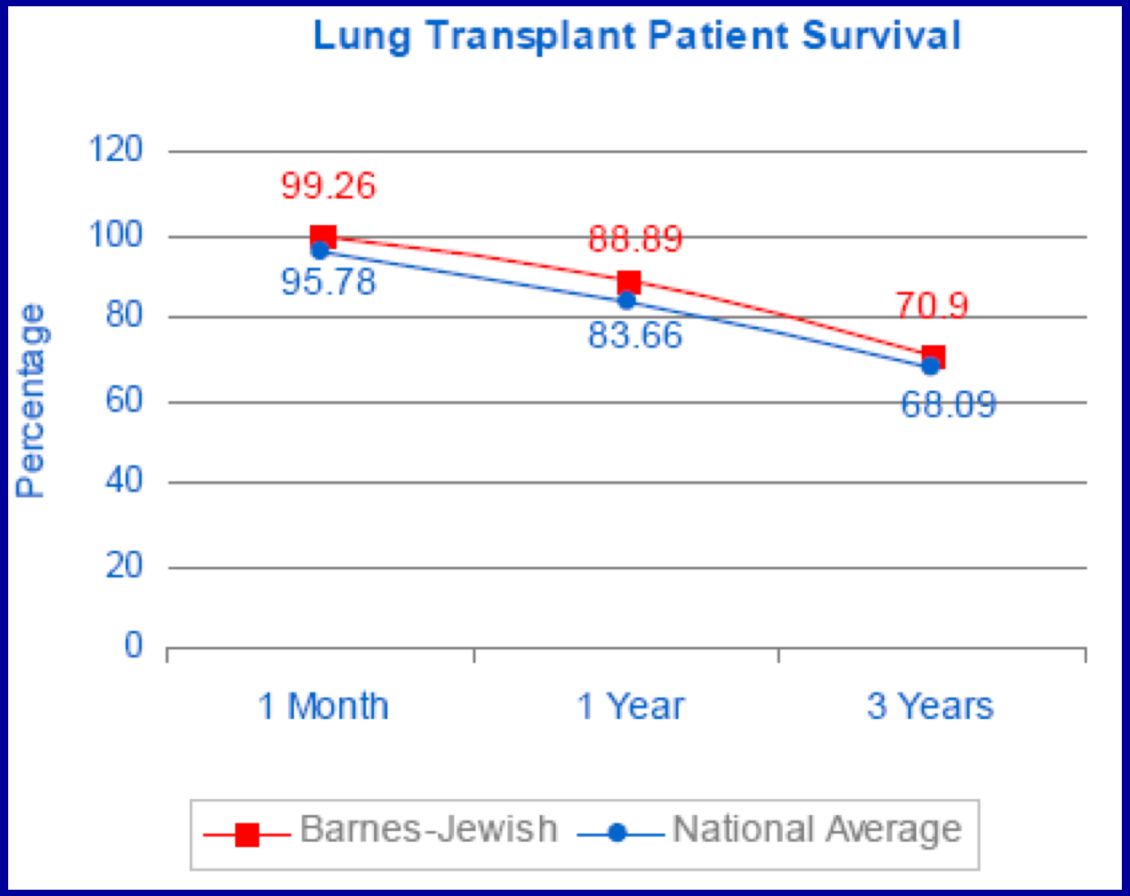
NEJM

Disease specific selection criteria

- **COPD-**
  - Pt. with BODE index 7 to 10 of at least 1 of the following:

1. FEV1 < 25% predicted (without reversibility)
2. PaCO2 >55 mm of Hg
3. Elevated pulmonary artery pressure (PAP)
4. Cor pulmonale

Survival



Barnesjewish.org

Complication

- Transplant typically improves QOL
- Complications
  - Expensive medications
  - High blood pressure/kidney dysfunction
  - Cancer risks
  - Infections
  - Acute/chronic rejection

SUMMARY

- Review GOLD criteria
- Brief Review of Pharmacologic Medications
- Long Term Oxygen Therapy
- Smoking Cessation
- Pulmonary Rehabilitation
- Surgical concerns
- Lung Volume Reduction
  - Surgical
  - Endobronchial
- Lung Transplantation

QUESTIONS?


LOST
CONFUSED
UNSURE
UNCLEAR
PERPLEXED
DISORIENTED
BEWILDERED