IONS OF MICROORGANISMS – BACTERIA, VIRUSES, AND FUNGI – populate the air during inhalation, these minute organisms can easily enter the air passages and lead to the lungs, making respiratory infections quite common. Infections in the upper airways, also known as upper respiratory tract infections, may cause illness, such as a common cold or pharyngitis, or a more complex disease such as sinusitis. Other respiratory infections can affect the lower air passages, including bronchitis, or the lung tissue itself, which is termed pneumonia.

UPPER AIRWAY INFECTIONS

These illnesses include infections of the nasal sinuses, pharynx, and larynx, and are caused when droplets contaminated by viruses and sometimes bacteria are inhaled. Infections often result in the inflammation and swelling of mucous membranes that line these structures. As people grow older, they become immune to most of the common viruses and have fewer infections.

Sinusitis
A bacterial infection may follow a viral infection, causing pus and mucus to accumulate in the nasal sinuses. Fever, headache, stuffy nose, and no sense of smell are common symptoms.

Tonsillitis
Most common in young children, inflamed tonsils may cause a fever, headache, sore throat, discomfort when swallowing, and earache. The lymph nodes in the neck often swell.

Pharyngitis
Inflammation of the pharynx (throat) causes a sore throat, fever, difficulty swallowing, and sometimes an earache and swollen lymph nodes in the neck.

THE COMMON COLD

Colds are easily transmitted from person to person by virus-containing droplets that are released onto hands or clothing or into the atmosphere when an infected person coughs or sneezes. Approximately 200 different viruses cause colds. Antibiotics have no effect and only symptoms can be treated; the body’s immune system must overcome infections.

1. After being carried by infected droplets, virus particles enter the body and invade the cells that line the throat and nose. These virus particles then replicate to produce new viruses, which continue to multiply rapidly.

2. The blood supply brings lymphocytes (white blood cells) to the infected mucosa. The blood vessels within the nasal mucosa swell and cause the secretion of excess fluid, resulting in a “runny nose.”

3. Some types of lymphocyte make virus-specific proteins (antibodies) that immobilize the virus particles, while other types secrete chemical substances that can destroy infected cells.

4. Phagocytes, a type of white blood cell, can engulf and destroy dead viruses, immobilized virus particles, and damaged cells. Symptoms of the cold soon subside.

INFLUENZA

Commonly called “flu,” this serious viral infection causes fever, chills, headache, muscle aches, cough, and pneumonia in some. It spreads rapidly, often occurring in localized outbreaks, or every few years in epidemics. There are three main types of virus: A, B, and C. Because the viruses can change their structures, a previous immunity to one type may no longer be effective. Influenza is life-threatening to the very young as well as the elderly, and some epidemics kill people of all ages.
**ACUTE BRONCHITIS**

This form of bronchitis – which means inflammation of the bronchi – develops suddenly. It can occur as a complication of an upper respiratory tract infection, such as a common cold, or can accompany measles or influenza. This disease is usually caused by a virus, and produces symptoms that include a sputum-producing cough, a fever, and sometimes a slight wheeze.

**Site of infection**

Usually only the large and medium-sized bronchi are inflamed. The glands in the bronchiolar walls produce abundant mucus, which is transported upward and coughed out. In children, older people, and those with lung disease, infection may spread, inflaming the bronchioles or lung tissue.

**Effects**

In acute bronchitis, the lining or deeper tissues of the bronchi become inflamed and swollen, narrowing the lumen. The amount of mucus also increases and causes congestion.

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**PNEUMONIA**

In pneumonia, the smallest bronchioles and alveolar tissue become inflamed. There are two main types: Lobar pneumonia affects one lobe of the lung, whereas bronchopneumonia affects patches of tissue in one or both lungs. Usually resulting from a viral or bacterial infection, pneumonia may also be caused by fungal yeasts, or protozoa. Early symptoms include chill fever, sweating, joint and muscle pain, and headache. Chest pain, coughing, and breathlessness develop.

**Bronchopneumonia**

This type of pneumonia mainly affects the chronically ill, the elderly, and the very young; it may also accompany influenza or measles. The scattered white areas shown in this illustration are areas of inflamed lung tissue.

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**LEGIONNAIRE’S DISEASE**

This rare bacterial condition was first described in 1976, after an outbreak of severe pneumonia that affected war veterans attending an American Legion convention. The disease affects men more often than women. Symptoms include a high fever, chills, muscle aches, a severe headache, abdominal pain, confusion, and diarrhea. Patients usually require hospitalization and intravenous antibiotics such as erythromycin.

**The cause**

The bacterium *Legionella pneumophila* is found in small numbers in almost all water supplies. It thrives, however, in water-cooled air conditioning systems, and in plumbing systems where water stagnates.
DISORDERS THAT CAUSE BREATHING PROBLEMS may be present from birth or may develop over many years. Others may occur suddenly without warning or after an injury. Inhaled substances, such as gases, fumes, organic chemicals, or mineral dust, can contribute to some disorders, while others have no known cause. Lung disorders may be grouped into those marked by inflammation that is caused by a variety of chemicals, infections, allergies, or other autoimmune disorders; those due to cancers and other growths; and those that are inherited.

PULMONARY HYPERTENSION
Elevated blood pressure in the pulmonary arteries leading to the lungs may be the result of a lung disorder, such as emphysema, or a circulatory disorder affecting the veins in the arms and legs. Left-sided heart failure causing a backup of blood in the lungs also raises pulmonary artery pressure.

PNEUMOTHORAX
A pneumothorax occurs when one of the pleural membranes ruptures, which allows air to enter the pleural space and cause the lung to collapse. Sometimes a spontaneous pneumothorax occurs, while others are the result of an injury; breathlessness and chest pain are common symptoms. If air is not reabsorbed, it may compress the lungs and heart and must be drained by a needle or tube inserted into the pleural space.

SARCOIDOSIS
Thought to be due to an extreme immune response, sarcoidosis features multiple areas of inflammation interspersed with fibrous and grainlike tissue. The circular nodules, called granulomas (shown right), are often found in the lungs, lymph nodes, and eyes. Symptoms include breathlessness, fatigue, joint pain, and sometimes a skin rash.
Fibrosing alveolitis is sometimes called idiopathic pulmonary fibrosis (IPF), an autoimmune disorder of unknown cause. It also occurs with various other immune disorders, such as rheumatoid arthritis. The disease causes fibrosis (scarring) and thickening of the walls of the lung's air sacs, resulting in severe breathlessness. Corticosteroid drugs may be given.

**Early stages**

IPF may be the result of an increased number of white blood cells in the alveoli of the lungs. As these white blood cells break down, they secrete substances that cause inflammation.

**Late stages**

Formation of scar tissue (fibrosis) occurs, thereby destroying the alveolar walls. The remaining alveoli both widen and thicken, reducing the surface area for gas exchange. Scar tissue also restricts lung expansion.

**BRONCHOSCOPY**

To diagnose and sometimes to treat a lung disorder, bronchoscopy may be performed. A bronchoscope may be a rigid tube or a flexible fiberoptic tube, which can reach farther into small air passages. After a light sedative and a local anesthetic have been given, the tube is inserted into the patient’s throat and down into the bronchi. Attachments can then be passed through the tube to remove tissue samples or to perform surgery.

**DUST DISEASES**

Asbestosis, silicosis, and pneumoconiosis are some of the diseases that are caused by inhalation of dust particles. These irritant particles inflame lung tissue, thus cause irreversible scarring. Those most at risk are people whose work exposes them to these dusts for several years. Some may develop in hay, grain, or straw, which cause farmer's lung, an allergic reaction that results in inflammation of the alveoli and bronchiolitis.

**Coal-miner's pneumoconiosis**

If coal dust is inhaled, a period of 10 to 15 years can lead to pneumoconiosis, or "black lung disease." Dust particles deposit lung tissue (left), producing inflammatory nodules from tissue formation. Dense nodules of scar tissue also develop, leading to dense nodules of scar tissue. Buildup of this tissue severely restricts effective lung function.

**Silicosis**

Silicosis is the world's most common occupational disease. It is a form of fibrosis in the lungs caused by silica dust, usually in the form of quartz. Workers, stone masons, coal miners, and others are at risk. Symptoms such as breathlessness may develop for many years. The disease may lead to lung cancer, especially if an affected person smokes.

1. Inhaled silica particles are deposited in the lungs and ingested by scavenging white blood cells called macrophages.

2. Macrophages eat and die, releasing silica and chemicals that attract fibroblasts, which produce fibrous tissue. Silica is conserved by more macrophages; the process is repeated.

3. More fibrous tissue develops, leading to dense nodules of scar tissue. Buildup of this tissue severely restricts effective lung function.
COMMON IN SMOKERS AND IN URBAN OR INDUSTRIALIZED AREAS, chronic lung orders that obstruct the airways and reduce airflow have increased in every rt of the world. The disorders increasingly affect women, partly due to the eater numbers who smoke or who are in industrial workplaces. Known risk tors include passive exposure to cigarette smoke and repeated respiratory ections during childhood, as well as a family member with a similar disease. the past 20 years, the number of childhood asthma cases has doubled.

CHRONIC BRONCHITIS

Though recurring acute bronchitis caused by a virus or a terium may cause chronic inflammation of the bronchi, most common cause is smoking and chemical irritants. the resulting cough is troublesome mostly during damp, cold months, but eventually it persists all year. nptoms such as hoarseness and breathlessness also occur.

HOW BRONCHITIS DEVELOPS

Bronchi are irritated by smoking or prolonged ssure to pollutants, they begin to produce much mucus. This causes a progressively nsening cough in order to clear the airways.

EMPHYSEMA

The lungs are filled with millions of tiny air sacs called alveoli. In emphysema, they become overstretched and rupture. Most people who are severely affected are heavy, long-term smokers, but a rare inherited enzyme deficiency is a known risk factor. At present the disorder is incurable, but stopping smoking slows its progression.

Healthy bronchi

In normal lungs, the airways are lined with cilia (surface hairs). The cilia propel mucus, produced by mucous glands and containing inhaled dust and germs, up into the throat, where it is either coughed up or swallowed.

1. Inhaled irritants cause goblet cells to increase in number and mucous glands to enlarge so that more mucus is produced. Damaged cilia cannot propel mucus along.

2. Mucus retained in the airway becomes a breeding ground for bacteria so that inflammation is likely to recur. Cilia are slowly destroyed; more mucus collects.

Inhaled irritants

Smoke or other pollutants may stimulate chemicals that cause alveolar walls to break down and merge. Fewer, larger sacs reduce the area for gas exchange, causing breathlessness.

DEATHS FROM SMOKING

A comparison of death rates in nonsmokers and smokers from both chronic bronchitis and emphysema is shown in the graph below.
**Asthma**

Asthma attacks involve both wheezing and breathlessness, varying in intensity, and caused by constricted airways. Allergic asthma often develops in childhood and may be accompanied by eczema. Asthma is confirmed by lung function tests, and by skin and blood tests to identify substances triggering these attacks. In some forms of the disease, there is no specific trigger and no known cause.

**TREATMENT OF ASTHMA**

Obstruction of airways may be relieved by inhaled steroids to suppress inflammation and by bronchodilator drugs, which relax bronchiolar walls. Beta adrenergic stimulants and anticholinergic drugs are also used for the relief of asthma attacks. Both the frequency and severity of asthma attacks can be reduced by avoiding the specific allergens that trigger attacks.

**Mast-cell Stabilizers**

Mast cells play a critical role in the allergic response. Allergens (antigens) attach to these cells, stimulating them to produce histamine. Mast-cell stabilizers can inhibit the production of histamine by bronchiolar mast cells, which helps reduce inflammation of the airways.

**Bronchodilators and Steroids**

Bronchodilator drugs work by affecting the nerve signals that control the contraction and relaxation of bronchiolar muscles. They do not reduce inflammation of the mucous lining. Corticosteroid drugs, usually inhaled, widen bronchioles by reducing inflammation.

**The Role of Allergens**

Allergens are substances that trigger an allergic response. Common allergens that may trigger or intensify attacks of asthma include molds, pollens, animal dander, dust, and some foods and drugs. Anxiety, vigorous exercise in cold weather, and respiratory infections are other factors.

**A specific allergen**

In some people, exposure to certain pollens triggers asthma attacks. A variety of pollen types can cause problems, but the most common are tree pollens in the spring and ragweed pollens in the fall. Other allergens that can trigger attacks include animal dander, dust, and mold spores. Food allergies can also cause asthma attacks in some people.
Lung Cancer

The most common cause of lung cancer - about 87 percent of all cases in the US - is tobacco smoking. In the past, lung cancer was far more common in men than women because more men than women smoked in the first half of this century; now its incidence in women is rapidly rising and it has overtaken breast cancer as the most common cancer causing death in women. Other causes of lung cancer include exposure to coal dust, asbestos, and silica. Lung cancer is more common in industrial areas of the world than in rural areas.

Causes of Lung Cancer

Many inhaled irritants trigger the growth of abnormal cells in the lungs. Cigarette smoke, however, contains thousands of known carcinogenic (cancer-causing) substances, and is the main cause of lung cancer. Diagnostic tests may include a chest X-ray, biopsy, and bronchoscopy (examining the bronchi through a viewing tube).

How Smoking Damages the Lungs

Tobacco smoke is a complex mixture of over 3,000 different substances, and burning cigarette tar is strongly carcinogenic. Some risk factors known to predispose toward the development of lung cancer include the number of cigarettes smoked per day, their tar content, the number of years a person has smoked, and the depth of inhalation.

Growth of Lung Cancer

In about 95 percent of lung cancer cases, the tumor starts to grow in the bronchi, where it may enlarge or bleed and obstruct breathing. Some cells of a bronchial tumor may break away and infiltrate other parts of the lung, or spread to other organs either directly or via the bloodstream. The cancerous tissue that develops at the new site is known as a metastasis.

Tumor in an alveolus

A tiny tumor fills a single alveolus. A few of the cancer cells (shown in red) have broken away and begun to spread.
A persistent cough is usually the earliest symptom of lung cancer. Because most people who develop lung cancer are smokers, this is often dismissed as simply a "smoker’s cough." Other symptoms of lung cancer include coughing up blood, wheezing, persistent hoarseness, headache, weight loss, and chest pain.

Symptoms from tumor growth
A tumor that grows may obstruct a bronchus, causing shortness of breath and chest pain. Sometimes a tumor invades the esophagus, thus making swallowing difficult.

Symptoms of spreading cancer
Lung cancer metastasizes (or spreads) to other parts of the body and causes a variety of symptoms. Metastases in bones may cause pain and fractures; in the brain they may cause paralysis and confusion; in the liver they may cause nausea and weight loss.

DRUG TREATMENT
Some anticancer drugs will relieve symptoms of certain lung cancers, or cause those symptoms to temporarily disappear. Since these drugs damage normal cells as well, they are given at intervals of 3 to 4 weeks to allow healthy tissue to recover between treatments. Vomiting, diarrhea, and hair loss may be side effects.

Cytotoxic antibiotics
For cells to multiply, DNA must replicate to create chromosomes in the new cell. Cytotoxic antibiotics prevent replication, halting growth of normal and cancer cells.

Alkylation drugs
Spindle fibers form in cells that are about to divide. By breaking up these fibers, alkylating drugs interfere with rapidly reproducing cancer cells.

LOBECTOMY
If diagnostic tests confirm the presence of lung cancer, a lobectomy, or the removal of a lobe of the lung, may be performed. This operation is only appropriate in certain circumstances. The tumor must be small and confined to a localized area; breakaway cancer cells must not have spread to other parts of the body; and the patient must also be reasonably well. For the few for whom the operation is suitable, it offers relief of symptoms as well as the chance of a cure.

1 After administration of a general anesthetic, the surgeon makes an incision around the side of the chest. The muscles between the ribs are cut and the ribs are then separated in order to expose the affected lung, which is covered by its pleura.