

Pneumonia

Pneumonia is a broad term that refers to inflammation of the lung and is therefore considered a lower respiratory tract infection. It can be caused by infection by bacteria, viruses, and fungi. The air sacs may fill with fluid or pus, leading to difficulty breathing. Pneumonia can be life-threatening to anyone, but is especially dangerous for infants, children, and people over 65. Risk factors that predispose one to colonization and infection of the lower respiratory tract include loss of the cough reflex, damage to the ciliated epithelium that lines the respiratory tract, and impaired immune defenses.

Pneumonia can be classified as typical or atypical:

Typical pneumonia is usually caused by a bacterial infection that multiplies in the extracellular fluid of alveoli and bronchi and causes inflammation and exudation of fluid into the normally air-filled space. Typical pneumonia often involves the sudden onset of fever, chills, pleuritic chest pain, and a productive cough. Measures of inflammation like erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and total leukocyte counts are generally raised. Typical pneumonia tends to consolidate in a lobe rather than spreading out through the whole lung, so radiographs will show lobar or segmental opacity. The ventilation/perfusion ratio (V/Q) will decrease as air is replaced with fluid and pulmonary consolidation occurs.

Atypical pneumonia is caused by a viral or mycoplasma bacterial infection that invades the alveolar septum and the interstitial tissue of the lung. Viral pneumonia makes up about a third to half of pneumonia infections depending on the data source and when it was collected. Some viruses that are particularly known for causing atypical pneumonia include SARS, MERS, swine flu, and coronavirus (COVID19). These all represented a novel virus to the human population after it jumped species from animal to human. Be aware that atypical pneumonia due to a virus does not respond to antibiotics. Atypical pneumonia does not create the same degree of fever, chills, and productive cough as typical pneumonia. In fact, there may be relatively little sputum with a cough. Atypical pneumonia is sometimes called “walking pneumonia” because individuals may not feel quite as sick as they would with typical pneumonia. Even though the symptoms of viral pneumonia are generally more mild than bacterial pneumonia, viral pneumonia caused by the influenza virus is still the eighth leading cause of death in the United States. Viral pneumonia can be particularly lethal in the very young or elderly, or in individuals who have immunocompromised lungs. The pneumonia in these individuals can lead to an acute inflammation that is severe and this may lead to acute respiratory failure. Measures of inflammation like ESR, CRP and leukocyte count in atypical pneumonia are only slightly raised if they are raised at all. V/Q ratio mismatch is not as likely in atypical pneumonia. Radiographs may show segmental or lobar opacity, but it is not as common as with typical pneumonia. Instead, it is more common to find diffuse, patchy shadows on the film. Pneumonia that causes these diffuse patchy shadows on the x-ray images rather than consolidation of an entire lobe is often called bronchopneumonia, which refers to inflamed bronchi spread widely through a lung. Patchy areas of opacity can also be seen with interstitial pneumonia which involves inflammation of the interstitial tissue of the lung and is more often caused by viral infections.

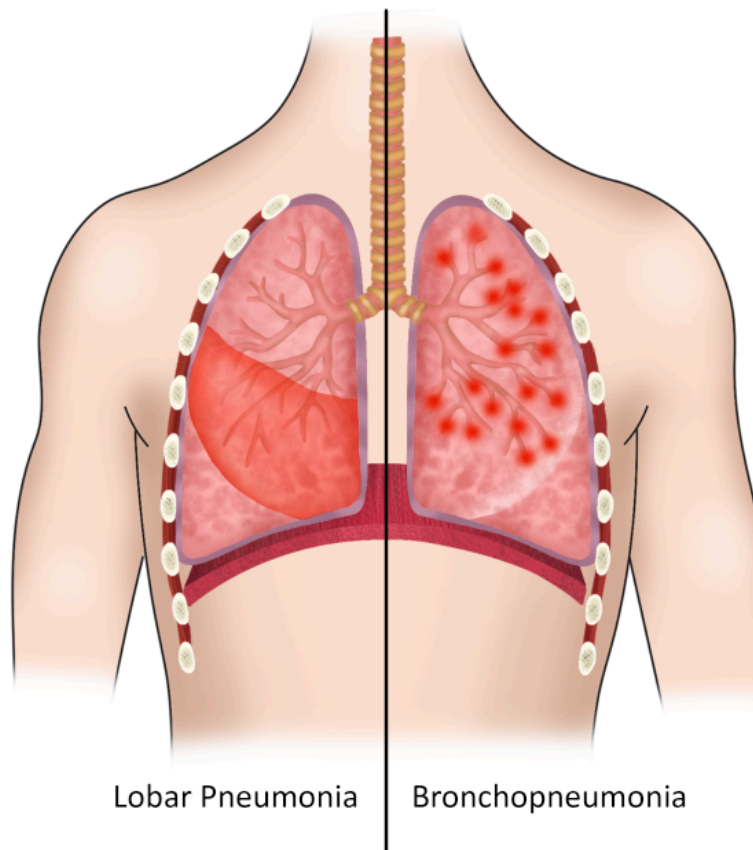


Image by Becky T. BYU-I S20

Pneumonia may also be described based on how it was acquired. **Community acquired pneumonia** is most commonly contracted as part of normal daily activities in the community. This type of pneumonia is most commonly caused by *H. influenza*, *S. aureus*, and gram-negative bacilli. Because these are bacterial species, community acquired pneumonia is frequently a “typical” type of pneumonia. **Hospital acquired (or nosocomial) pneumonia** is defined as a lower respiratory tract infection that was not present or incubating on admission to the hospital, but developed while the patient was in the hospital. People who have intubation, mechanical ventilation, weakened immune systems, and chronic lung disease are particularly at risk for developing nosocomial pneumonia. The most common agents for hospital acquired pneumonia are gram-negative rods and *S. aureus* also leading to typical pneumonia symptoms. One particularly frightening nosocomial infection is methicillin resistant *Staphylococcus aureus*, otherwise known as MRSA. This species of bacteria has obtained a genetic mutation that makes it resistant to several drugs used in the past to treat *S. aureus* infections. MRSA started as a nosocomial infection but has quickly spread outside of hospitals and is now fairly common in the community. Mostly, this pathogen is manifested as skin lesions, but it can also infect the lung and cause pneumonia.

Streptococcus pneumoniae

Watch this video on [Bacterial Pneumonia - Pathogenesis](#)

Streptococcus pneumoniae (or **pneumococcal pneumonia**) is a type of bacterial pneumonia that we would like to take the time to explain in greater detail. *Streptococcus pneumoniae* is the most common etiological agent for bacterial pneumonia and has roughly 90 serotypes.

The pathogenesis of bacterial pneumonia is as follows. Once the bacteria have entered the lungs, they are phagocytosed by dust cells (resident macrophages of the lungs) which then release inflammatory mediators like IL-1 and TNF-alpha. These mediators trigger an immune response leading to endothelial retraction and also increase the

gaps between the epithelial cells (type 1 pneumocytes) of the alveoli. These changes allow protein and fluid to enter the alveoli which thickens the respiratory membrane and diminishes respiration. Additionally, leukocytes (macrophages and neutrophils) migrate into the alveoli creating a more purulent exudate which contributes to the lung consolidation (normal air-filled spaces become filled with a thick fluid) observed by x-ray.

Pathogenesis of Bacterial Pneumonia

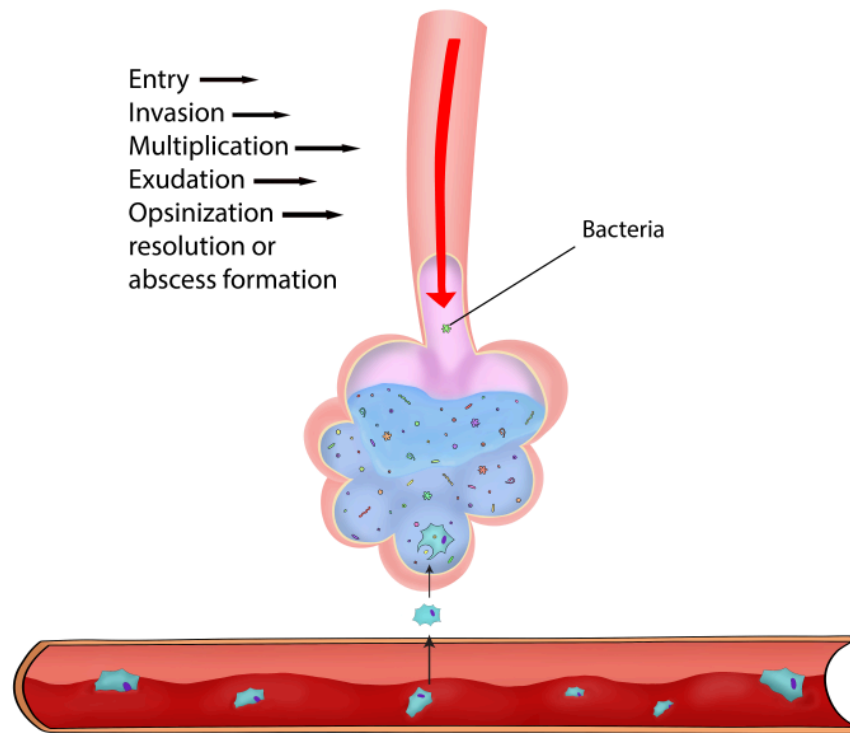


Image by Becky Torgerson BYUI S18

Common signs and symptoms of pneumococcal pneumonia include sudden onset with malaise, severe shaking, chills, and fever. Treatment includes the use of antibiotics that are effective against *S. pneumoniae*. There are vaccine options for prevention of pneumococcal pneumonia. The pneumococcal conjugate vaccine (PCV13) is used mostly for children and those older than 50 with immune problems. The pneumococcal polysaccharide vaccine (PPSV23) is used for 65 and older and those 2 years and older who are at high risk for disease. Pneumococcal vaccination is not recommended for healthy adults under the age of 65. However, vaccination is recommended for all adults over the age of 65, all individuals who have had their spleen removed, individuals who have chronic lung disease, and those who are immunocompromised. It is also recommended for individuals who have had any history of CSF leakage. Individuals who have cochlear implants are at risk of leaking CSF as the implant creates a possible structural conduit between blood and CSF.

The risk for developing complications from pneumococcal pneumonia is greater for asplenic individuals. *Streptococcus pneumoniae* has a polysaccharide capsule that makes it resistant to antibody coating and opsonization, which tends to decrease phagocytosis. The spleen normally helps to overcome the phagocytic-resistant adaptations of the pneumococcal bacteria because of its high concentration of phagocytes and ability to filter the blood as it moves slowly through the reticular fibers. Without the spleen, the liver may not be able to compensate for this function and bacteremia with sepsis could result.



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