COPD: What does it stand for?
Chronic Obstructive Pulmonary Disease

Professor William MacNee
Past President European Respiratory Society
Definition of COPD

- COPD is a *preventable and treatable* disease. In the lungs it is characterized by airflow limitation (or *obstruction to the flow of air*) that is not fully reversible.

- The airflow limitation is usually *progressive* and associated with an *abnormal inflammation* in the lungs in response to noxious particles or gases.

- COPD has significant *effects out with the lungs* that may contribute to the severity in individual patients.
Global Burden of Disease: Top 10 Causes of Death in 1990 and 2020

1990
- Ischaemic heart disease
- Cerebrovascular disease
- Lower respiratory infection
- Diarrhoal disease
- Perinatal disorders
- COPD
- Tuberculosis
- Measles
- Road Traffic Accidents
- Lung Cancer

2020
- COPD is the only major cause of death to increase significantly in recent years
- Stomach cancer
- HIV
- Suicide

Murray et Lopez. Lancet 1997;349:1498-1504
The burden of COPD in Europe

- The frequency of COPD varies in European countries from 4-10% of the adult population, 50/100,000 males; 20/100,000 females
- Many more are undiagnosed
- 2-300,000 people die in Europe each year because of COPD
- Estimated direct cost in EU –
  - Out-patient € 4.7 billion
  - In-patient € 2.9 billion
  - Drugs € 2.9 billion
- 41,300 Lost work days/100,000 pop
- Productivity losses € 28.5 billion
Burden of mortality from COPD in Europe

Death rates due to COPD per 100,000

By 2010, COPD will be the fourth leading cause of death in Europe

ERS/ELF, European Lung White Book 2003
Prevalence of COPD in Europe

Better data is urgently needed

ERS/ELF European White Book 2003
COPD is under-recognised and under-diagnosed

At least half of those affected with COPD may be undiagnosed

- Disease with insidious onset
- Often treated as asthma
- Smokers don’t seek treatment
- Can present late with more advanced disease
Risk Factors for COPD

- Cigarette smoke
- Occupational dust and chemicals
- Environmental tobacco smoke (ETS)
- Indoor and outdoor air pollution

Nutrition
Infections
Socio-economic status
Aging Populations
Chronic Bronchitis

Bronchiolitis
Small airways disease

Emphysema

COPD

COUGH and SPUTUM

AIRFLOW LIMITATION

BREATHELESSNESS

Normal
COPD Progression

FEV₁ (% of value at age 25)

- Never smoked or not susceptible to smoke
- Smoked regularly and susceptible to its effects
- Disability
- Death

Age (years)

25 50 75

COPD Exacerbations: Clinical Consequences

- Reduced health-related quality of life
- Increased mortality with exacerbation hospitalizations
- FEV₁ accelerated decline
- Increased health resource utilization and direct costs

Lung Attack
SYSTEMIC EFFECTS OF COPD - COMORBIDITIES

Respiratory system
- Lung infections
- Lung Cancer

Target organs
- Muscle weakness
- Weight loss
- Osteoporosis (thin bones)

Other co-morbidities
- Depression
- Diabetes
- Peptic Ulcer

Angina
Heart attacks

Systemic inflammation
Diagnosis of COPD

SYMPTOMS
- cough
- sputum
- shortness of breath

EXPOSURE TO RISK FACTORS
- tobacco
- occupation
- indoor/outdoor pollution

SPIROMETRY

Diagnosis of COPD

<table>
<thead>
<tr>
<th></th>
<th>FEV₁</th>
<th>FVC</th>
<th>FEV₁/FVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>4.150</td>
<td>5.200</td>
<td>80%</td>
</tr>
<tr>
<td>COPD</td>
<td>2.050</td>
<td>3.000</td>
<td>60%</td>
</tr>
</tbody>
</table>

FEV₁: Forced Expiratory Volume in 1 second
FVC: Forced Vital Capacity
FEV₁/FVC: Ratio of FEV₁ to FVC
Preventive treatment in COPD

- Avoidance of risk factors
  - smoking cessation
  - reduction of indoor pollution
  - reduction of occupational exposure
- Influenza vaccination
GOALS of COPD MANAGEMENT

- Relieve symptoms
- Prevent disease progression
- Improve exercise tolerance
- Improve health status
- Prevent and treat complications
- Prevent and treat exacerbations
- Reduce mortality
Management of Stable COPD

Non-Drug Treatments

- **Rehabilitation**: All COPD patients benefit from exercise training programs, improving with respect to both exercise tolerance and symptoms of dyspnea and fatigue (*Evidence A*).

- **Provision** of Pulmonary rehabilitation services is inadequate.
Management of Exacerbations (Lung Attack)

- Noninvasive ventilation (NIV): improves blood gases, reduces in-hospital mortality, decreases the need for invasive mechanical ventilation and decreases the length of hospital stay (Evidence A).
WORLD COPD DAY
November 14, 2007

Raising COPD Awareness Worldwide
COPD: What do we need?

**Health care provision**
- Recognition of COPD as a health care priority.
- Spirometry available for screening and diagnosis.
- Vaccination programme specifically targeting COPD patients.
- Smoking cessation services.
- Health care professionals with specific training in COPD and smoking cessation.
- Access to specialist respiratory services for diagnosis and assessment (oxygen therapy, surgical intervention, exacerbations).
- Pulmonary rehabilitation services.
- Access to non-invasive ventilation.
- Hospital at home services to manage non life-threatening exacerbations.
- Palliative care services.
COPD: What do we need?

Research priorities

- To create a stronger foundation for fighting COPD by acquiring accurate data on illness, exacerbations, natural history, deaths and costs.
- To perform scientific surveys with spirometry in population samples of all European countries to improve knowledge of the distribution of COPD.
- To establish higher standards of care through studies on the effectiveness of current prevention, education, medication and rehabilitation.
- To develop new therapies to inhibit the progression of the disease.
- To study the most effective smoking cessation intervention techniques to prevent people from starting smoking.
- To guide caregivers and care payers in the most efficient and effective ways to manage this disease.
Impact of air trapping (hyperinflation)

- Occurs in all patients with COPD
- Increases the work of breathing
- Respiratory muscles at a mechanical disadvantage
- Contributes to breathlessness

Airway obstruction

Air trapping

Hyperinflation

Dyspnoea

Deconditioning

Reduced activity

Poor health-related quality of life
COPD is the only major cause of death to increase significantly in recent years.

Change in age-adjusted death rate in USA, from 1965 to 1998 (%)

<table>
<thead>
<tr>
<th>Cause</th>
<th>Death Rate Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHD</td>
<td>-59</td>
</tr>
<tr>
<td>Stroke</td>
<td>-64</td>
</tr>
<tr>
<td>CVD</td>
<td>-35</td>
</tr>
<tr>
<td>COPD</td>
<td>+163</td>
</tr>
<tr>
<td>All other causes</td>
<td>-7</td>
</tr>
</tbody>
</table>

COPD = chronic obstructive pulmonary disease
CHD = coronary heart disease
CVD = cerebrovascular disease

Adapted from: www.copdgold.com
Increasing burden of diseases and Injuries: change in rank order of DALYs

**1999**

1. Acute lower respiratory infections
2. HIV/AIDS
3. Perinatal conditions
4. Diarrhoeal diseases
5. Unipolar major depression
6. Ischaemic heart disease
7. Cerebrovascular disease
8. Malaria
9. Road traffic injuries
10. COPD
11. Congenital abnormalities
12. Tuberculosis
13. Falls
14. Measles
15. Anaemias

**2020**

1. Ischaemic heart disease
2. Unipolar major depression
3. Road traffic injuries
4. Cerebrovascular disease
5. COPD
6. Acute lower respiratory infections
7. Tuberculosis
8. War
9. Diarrhoeal diseases
10. HIV
11. Perinatal conditions
12. Violence
13. Congenital abnormalities
14. Self-inflicted injuries
15. Trachea, bronchus and lung cancers

DALY = Disability-adjusted life year

Source: WHO Evidence, Information and Policy, 2000
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COPD has significant extra-pulmonary effects that may contribute to the severity in individual patients.
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Infections

Socio-economic status

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- To perform scientific surveys with spirometry in population samples of all European countries to improve knowledge of the distribution of COPD
- To establish higher standards of care through studies on the effectiveness of current prevention, education, medication and rehabilitation
- To develop new therapeutic modalities to inhibit the progression of the disease
- To study the most effective smoking cessation intervention and techniques to prevent people from starting smoking
- To guide caregivers and care payers in the most efficient and effective ways to manage this disease
In 2030

Plos Med (25 Nov 2006)

- COPD: 4th cause of death
- Tobacco > 8 million deaths
- Biomass fuel combustion > 10 million deaths (Ezzatti, Science 2005)
Management of Stable COPD

Reduce Risk Factors

- Reduction of total personal exposure to tobacco smoke, occupational dusts and chemicals, and indoor and outdoor air pollutants are important goals to prevent the onset and progression of COPD.

- Smoking cessation is the single most effective — and cost effective — intervention in most people to reduce the risk of developing COPD and stop its progression (Evidence A).

Evidence A: [Provide evidence citation here]
**KEY POINTS**

- Spirometric confirmation is a key component of the diagnosis of COPD and primary care practitioners should have access to high quality spirometry.

- Older patients frequently have multiple chronic health conditions. Comorbidities can magnify the impact of COPD on a patient’s health status, and can complicate the management of COPD.
Management of Stable COPD
Non-Pharmacologic Treatments

- **Rehabilitation**: All COPD patients benefit from exercise training programs, improving with respect to both exercise tolerance and symptoms of dyspnea and fatigue (Evidence A).

- **Oxygen Therapy**: The long-term administration of oxygen (> 15 hours per day) to patients with chronic respiratory failure has been shown to increase survival (Evidence A).
New Advances in COPD

• Assessment

• Understanding disease processes

• Treatment
COPD Sub(Pheno)types Important for treatment?

FEV1 < 35% Predicted

Severe disease

Patient # 1
58 y
FEV1: 28 %

Patient # 4
72 y
FEV1: 34%
MRC: 4/4
6MWD: 154 m
BMI: 24
BODE: 9

Cote et al
COPD: a multicomponent disease

- Chronic Bronchitis
- Small airways disease bronchiolitis
- Emphysema
- Airflow Obstruction
- Hyperinflation
- Systemic component
- Exacerbations
- Co-morbidities
- Lung
Surgical volume reduction for emphysema

In selected patients:-

• Removes hyperinflated areas of lung
• Reduces air trapping
• Improves breathlessness
• Improves health status
• Improves survival
LVRS improves mortality:
Patients Upper-lobes emphysema and low exercise capacity

High-risk patients excluded
Bronchoscopic Lung Volume Reduction
Airway bypass for emphysema

Before Bypass After

FEV₁ increased 666 ml

Proof of concept

Designed for patients with diffuse severe emphysema:

• Creation of new pathways for trapped gas to escape from the lungs
• Reduces hyperinflation
• Improves breathlessness and quality of life

Preliminary results in emphysema patients

<table>
<thead>
<tr>
<th></th>
<th>1 month</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in SGRQ scores</td>
<td>-8.1 ± 9.6 (p&lt;0.0001)</td>
<td>-6.8 ± 14.3 (p&lt;0.05)</td>
</tr>
<tr>
<td>Proportion with ≥ -4 points</td>
<td>17 (63%)</td>
<td>12 (52%)</td>
</tr>
<tr>
<td>Proportion with ≥ -8 points</td>
<td>11 (41%)</td>
<td>9 (39%)</td>
</tr>
<tr>
<td>Proportion with FEV₁ change ≥ 15%</td>
<td>3 (10%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Proportion with 6MWD change ≥ 15%</td>
<td>8 (29%)</td>
<td>6 (24%)</td>
</tr>
</tbody>
</table>

COPD: a multicomponent disease

- Chronic Bronchitis
- Small airways disease bronchiolitis
- Emphysema
- Airflow Obstruction
- Systemic component
- Co-morbidities
- Lung Hyperinflation
- Exacerbations
Small airways disease and emphysema

A
Age 53
44 Pack years
FEV\textsubscript{1} 42.1%
FEV\textsubscript{1}/FVC 0.39

B
Age 59
48 pack years
FEV\textsubscript{1} 44.2%
FEV\textsubscript{1}/FVC 0.39

Mild emphysema

Severe emphysema
Airway wall dimensions

- Airway dimensions
  - Lumen diameter
  - Wall thickness
  - Wall area
  - Percentage wall area
Rate of Exacerbations Requiring Oral Corticosteroids

<table>
<thead>
<tr>
<th></th>
<th>Placebo</th>
<th>Salmeterol</th>
<th>Fluticasone</th>
<th>SFC50/500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of Exacerbations</td>
<td>0.80</td>
<td>0.64</td>
<td>0.52</td>
<td>0.46</td>
</tr>
</tbody>
</table>

* p<0.001 vs placebo,
† p<0.001 vs salmeterol,
# p=0.017 vs fluticasone

Calverley NEJM 2007
Pulmonary rehabilitation for COPD

- Improves exercise tolerance
- Improves breathlessness
- Improves quality of life
- Reduces re-admission to hospital with exacerbations of COPD
Systemic inflammation, function and health status in COPD

Exercise capacity

- Peak load
- Duration
- 6-min WD

Health status

- Total
- Symptom
- Activity
- Impact

Systemic inflammation can be treated

Broekhuizen Thorax 2006
Can we repair the emphysema?
Retinoic acid reverses elastase-induced pulmonary emphysema in rats

Normal

Retinoic acid reverses elastase-induced pulmonary emphysema in rats

Normal

After elastase

Retinoic acid reverses elastase-induced pulmonary emphysema in rats

Tissue engineering- the future for chronic diseases?

Take two stem cells and call me in the morning.
New Advances in COPD

• Assessment

• Understanding disease processes

• Treatment
Emphysema and aging

29 year old non-smoker

100 year old non-smoker

Natural history of COPD

FEV\textsubscript{1} (% of value at age 25)

Non-smoker

Smoked regularly and susceptible to its effects

Disability

Death

An extrapolation of Fletcher and Peto. 1977
“Are you sure you don’t want to add something about smoking?”
Varenicline and Smoking Cessation

Gonzales et al JAMA 2006;296:47
Factsheets

How can I interpret air pollution levels?

Many countries and international agencies have developed systems to show the different levels of air pollution in different areas each day and this alerts the population when levels are excessive. One of these, from the UK Department of Health, is shown below. This system works by grading each concentration of pollutant, and ranking it at a level between 1 and 10. These levels are then split into four categories: low; moderate; high; and very high.

<table>
<thead>
<tr>
<th>Band</th>
<th>Index</th>
<th>O₃ [μg/m³]</th>
<th>NO₂ [μg/m³]</th>
<th>PM [μg/m³]</th>
<th>SO₂ [μg/m³]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>1</td>
<td>0-32</td>
<td>0-95</td>
<td>0-16</td>
<td>0-88</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>33-66</td>
<td>96-190</td>
<td>17-32</td>
<td>89-176</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>67-99</td>
<td>191-286</td>
<td>33-49</td>
<td>177-265</td>
</tr>
<tr>
<td>Moderate</td>
<td>4</td>
<td>100-126</td>
<td>287-381</td>
<td>50-57</td>
<td>266-354</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>127-152</td>
<td>382-476</td>
<td>58-66</td>
<td>355-442</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>153-179</td>
<td>478-572</td>
<td>67-74</td>
<td>443-531</td>
</tr>
<tr>
<td>High</td>
<td>7</td>
<td>180-239</td>
<td>573-635</td>
<td>75-82</td>
<td>532-708</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>240-299</td>
<td>636-700</td>
<td>83-91</td>
<td>709-886</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>300-359</td>
<td>701-763</td>
<td>92-99</td>
<td>887-1063</td>
</tr>
<tr>
<td>Very high</td>
<td>10</td>
<td>≥360</td>
<td>≥764</td>
<td>≥100</td>
<td>≥1064</td>
</tr>
</tbody>
</table>
Rate of decline of FEV$_1$ <50% pre-bronchodilator FEV$_1$

<table>
<thead>
<tr>
<th>Treatment arm</th>
<th>Adjusted rate of decline (ml/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>-56</td>
</tr>
<tr>
<td>SALM</td>
<td>-41*</td>
</tr>
<tr>
<td>FP</td>
<td>-38**</td>
</tr>
<tr>
<td>Seretide</td>
<td>-36**</td>
</tr>
<tr>
<td>Normal healthy decline</td>
<td>-30</td>
</tr>
</tbody>
</table>

*p=0.004,
**p<0.001

GSK Data on File SERTCODOF012 <50% FEV$_1$
All-cause mortality at 3 years

Probability of death (%)

Time to death (weeks)

Placebo  SALM  FP  SFC

RR reduction in mortality of 17.5%
Absolute reduction 2.6% over 3 years
Seretide™ 500 Accuhaler™
vs. Placebo
P=0.052 (CI 0.681-1.002)

Calverley et al. NEJM 2007
COPD: Life Continues...
Asthma versus COPD

- different diseases
- different treatments
- different prognoses

www.ginasthma.com  www.goldcopd.org
Asthma versus COPD

Additional investigations

- Imaging
- Allergy testing
chest radiograph

PA (left) and lateral (right) radiographs of a young woman with alpha-1-antitrypsin deficiency and typical changes of severe obstructive lung disease. There is diminished vascularity (arterial deficiency pattern) along with flattened diaphragms and an increase in the AP dimension of the chest.

Bullae
Focal absence of pulmonary vessels
Reduction in vessel calibre, vessel tapering
Signs of overinflation

Sensitivity for emphysema ~ 40%
Thurlbeck and Simon 1978
Sensitive in diagnosis but not quantification in Moderate–severe disease
Thurlbeck and Muller 1999
Pathogenesis of COPD

Cigarette smoke
Biomass particles
Particulates

Host factors
Amplifying mechanisms

LUNG INFLAMMATION

Anti-oxidants
Oxidative stress

Anti-proteinases
Proteinases

Repair mechanisms

COPD PATHOLOGY

Source: Peter J. Barnes, MD
Changes in Small Airways in COPD Patients

- Disrupted alveolar attachments
- Inflammatory exudate in lumen
- Thickened wall with inflammatory cells: macrophages, CD8+ cells, fibroblasts
- Peribronchial fibrosis

Source: Peter J. Barnes, MD
<table>
<thead>
<tr>
<th>Risk Factors for COPD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Genes</strong></td>
</tr>
<tr>
<td>Exposure to particles</td>
</tr>
<tr>
<td>• Tobacco smoke</td>
</tr>
<tr>
<td>• Occupational dusts, organic and inorganic</td>
</tr>
<tr>
<td>• Indoor air pollution from heating and cooking with biomass in poorly ventilated dwellings</td>
</tr>
<tr>
<td>• Outdoor air pollution</td>
</tr>
<tr>
<td><strong>Lung growth and development</strong></td>
</tr>
<tr>
<td><strong>Oxidative stress</strong></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
</tr>
<tr>
<td><strong>Age</strong></td>
</tr>
<tr>
<td><strong>Respiratory infections</strong></td>
</tr>
<tr>
<td><strong>Socioeconomic status</strong></td>
</tr>
<tr>
<td><strong>Nutrition</strong></td>
</tr>
<tr>
<td><strong>Comorbidities</strong></td>
</tr>
</tbody>
</table>
Management of Stable COPD

Assess and Monitor COPD: Key Points

- A clinical diagnosis of COPD should be considered in any patient who has dyspnea, chronic cough or sputum production, and/or a history of exposure to risk factors for the disease.

- The diagnosis should be confirmed by spirometry. A post-bronchodilator FEV\(_1\)/FVC < 0.70 confirms the presence of airflow limitation that is not fully reversible.

- Comorbidities are common in COPD and should be actively identified.
**Management of Stable COPD**

**Assess and Monitor COPD: Spirometry**

- Spirometry should be performed after the administration of an adequate dose of a short-acting inhaled bronchodilator to minimize variability.

- A post-bronchodilator FEV₁/FVC < 0.70 confirms the presence of airflow limitation that is not fully reversible.

- Where possible, values should be compared to age-related normal values to avoid overdiagnosis of COPD in the elderly.
COPD has significant extrapulmonary (systemic) effects including:

- Weight loss
- Nutritional abnormalities
- Skeletal muscle dysfunction
<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASK</strong></td>
<td>Systematically identify all tobacco users at every visit.</td>
</tr>
<tr>
<td><strong>ADVISE</strong></td>
<td>Strongly urge all tobacco users to quit.</td>
</tr>
<tr>
<td><strong>ASSESS</strong></td>
<td>Determine willingness to make a quit attempt.</td>
</tr>
<tr>
<td><strong>ASSIST</strong></td>
<td>Aid the patient in quitting.</td>
</tr>
<tr>
<td><strong>ARRANGE</strong></td>
<td>Schedule follow-up contact.</td>
</tr>
</tbody>
</table>
Management of Stable COPD

Reduce Risk Factors: Indoor/Outdoor Air Pollution

- Reducing the risk from indoor and outdoor air pollution is feasible and requires a combination of public policy and protective steps taken by individual patients.

- Reduction of exposure to smoke from biomass fuel, particularly among women and children, is a crucial goal to reduce the prevalence of COPD worldwide.
## Therapy at Each Stage of COPD

<table>
<thead>
<tr>
<th>I: Mild</th>
<th>II: Moderate</th>
<th>III: Severe</th>
<th>IV: Very Severe</th>
</tr>
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<tbody>
<tr>
<td>- FEV₁/FVC &lt; 70%</td>
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</tr>
<tr>
<td>- FEV₁ ≥ 80%</td>
<td>- 50% ≤ FEV₁ &lt; 80% predicted</td>
<td>- 30% ≤ FEV₁ &lt; 50% predicted</td>
<td>- FEV₁ &lt; 30% predicted or FEV₁ &lt; 50% predicted plus chronic respiratory failure</td>
</tr>
</tbody>
</table>

**Active reduction of risk factor(s); influenza vaccination**

*Add* short-acting bronchodilator (when needed)

*Add* regular treatment with one or more long-acting bronchodilators (when needed); *Add* rehabilitation

*Add* inhaled glucocorticosteroids if repeated exacerbations

*Add* long term oxygen if chronic respiratory failure.

*Consider* surgical treatments
Patient with COPD and Cachexia

- loss in fat free mass (FFM)
- low body mass index (BMI)
- predicts mortality
- GH and diet supplement resist.

Systemic Phenotype

- elevated TNFα
- loss in myosin heavy chain
- Increased oxidative stress
- muscle apoptosis
These COPD patients have different phenotypes.

Should they both receive the same Treatment?

From T Petty
Facts About COPD

- COPD is the 4th leading cause of death in the United States (behind heart disease, cancer, and cerebrovascular disease).

- In 2000, the WHO estimated 2.74 million deaths worldwide from COPD.

- In 1990, COPD was ranked 12th as a burden of disease; by 2020 it is projected to rank 5th.
Alpha –1 antitrypsin deficiency
(\(\alpha_1\) proteinase deficiency)

- Pi ZZ 1/5000 Live births in UK
- Liver disease in some cases in childhood
- Emphysema < 50 years of age often in 4\(^{th}\) decade
- Some individuals lead a normal life
- Panlobular predominantly basal emphysema
- Smoking is a cofactor in the risk of emphysema
COPD is a Complex Disease

- Inflammation
  - Bronchoconstriction
  - Airflow Limitation & Hyperinflation
  - Structural Changes

Progressive Loss of Lung Function
Reduced Quality of Life
Exacerbations
Mortality
Latest data on mortality due to COPD in Europe
(Source: OECD; www.oecd.org)

Data are presented as n per 100,000.

- >75
- 51-75
- 25-50
- <25
- NO DATA
Fig. 1. - Standardised mortality rates of chronic obstructive pulmonary disease for males in 42 European countries in 1980 (○) and 1990 (●). ………: mean for European region, 1990. Dots indicate estimates within the regions of the country.
Fig. 2. – Age-adjusted death rates for chronic obstructive pulmonary disease for males (●) and females (○) in 19 European countries. Reproduced from Chest 2000; 117: Suppl. 2, 336S–338S, with permission.
### EU25 - Principal causes of death by age group, in percent

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Cancer</th>
<th>Circulatory diseases</th>
<th>Respiratory diseases</th>
<th>Digestive diseases</th>
<th>External causes¹</th>
<th>Others¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>All age groups</td>
<td>25.3</td>
<td>41.0</td>
<td>8.0</td>
<td>4.6</td>
<td>5.2</td>
<td>15.9</td>
</tr>
<tr>
<td>0-19 years old</td>
<td>7.2</td>
<td>3.2</td>
<td>2.8</td>
<td>0.9</td>
<td>26.6</td>
<td>59.3</td>
</tr>
<tr>
<td>20-44 years old</td>
<td>19.7</td>
<td>13.8</td>
<td>2.5</td>
<td>6.6</td>
<td>38.0</td>
<td>19.4</td>
</tr>
<tr>
<td>45-64 years old</td>
<td>41.4</td>
<td>26.3</td>
<td>4.1</td>
<td>7.6</td>
<td>8.3</td>
<td>12.3</td>
</tr>
<tr>
<td>65-84 years old</td>
<td>29.1</td>
<td>42.0</td>
<td>8.2</td>
<td>4.2</td>
<td>2.8</td>
<td>13.7</td>
</tr>
<tr>
<td>Over 85 years old</td>
<td>11.6</td>
<td>52.0</td>
<td>10.6</td>
<td>3.5</td>
<td>2.9</td>
<td>19.4</td>
</tr>
</tbody>
</table>
Figure 1: Main causes of death by 5-year age group
COPD epidemiology in Scotland

The number of people with COPD is substantial and rising.

Those most likely to be affected already have the poorest health.

COPD is one of the most common (1 in 8) reasons for hospital admission.

COPD is a major killer but it also affects quality of life.

Number of COPD deaths in Scotland

Scottish Prevalence COPD X 10^3

New cases of COPD in Scotland in 2001

Number of hospital episodes in Scotland

Age band

Number of COPD deaths in Scotland


14 15 16 17 18

25 26 27 28 29 30 31 32 33

0 200 400 600 800 1000

0 4 8 12 16 20 24 28 32 36


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COPD is a major killer but it also affects quality of life.

COPD is one of the most common (1 in 8) reasons for hospital admission.
Mortality of COPD

- 30,000 in UK
- 5% of all deaths
- 4% of all females
- 6% of all males

Ref. 1. The Burden of Lung Disease BTS, Nov 2001
Ref. 2. Calverley PMA, Thorax 2002
Hospital admission for COPD

- 26% of medical admissions are for respiratory disease
- half due to COPD!

220,000 admissions/year

- mean length of stay 7.5 days
- over 1 million bed days
- 1 in 8 of all admissions

Ref 1: Crocket A, Men’s Health Journal 2003

2: NICE website
Consultations for COPD

- Annual GP consultation rates 2 x angina
- 417/1000 for patients 45-64 years
- 1032/1000 for patients 75-84 years

Pearson, BTS Guidelines Group / Standards of Care Committee
Thorax 1997
COPD and Systemic Effects

COPD has significant extrapulmonary (systemic) effects including:

- Weight loss
- Nutritional abnormalities
- Skeletal muscle dysfunction
COPD and Co-Morbidities

COPD patients are at increased risk for:

- Myocardial infarction, angina
- Osteoporosis
- Respiratory infection
- Depression
- Diabetes
- Lung cancer
Air Trapping

▲ Occurs in all patients with COPD
▲ Results in an increase in the work of breathing
▲ Places respiratory muscles at a mechanical disadvantage
▲ Contributes to the sensation of breathlessness (dyspnea)

Images courtesy of Denis O’Donnell, Queen’s University, Kingston, Canada
<table>
<thead>
<tr>
<th>Disease</th>
<th>1990</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ischemic heart disease</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cerebrovascular disease</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>COPD</strong></td>
<td><strong>6</strong></td>
<td><strong>3</strong></td>
</tr>
<tr>
<td>Lower respiratory infection</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Lung cancer</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Road traffic accidents</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Stomach cancer</td>
<td>14</td>
<td>8</td>
</tr>
</tbody>
</table>

WHO Global Burden of Disease study
## Increasing burden of diseases and Injuries: change in rank order of DALYs

**1999**
1. Acute lower respiratory infections
2. HIV/AIDS
3. Perinatal conditions
4. Diarrhoeal diseases
5. Unipolar major depression
6. Ischaemic heart disease
7. Cerebrovascular disease
8. Malaria
9. Road traffic injuries
**10. COPD**
11. Congenital abnormalities
12. Tuberculosis
13. Falls
14. Measles
15. Anaemias

**2020**
1. Ischaemic heart disease
2. Unipolar major depression
3. Road traffic injuries
4. Cerebrovascular disease
**5. COPD**
6. Acute lower respiratory infections
7. Tuberculosis
8. War
9. Diarrhoeal diseases
10. HIV
11. Perinatal conditions
12. Violence
13. Congenital abnormalities
14. Self-inflicted injuries
**15. Trachea, bronchus and lung cancers**

**DALY** = Disability-adjusted life year

Source: WHO Evidence, Information and Policy, 2000
Underdiagnosis of COPD

Diagnosed COPD
2.4 - 7 million

Estimated total COPD
16 million

56 - 85%
Undiagnosed/misdiagnosed

US estimates
Stang, 2000
Burden of COPD: Key Points

- COPD is a leading cause of morbidity and mortality worldwide and results in an economic and social burden that is both substantial and increasing.

- COPD prevalence, morbidity, and mortality vary across countries and across different groups within countries.

- The burden of COPD is projected to increase in the coming decades due to continued exposure to COPD risk factors and the changing age structure of the world's population.
Of the six leading causes of death in the United States, only COPD has been increasing steadily since 1970.

Source: Jemal A. et al. *JAMA* 2005
Air Trapping in COPD

**Inspiration**
- Normal
  - Small airway
  - Alveolar attachments
- Mild/moderate COPD
  - Loss of elasticity
- Severe COPD
  - Loss of alveolar attachments

**Expiration**
- Small airway
- Alveolar attachments
- Loss of elasticity
- Loss of alveolar attachments
- Closure
- Dyspnea
- ↓ Exercise capacity
- ↓ Health status
- Air trapping
- Hyperinflation

*Source: Peter J. Barnes, MD*
Air Trapping

- Occurs in all patients with COPD
- Results in an increase in the work of breathing
- Places respiratory muscles at a mechanical disadvantage
- Contributes to the sensation of breathlessness

Images courtesy of Denis O’Donnell, Queen’s University, Kingston, Canada
Impact of air trapping (hyperinflation)

- Airway obstruction
- Air trapping
- Hyperinflation
- Dyspnoea
- Deconditioning
- Reduced activity
- Poor health-related quality of life

Before Bronchodilator

<table>
<thead>
<tr>
<th></th>
<th>Inspiratory capacity</th>
<th>End-expiratory volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Before</td>
<td>After</td>
</tr>
</tbody>
</table>

Normal

Hyperinflation
Air Trapping

▲ Occurs in all patients with COPD
▲ Results in an increase in the work of breathing
▲ Places respiratory muscles at a mechanical disadvantage
▲ Contributes to the sensation of breathlessness

Normal

Hyperinflation
Diagnosis of COPD

SYMPTOMS
- cough
- sputum
- shortness of breath

EXPOSURE TO RISK FACTORS
- tobacco
- occupation
- indoor/outdoor pollution

SPIROMETRY
Definition of COPD

- COPD is a **preventable and treatable** disease. Its lung component is characterized by airflow limitation (or obstruction to the flow of air) that is not fully reversible.

- The airflow limitation is usually **progressive** and associated with an **abnormal inflammatory response** of the lung to noxious particles or gases.

- COPD has significant **extra-pulmonary effects** that may contribute to the severity in individual patients.
Standards for the diagnosis and treatment of patients with COPD: a summary of the ATS/ERS position paper

Diagnosis

The diagnosis of COPD should be considered in any patient who has the following: symptoms of cough; sputum production; or dyspnoea; or history of exposure to risk factors for the disease.

The diagnosis requires spirometry;
a post-bronchodilator forced expiratory volume in one second (FEV1)/forced vital capacity (FVC) \( \leq 0.7 \) confirms the presence of airflow limitation that is not fully reversible.
NICE recommendations: Diagnosis (2)

• If a diagnosis of COPD seems likely, perform spirometry
  – A diagnosis of airflow obstruction can be made if:
    • FEV$_1$/FVC < 0.7
    • FEV$_1$ < 80% predicted

Diagnosis can be made on patients’ symptoms and be confirmed with spirometry

Spirometry: Normal and Patients with COPD

<table>
<thead>
<tr>
<th></th>
<th>FEV₁</th>
<th>FVC</th>
<th>FEV₁/FVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>4.150</td>
<td>5.200</td>
<td>80%</td>
</tr>
<tr>
<td>COPD</td>
<td>2.350</td>
<td>3.900</td>
<td>60%</td>
</tr>
</tbody>
</table>
COPD patients are at increased risk for:

- Myocardial infarction, angina
- Osteoporosis
- Respiratory infection
- Depression
- Diabetes
- Lung cancer