
Pneumonia

Types, Causes, Symptoms, Diagnosis, and Treatments

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Abstract

Pneumonia is a lung infection that causes inflammation in the air sacs, leading to symptoms like cough, fever, and difficulty breathing. This comprehensive guide provides an in-depth look at pneumonia, covering its definition, contagiousness, severity, types, causes, symptoms, stages, underlying mechanisms, diagnosis, complications, treatment options, preventive measures, prognosis, and advice for living with the condition. The information is presented in straightforward language to ensure clarity and accessibility for all readers.

Introduction

Pneumonia is a significant health concern worldwide, affecting millions annually. It can range from mild to severe and can be life-threatening, especially for certain populations. Understanding pneumonia is crucial for early detection, effective treatment, and prevention. This guide aims to equip readers with essential knowledge about pneumonia, its impact, and management strategies (1-8).



Pneumonia is an infection that inflames the air sacs in one or both lungs. These air sacs may fill with fluid or pus, causing symptoms such as cough, fever, chills, and breathing difficulties. Image: Conceptual illustration of lung infection. Image Credit: KATERYNA KON/SCIENCE PHOTO LIBRARY from sciencephoto via Canva.com

What is Pneumonia?

Pneumonia is an infection that inflames the air sacs in one or both lungs. These air sacs may fill with fluid or pus, causing symptoms such as cough, fever, chills, and breathing difficulties. Various organisms, including bacteria, viruses, and fungi, can cause pneumonia.

Is Pneumonia Contagious?

Pneumonia itself is not contagious, but the infectious agents that cause it, such as certain bacteria and viruses, can spread from person to person. For example, if pneumonia is caused by the flu virus or SARS-CoV-2 (the virus responsible for COVID-19), these viruses can be transmitted through respiratory droplets. However, not everyone exposed to these pathogens will develop pneumonia; it often depends on individual health factors and immune response.

Is Pneumonia Deadly?

Pneumonia can be life-threatening, particularly for infants, young children, older adults, and individuals with weakened immune systems or underlying health conditions. According to the World Health Organization, pneumonia is the single largest infectious cause of death in children worldwide, accounting for 14% of all deaths of children under 5 years old in 2019.

Types of Pneumonia

Pneumonia is categorized based on how and where it is acquired, as well as the causative agents.

Bacterial Pneumonia

Bacterial pneumonia is one of the most common and potentially serious forms of pneumonia. It occurs when bacteria enter the lungs and cause inflammation in the air sacs, which then fill with fluid or pus. The most frequent culprit is *Streptococcus pneumoniae*, which is responsible for the majority of community-acquired bacterial pneumonia cases. Other bacteria such as *Haemophilus influenzae*, *Staphylococcus aureus* (including MRSA strains), *Klebsiella pneumoniae*, and *Pseudomonas*

aeruginosa are also known to cause bacterial pneumonia, particularly in hospital settings or in people with weakened immune systems.

Viral Pneumonia

Viral pneumonia is caused by viruses that infect the respiratory tract and eventually spread to the lungs, causing inflammation in the alveoli. Common viruses include influenza virus, respiratory syncytial virus (RSV), adenovirus, parainfluenza virus, and more recently, SARS-CoV-2, the virus responsible for COVID-19. Unlike bacterial pneumonia, viral pneumonia typically starts with flu-like symptoms such as fever, cough, fatigue, and muscle aches, and may later progress to include shortness of breath and chest discomfort. Children, the elderly, and people with underlying conditions are more likely to develop severe viral pneumonia. While mild cases often resolve without specific antiviral treatment, severe infections like influenza or COVID-19 may require antiviral medications such as oseltamivir (Tamiflu) or remdesivir, as well as supportive care.

Fungal Pneumonia

Fungal pneumonia is less common but can be serious, especially in people with weakened immune systems, such as those undergoing chemotherapy, transplant recipients, or individuals with HIV/AIDS. It occurs when fungal spores are inhaled and cause infection in the lungs. *Histoplasma capsulatum*, *Coccidioides immitis*, and *Blastomyces dermatitidis* are examples of fungi that can cause pneumonia, often in specific geographic regions. For instance, *Histoplasma* is more prevalent in the Ohio and Mississippi River valleys. *Aspergillus* species can cause a severe type of fungal pneumonia known as invasive aspergillosis, especially in immunocompromised patients.

Mycoplasma Pneumonia

Mycoplasma pneumoniae, sometimes referred to as "walking pneumonia," is caused by the bacterium *Mycoplasma pneumoniae*. Unlike other bacteria, *Mycoplasma* lacks a cell wall, which makes it resistant to antibiotics like penicillin that target cell wall synthesis. This form of pneumonia is usually milder and more common in children, teenagers, and young adults. Symptoms may develop gradually and include a dry cough, sore throat, fatigue, low-grade fever, and sometimes headache or ear pain. Despite being bacterial, it behaves somewhat like a viral infection and can spread through respiratory droplets in close-contact settings like schools or military barracks.

Community-Acquired Pneumonia (CAP)

This type occurs outside of healthcare settings and is the most common form. It can result from bacterial infections like *Streptococcus pneumoniae*, viral infections such as the influenza virus, or other pathogens.

Hospital-Acquired Pneumonia (HAP)

HAP develops at least 48 hours after a patient has been admitted to a hospital. It is often more severe due to the presence of antibiotic-resistant bacteria and the patient's existing health conditions.

Ventilator-Associated Pneumonia (VAP)

A subset of HAP, VAP occurs in individuals using mechanical ventilators for breathing assistance. The risk increases the longer a person is on ventilation.

Aspiration Pneumonia

This form results from inhaling food, liquid, or vomit into the lungs, leading to infection. It is more common in individuals with swallowing difficulties or impaired consciousness.

Causes of Pneumonia

Pneumonia can develop when the immune system is compromised or when harmful microorganisms enter the lungs. Several risk factors increase a person's chances of developing the infection. Age is a major factor, with infants, young children, and adults over 65 being particularly vulnerable. People with chronic conditions such as asthma, chronic obstructive pulmonary disease (COPD), diabetes, or heart disease are also at higher risk. Smoking weakens the lungs' natural defense mechanisms, making it easier for infections to take hold. A weakened immune system due to conditions like HIV, cancer, or immunosuppressive treatments such as chemotherapy also raises the risk. Hospitalization, particularly in intensive care units or when using a ventilator, increases the chances of exposure to antibiotic-resistant bacteria. Poor nutrition, alcohol use disorder, and difficulty swallowing that leads to aspiration can also contribute. The underlying cause of pneumonia varies and may be bacterial, viral, or fungal in origin, with *Streptococcus pneumoniae*, influenza virus, and respiratory syncytial virus (RSV) being among the most common pathogens.

Symptoms of Pneumonia

Pneumonia symptoms often begin suddenly but can vary based on age, the cause of infection, and overall health. Common signs include a persistent cough, which may bring up mucus or phlegm, along with a high fever and chills. People often experience chest pain that worsens with deep breathing or coughing, shortness of breath, and fatigue. Muscle aches, headache, and general malaise are also frequently reported. In some cases, there may be nausea, vomiting, or diarrhea. Older adults and individuals with compromised immune systems may have more subtle symptoms such as confusion, a lower-than-normal body

temperature, or weakness. In young children, pneumonia may cause rapid breathing, poor feeding, or unusual sleepiness. The intensity of symptoms can range from mild to severe, and it's important to seek medical attention if breathing becomes difficult or symptoms worsen over time.

Stages of Pneumonia

Pneumonia typically progresses through four stages, each reflecting changes in the lungs and the body's immune response.

Congestion

The first stage is congestion, where the lungs fill with fluid and inflammatory cells begin to respond to the infection. This stage is marked by coughing, fatigue, and early respiratory symptoms.

Red hepatization

The second stage is red hepatization, where blood and immune cells flood the lungs' air sacs, giving the lung tissue a firm, reddish appearance and further impairing oxygen exchange.

Gray hepatization

In the third stage, known as gray hepatization, red blood cells break down, and the lungs take on a grayish color as inflammation continues.

Resolution

The final stage is resolution, during which the immune system clears the infection, and lung function gradually returns to normal. The length and intensity of each stage can vary, especially in individuals with underlying health conditions or weakened immune defenses.

Pathophysiology of Pneumonia

Pneumonia begins when infectious agents such as bacteria, viruses, or fungi bypass the upper respiratory defenses and reach the alveoli, the tiny air sacs in the lungs where gas exchange occurs. Once inside, these pathogens trigger an immune response that leads to inflammation. White blood cells and fluid accumulate in the alveoli, disrupting the normal transfer of oxygen into the blood and the removal of carbon dioxide. This fluid buildup causes symptoms such as difficulty breathing, coughing, and chest discomfort. In addition to local inflammation, the body may respond with a systemic reaction, including fever and increased heart rate. The severity of pneumonia depends on the type of pathogen, the strength of the individual's immune response, and the presence of any underlying health problems. In severe cases, the widespread inflammation can impair oxygen delivery to tissues, potentially leading to respiratory failure or sepsis.

Diagnosis of Pneumonia

Diagnosing pneumonia involves a combination of clinical assessment, imaging, and laboratory testing. Healthcare providers begin by taking a thorough history of the patient's symptoms, including the onset, duration, and severity. During the physical exam, they may listen to the lungs with a stethoscope for abnormal sounds such as crackles or reduced breath sounds. A chest X-ray is commonly used to confirm the presence of infection and assess the location and extent of lung involvement. Blood tests can show elevated white blood cell counts or markers of inflammation, suggesting the presence of infection. In some cases, a sputum sample is collected to identify the specific pathogen causing pneumonia, which helps guide treatment. Pulse oximetry or arterial blood gas testing may be used to check how well oxygen is being delivered to the

body. In severe or unclear cases, advanced imaging like CT scans or procedures such as bronchoscopy may be required to obtain a more detailed evaluation.

Complications of Pneumonia

Pneumonia can lead to several complications, especially if not diagnosed or treated early. One of the most common is pleural effusion, where fluid builds up in the space between the lungs and the chest wall. If this fluid becomes infected, it can lead to empyema, which may require drainage. Another complication is bacteremia, when the infection enters the bloodstream, potentially leading to septic shock, a life-threatening condition. Lung abscesses can also occur, where pus forms inside cavities in the lung tissue. In some cases, the infection can cause acute respiratory distress syndrome (ARDS), making breathing extremely difficult and often requiring mechanical ventilation. People with weakened immune systems or preexisting lung or heart disease are more vulnerable to these complications.

Treatment of Pneumonia

Treatment depends on the type and severity of pneumonia, as well as the patient's age, general health, and the cause of the infection. For bacterial pneumonia, antibiotics such as amoxicillin, azithromycin, or levofloxacin (Levaquin) are typically prescribed. The exact choice of antibiotic may vary based on local resistance patterns and the suspected pathogen. Viral pneumonia, including cases caused by influenza or respiratory syncytial virus (RSV), may not require specific antiviral medication and often resolves on its own with supportive care. However, if pneumonia is caused by the influenza virus, oseltamivir (Tamiflu) may be prescribed. For COVID-19-related pneumonia, treatments may include antivirals like remdesivir or corticosteroids such as dexamethasone in hospitalized patients. Fungal

pneumonia, which is less common, is treated with antifungal medications.

Supportive care plays a vital role. This includes rest, hydration, and medications to control fever and pain. In more severe cases, hospitalization may be necessary for intravenous antibiotics, oxygen therapy, or breathing support. Patients with chronic illnesses may need adjustments to existing medications to support recovery. Smoking cessation is strongly advised, as smoking impairs lung function and can delay healing. Follow-up chest X-rays may be done after treatment to ensure full recovery, especially in patients who experienced severe symptoms or complications.

Vaccination to Prevent Pneumonia

Preventing pneumonia involves a combination of vaccines, healthy habits, and avoiding known risk factors. Vaccines are highly effective in reducing the risk of certain types of pneumonia. The pneumococcal vaccine protects against *Streptococcus pneumoniae*, a common cause of bacterial pneumonia. Two versions exist: the pneumococcal conjugate vaccine (PCV13 or Prevnar 13) and the pneumococcal polysaccharide vaccine (PPSV23 or Pneumovax 23). The influenza vaccine, given annually, helps prevent viral infections that can lead to pneumonia, especially in older adults, children, and people with chronic illnesses. The COVID-19 vaccine also reduces the risk of severe pneumonia caused by SARS-CoV-2.

Good hygiene, including regular handwashing and covering the mouth when coughing or sneezing, helps reduce the spread of respiratory infections.

Prognosis of Pneumonia

The prognosis for pneumonia varies widely depending on age, general health, the cause of pneumonia, and how quickly treatment begins. Most healthy adults with mild community-acquired pneumonia recover within one to three weeks with appropriate treatment. In contrast, older adults or those with chronic illnesses may take longer to recover and are at higher risk for complications. Hospital-acquired pneumonia generally has a more serious outlook due to resistant bacteria and the often weakened state of hospitalized patients. Ventilator-associated pneumonia is one of the most difficult forms to treat and has a higher mortality rate.

When properly treated in time, the majority of pneumonia cases resolve without lasting effects. However, for individuals who experience severe pneumonia or complications, long-term lung function may be affected. Survivors of severe pneumonia may experience fatigue, breathlessness, or reduced exercise capacity for several weeks or months. Recovery is generally slower in people with chronic respiratory conditions or compromised immune systems.

Living with Pneumonia

Living with pneumonia, especially during the recovery phase, requires careful attention to rest, hydration, and gradual return to normal activities. It is important to complete the entire course of prescribed antibiotics, even if symptoms improve early, to ensure the infection is fully cleared. Adequate fluid intake helps loosen mucus in the lungs, while rest supports immune function. Breathing exercises recommended by healthcare providers can help expand the lungs and speed up recovery. Eating a balanced

diet rich in vitamins and protein supports tissue repair and immune health.

Patients recovering from severe pneumonia may benefit from pulmonary rehabilitation, especially if their breathing remains affected. In older adults, pneumonia may take a toll on overall energy levels and mobility, so a slow and steady approach to regaining strength is recommended. Monitoring for signs of complications, such as persistent cough, fever, or chest pain, is essential. If these symptoms occur after the initial recovery, a follow-up with a healthcare provider is necessary. Emotional health should not be overlooked, as prolonged illness may lead to anxiety or depression. Family members and caregivers play an important role in offering support and monitoring the patient's well-being during the recovery period.

Conclusion

Pneumonia is a serious but treatable infection that affects the lungs and can impact people of all ages. It can range from mild to life-threatening, especially in vulnerable populations such as young children, the elderly, and those with weakened immune systems or chronic diseases. Understanding the symptoms, causes, types, and progression of pneumonia is key to early diagnosis and effective treatment. With the right medical care, supportive measures, and preventive strategies such as vaccination and good hygiene, most people recover fully.

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