Rehabilitation programs should include, at a minimum:

- Exercise training
- Nutrition counseling
- Education

Patients at all stages of disease benefit from exercise training programs, with improvements in exercise tolerance and symptoms of dyspnea and fatigue. Benefits can be sustained even after a single pulmonary rehabilitation program. The minimum length of an effective rehabilitation program is 6 weeks; the longer the program continues, the more effective the results. Benefit does wane after a rehabilitation program ends, but if exercise training is maintained at home the patient's health status remains above pre-rehabilitation levels.

The goal of long-term oxygen therapy is to increase the baseline PaO_2 at rest to at least 8.0 kPa (60 mm Hg) at sea level, and/or produce SaO_2 at least 90%, which will preserve vital organ function by ensuring an adequate delivery of oxygen.

Oxygen Therapy: The long-term administration of oxygen (>15 hours per day) to patients with chronic respiratory failure increases survival and has a beneficial impact on pulmonary hemodynamics, hematologic characteristics, exercise capacity, lung mechanics, and mental state.

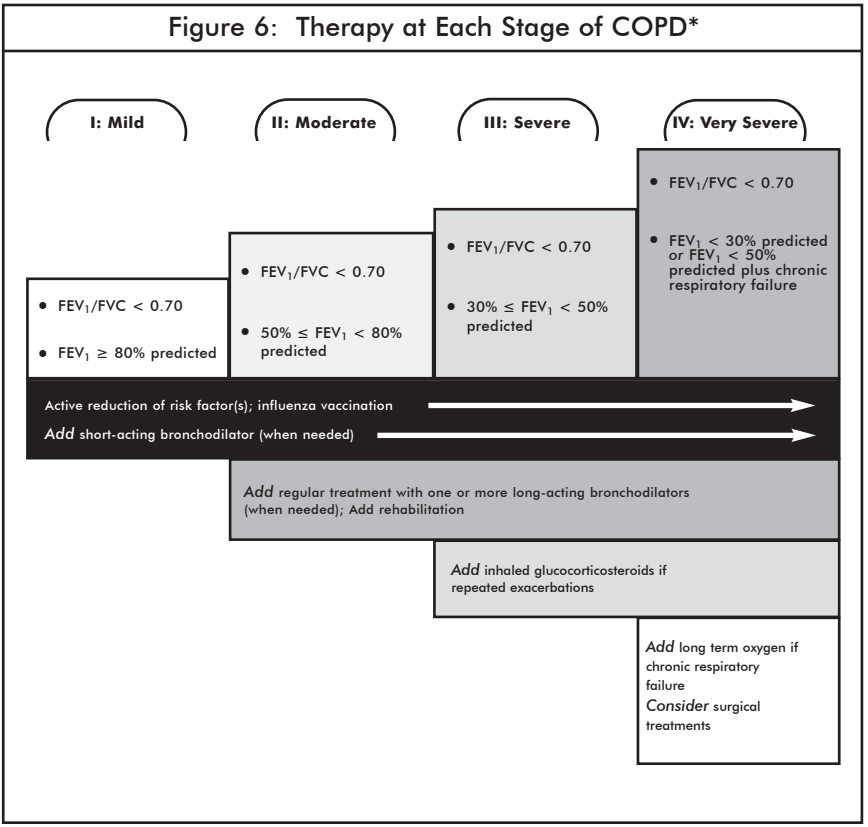
Initiate oxygen therapy for patients with *Stage IV: Very Severe COPD* if:

- PaO_2 is at or below 7.3 kPa (55 mm Hg) or SaO_2 is at or below 88%, with or without hypercapnia; or
- PO_2 is between 7.3 kPa (55 mm Hg) and 8.0 kPa (60 mm Hg) or SaO_2 is 88%, if there is evidence of pulmonary hypertension, peripheral edema suggesting congestive heart failure, or polycythemia (hematocrit > 55%).

Surgical Treatments: Bullectomy and lung transplantation may be considered in carefully selected patients with *Stage IV: Very Severe COPD*. There is currently no sufficient evidence that would support the widespread use of lung volume reduction surgery (LVRS).

There is no convincing evidence that mechanical ventilatory support has a role in the routine management of stable COPD.

A summary of characteristics and recommended treatment at each stage of COPD is shown in **Figure 6**.



**Postbronchodilator FEV_1 is recommended for the diagnosis and assessment of severity of COPD.*

Component 4: Manage Exacerbations

An exacerbation of COPD is defined as *an event in the natural course of the disease characterized by a change in the patient's baseline dyspnea, cough, and/or sputum that is beyond normal day-to-day variations, is acute in onset, and may warrant a change in regular medication in a patient with underlying COPD.*

The most common causes of an exacerbation are infection of the tracheobronchial tree and air pollution, but the cause of about one-third of severe exacerbations cannot be identified.

How to Assess the Severity of an Exacerbation

Arterial blood gas measurements (in hospital):

- PaO_2 < 8.0 kPa (60 mm Hg) and/or SaO_2 < 90% with or without $PaCO_2$ > 6.7 kPa, (50 mmHg) when breathing room air indicates respiratory failure.
- Moderate-to-severe acidosis (pH < 7.36) plus hypercapnia ($PaCO_2$ > 6-8 kPa, 45-60 mm Hg) in a patient with respiratory failure is an indication for mechanical ventilation.

Chest X-ray: Chest radiographs (posterior/anterior plus lateral) identify alternative diagnoses that can mimic the symptoms of an exacerbation.

ECG: Aids in the diagnosis of right ventricular hypertrophy, arrhythmias, and ischemic episodes.

Other laboratory tests:

- Sputum culture and antibiogram to identify infection if there is no response to initial antibiotic treatment.
- Biochemical tests to detect electrolyte disturbances, diabetes, and poor nutrition.
- Whole blood count can identify polycythemia or bleeding.

Home Care or Hospital Care for End-Stage COPD Patients?

The risk of dying from an exacerbation of COPD is closely related to the development of respiratory acidosis, the presence of serious comorbidities, and the need for ventilatory support. Patients lacking these features are not at high risk of dying, but those with severe underlying COPD often require hospitalization in any case. Attempts at managing such patients entirely in the community have met with limited success, but returning them to their homes with increased social support and a supervised medical care program after an initial emergency room assessment has been much more successful. However, detailed cost-benefit analyses of these approaches have not been reported.

Home Management

Bronchodilators: Increase dose and/or frequency of existing short-acting bronchodilator therapy, preferably with β_2-agonists. If not already used, add anticholinergics until symptoms improve.

Glucocorticosteroids: If baseline FEV_1 < 50% predicted, add 30-40 mg oral prednisolone per day for 7-10 days to the bronchodilator regimen. Nebulized budesonide may be an alternative to oral glucocorticosteroids in the treatment of nonacidotic exacerbations.

Hospital Management

Patients with the characteristics listed in **Figure 7** should be hospitalized. Indications for referral and the management of exacerbations of COPD in the hospital depend on local resources and the facilities of the local hospital.

Figure 7: Indications for Hospital Admission for Exacerbations

- Marked increase in intensity of symptoms, such as sudden development of resting dyspnea
- Severe background COPD
- Onset of new physical signs (e.g., cyanosis, peripheral edema)
- Failure of exacerbation to respond to initial medical management
- Significant comorbidities
- Frequent exacerbations
- Newly occurring arrhythmias
- Diagnostic uncertainty
- Older age
- Insufficient home support

Antibiotics: Antibiotics should be given to patients:

- With the following three cardinal symptoms: increased dyspnea, increased sputum volume, increased sputum purulence
- With increased sputum purulence and one other cardinal symptom
- Who require mechanical ventilation

APPENDIX I: SPIROMETRY FOR DIAGNOSIS OF COPD

Spirometry is as important for the diagnosis of COPD as blood pressure measurements are for the diagnosis of hypertension. Spirometry should be available to all health care professionals.

What is Spirometry?

Spirometry is a simple test to measure the amount of air a person can breathe out, and the amount of time taken to do so.

A ***spirometer*** is a device used to measure how effectively, and how quickly, the lungs can be emptied.

A ***spirogram*** is a volume-time curve.

Spirometry measurements used for diagnosis of COPD include (see Figure 2, page 9):

- **FVC** (Forced Vital Capacity): maximum volume of air that can be exhaled during a forced maneuver.
- **FEV_1** (Forced Expired Volume in one second): volume expired in the first second of maximal expiration after a maximal inspiration. This is a measure of how quickly the lungs can be emptied.
- **FEV_1/FVC**: FEV_1 expressed as a percentage of the FVC, gives a clinically useful index of airflow limitation.

The ratio FEV_1/FVC is between 70% and 80% in normal adults; a value less than 70% indicates airflow limitation and the possibility of COPD.

FEV_1 is influenced by the age, sex, height and ethnicity, and is best considered as a percentage of the predicted normal value. There is a vast literature on normal values; those appropriate for local populations should be used[1,2,3].

Why do Spirometry for COPD?

- Spirometry is needed to make a firm diagnosis of COPD.
- Together with the presence of symptoms, spirometry helps stage COPD severity and can be a guide to specific treatment steps.
- A normal value for spirometry effectively excludes the diagnosis of clinically relevant COPD.
- The lower the percentage predicted FEV_1, the worse the subsequent prognosis.
- FEV_1 declines over time and faster in COPD than in healthy subjects. Spirometry can be used to monitor disease progression, but to be reliable the intervals between measurements must be at least 12 months.

What You Need to Perform Spirometry

Several types of spirometers are available:

- relatively large bellows or rolling-seal spirometers (usually only available in pulmonary function laboratories). Calibration should be checked against a known volume e.g. from a 3-litre syringe on a regular basis.
- smaller hand-held devices, often with electronic calibration systems.

A hard copy of the volume time plot is very useful to check optimal performance and interpretation, and to exclude errors.

Most spirometers require electrical power to permit operation of the motor and/or sensors. Some battery operated versions are available that can dock with a computer to provide a hard copy.

It is essential to learn how your machine is calibrated and when and how to clean it.

How to Perform Spirometry

Spirometry is best performed with the patient seated. Patients may be anxious about performing the tests properly, and should be reassured. Careful explanation of the test, accompanied by a demonstration, is very useful. The patient should:

- Breathe in fully.
- Seal their lips around the mouthpiece.
- Force the air out of the chest as hard and fast as they can until their lungs are completely "empty."
- Breathe in again and relax.

Exhalation must continue until no more air can be exhaled, must be at least 6 seconds, and can take up to 15 seconds or more.

Like any test, spirometry results will only be of value if the expirations are performed satisfactorily and consistently. Both FVC and FEV_1 should be the largest value obtained from any of 3 technically satisfactory curves and the FVC and FEV_1 values in these three curves should vary by no more than 5% or 100 ml, whichever is greater. The FEV_1/FVC is calculated using the maximum FEV_1 and FVC from technically acceptable (not necessarily the same) curves.

Those with chest pain or frequent cough may be unable to perform a satisfactory test and this should be noted.

Where to find more detailed information on spirometry

1. American Thoracic Society
   www.thoracic.org/adobe/statements/spirometry1-30.pdf

2. Australian/New Zealand Thoracic Society
   www.nationalasthma.org.au/publications/spiro/index.htm

3. British Thoracic Society
   www.brit-thoracic.org.uk/copd/consortium.html

4. GOLD
   A spirometry guide for general practitioners and a teaching slide set is available: *www.goldcopd.org*

NOTES

The Global Initiative for Chronic Obstructive Lung Disease
is supported by educational grants from:

Visit the GOLD website at *www.goldcopd.org*

www.goldcopd.org/application.asp

Copies of this document are available at *www.us-health-network.com*