• Mr. B is 57 years old, high 157 cm and weight 76 kg. He has worked as the dump truck driver in the coal mine since 1980, and also smoked cigarette 1 pack/day more than 30 years. What are the risk factors of his disease or illness?

Pulmonary defense mechanisms

• 1. Nasopharyngeal clearance
  - Sneezing and mucociliary escalator
• 2. Larynx
  - Epiglotic closure
• 3. Tracheobronchial clearance
  - Coughing, mucociliary escalator
• 4. Alveolar clearance
  - Phagocytosis by macrophages

A - ciliated pseudostratified columnar epithelium
B - lamina propria
C - muscularis mucosae
D - submucosa

https://courses.stu.qmul.ac.uk/smd/kb/microanatomy/respiratory/images/l3a.jpg

http://ars.els-cdn.com/content/image/1-s2.0-S0300483X10001770-gr1.jpg
Particulate matter PM > 5 microns are trapped and filtered in the nasopharynx. PM 3-5 microns are handled by the action of mucus (which traps the particles) and cilia (which transports the particles up into the nasopharynx). PM < 2 microns reach the alveoli where they may be engulfed by macrophages.

### Particulate Matter Handling

**Airway diseases**
- Small airway obstruction
- Asthma
- Chronic bronchitis
- Emphysema
- Large airway disease
- Bronchiectasis

**Parenchymal diseases**
- Infective: Pneumonias
- Non-infective: Pneumononiosis

**Lung Cancer**

### Pulmonary Defense Mechanisms

**Asthma**
- Asthma (Greek “panting”) is the chronic inflammatory disease of the airways characterized by bronchospasm (the tightening of the muscles surrounding the airways), inflammation (the swelling and irritation of the airways), and symptoms such as wheezing, coughing, chest tightness, and shortness of breath.

### Airway Diseases

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http://www.nhlbi.nih.gov/health/health-topics/images/asthma.jpg
Chronic bronchitis

- Chronic bronchitis is a chronic inflammation of the bronchi (medium-size airways) in the lungs.
- It is defined clinically as a persistent cough that produces sputum and mucus, for at least three months per year in two consecutive years.
- Cause → most often by exposure to airborne pollutants such as cigarette smoke, excessive dust in the air, or chemicals.
Chronic bronchitis

1. Hypertrophy and hyperplasia of submucosal glands (Reid Index)
2. Goblet cell hyperplasia
3. Mucous hypersecretion with plugging
4. Variable degree of chronic inflammation

- Increase in size and number of mucus gland, goblet cells
  Persistent irreversible diffuse changes
**Chronic bronchitis**

- Increased thickness of mucus gland layer in bronchial mucosa
- Cigarette smoke paralyses cilia, predisposing to bronchial infection

**Emphysema**

- Emphysema (Greek "inflate")
- It is a lung disease involving damage to the alveoli.
  - There is progressive destruction of alveoli and the surrounding tissue that supports the alveoli.
  - With more advanced disease, large air cysts develop where normal lung tissue used to be.
- Cause → most often by cigarette smoke

- The ducts of dilated air spaces which are conspicuous in the middle and lower lobes of the right lung and the lower lobe of the left lung. Both lungs are markedly enlarged.

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Lung showing centrilobular emphysema characteristic of smoking. Cut surface shows multiple cavities lined by heavy black carbon deposits.

Emphysema

Loss of alveolar septa, Enlarged air spaces

Bronchiectasis

- Bronchiectasis is a disease defined by localized, irreversible dilation of part of the bronchial tree caused by destruction of the muscle and elastic tissue, associated with, abnormal dilation of these airways.
- Patients have copious foul-smelling sputum, induced by postural change.
- Cause → bacterial infections, *Staphylococcus* or *Klebsiella*, *Bordetella pertussis*.

Morphology of Bronchiectasis

- Gross exam:
  - Marked dilatation of bronchial and bronchiolar airways (up to 4x normal size); airways can be visibly followed out to the pleural surfaces
- Microscopic exam:
  - Acute and chronic inflammation, ulceration, necrosis, abscess formation, squamous metaplasia and fibrosis
• Bronchiectasis is an abnormal, permanent dilation of the bronchial tubes in the lungs.

Pneumonia

- Pneumonia is an inflammatory affecting the alveoli, associated with fever, chest symptoms, and a lack of air space (consolidation) on a chest X-ray.
- Infectious agents or injury caused by aspiration of dust or chemical agents (gastric contents) causes fluid to enter the alveolar spaces.
• Lobar pneumonia affects a section (lobe) of a lung.

• Bronchial pneumonia (or bronchopneumonia) affects patches throughout both lungs.

Pneumonia

- Lobar pneumonia demonstrates the distinct difference between the upper lobe and the consolidated lower lobe.
• White nail syndrome may also be called leukonychia. Leukonychia can occur with arsenic poisoning, heart disease, renal failure, pneumonia, or hypoalbuminemia.

Tuberculosis

A person may contract pulmonary tuberculosis from inhaling droplets from a cough or sneeze by an infected person.

Granuloma in lung tissue

Main symptoms of Pulmonary tuberculosis

- Central
  - appetite loss
  - fatigue

- Lungs
  - chest pain
  - coughing up blood
  - productive, prolonged cough

- Skin
  - night sweats,
  - pallor

Main sites of Extrapulmonary tuberculosis

- Central nervous system
  - Meningitis

- Lymphatics
  - Scrotal (of the neck)

- Pleura
  - Tuberculosis pleurisy

- Disseminated
  - Military tuberculosis

- Bones and joints of spine
  - Pott's disease

- Genitourinary
  - Urogenital tuberculosis
**Mantoux tuberculin skin test**

**Granuloma (tubercle) of tuberculosis with caseous necrosis**

**Johann Ferdinand Friedrich Theodor Langhans**

1839–1915

German pathologist

**Charles Mantoux**

1877–1947

French physician
Pneumoconiosis is a term originally coined to describe the non-neoplastic lung reaction to inhalation of mineral dusts. "Pneumo" in Greek = dust)

1. Anthracosis (Coal dust accumulation)
2. Simple coal workers pneumoconiosis
   - occurs after years of exposure to coal dust
   - carbon laden macrophages in alveolar spaces
   - minimal defects in lung function

Coal Workers’ Pneumoconiosis (CWP)

Progressive massive fibrosis (PMF)

1. Coal dust
2. Silica
3. Asbestos
4. Beryllium

Carbon laden macrophages in alveolar spaces

Complicated CWP = progressive massive fibrosis
- CWP in many years can progress to PMF
- blackened large scars, dense collagen
- compromised lung function

Black lung disease

Progressive massive fibrosis: Large black nodules in the lung and diffusely black parenchyma.
Silicosis

- Silicosis, also known as Potter's rot, is a form of occupational lung disease caused by inhalation of crystalline silica dust, and is marked by inflammation and scarring in forms of nodular lesions in the upper lobes of the lungs.

![Amethyst quartz from Brazil](image1)

![vermiculite](image2)

Silicosis

Advanced silicosis seen on transection of lung. Scarring has contracted the upper lobe into a small dark mass (arrow). Note the dense pleural thickening.

Silicosis

- The confluence of whorled, hyalinized, fibrous silicotic nodules.

Asbestosis

Asbestosis is a chronic inflammatory and fibrotic medical condition affecting the parenchymal tissue of the lungs caused by the inhalation and retention of asbestos fibers.
Ferruginous bodies are fibers of asbestos coated with an iron-rich material derived from proteins such as ferritin and hemosiderin. Ferruginous bodies are believed to be formed by macrophages that have phagocytized and attempted to digest the fibers.

This long, thin object is an asbestos fiber.

Asbestosis

Asbestosis, or chronic beryllium disease (CBD), is a chronic allergic-type lung response and chronic lung disease caused by exposure to beryllium and its compounds.

Berylliosis

Berylliosis, or chronic beryllium disease (CBD), is a chronic allergic-type lung response and chronic lung disease caused by exposure to beryllium and its compounds.

Cytoplasmic star-like formation (asteroid body) is seen in a multinucleated giant cell in beryllium granuloma.
Lung Cancer

- Lung cancer is a malignant tumor of the lungs.
- Gross classification into 2 types:
  1. Central group: neoplasms arising in major bronchi, segmental bronchi or divisions up to 1 mm in diameter
  2. Peripheral group: neoplasms arising in lung parenchyma where bronchioles are less than 1 mm in diameter

Histological Classification

- 1. Squamous cell carcinoma
- 2. Adenocarcinoma
- 3. Small cell carcinoma (Oat cell)
- 4. Large cell carcinoma

- Squamous cell carcinoma commonly starts in the bronchi and may not spread as rapidly as other lung cancers.

- Adenocarcinoma usually develops on the outer boundaries of the lungs and is more commonly found in women than in men.
- Small cell carcinoma, also called oat cell carcinoma, can create its own hormones, which alter body chemistry.
- Large cell carcinoma is any lung tumor that cannot be classified.
- The tumor involves the bronchus (probable site of origin) and extends deeply into lung parenchyma. Tumor nodules are present in the lower lung. The pleura is focally involved.
- Tissue obtained via ultrasound-guided biopsy showing squamous cell carcinoma in the left lower lobe.
• This is a peripheral adenocarcinoma of the lung.
• Adenocarcinoma is the one cell type of primary lung tumor that occurs more often in non-smokers and in smokers who have quit.

• Gland production and/or mucin production is diagnostic of adenocarcinoma.

• Small cell carcinoma: sheets of cells, cells with scant cytoplasm, molded nuclei (nuclear molding, is conformity of adjacent cell nuclei to one another), uniform fine chromatin.
This large cell carcinoma at autopsy shows a large multilobulated tumor adjacent to the hilum. A metastatically involved lymph node is present next to the bronchus.


Large cell carcinoma: Tumor cells have abundant cytoplasm, clumped chromatin (blue), but no evidence of gland formation, mucin production, bridges, or pearls.

http://willroberts.com/lungcancer/image10.jpg

References