

A systematic review of the etiology, clinical features, and management of pneumonia in children: Implications for clinical practice, and public health

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ABSTRACT:

Pneumonia is a common illness that continues to pose a significant health challenge worldwide. It known as common Inflammatory condition of alveoli or air sacs and the nearby tissues. It often leads to a spontaneous high fever, the feeling that you are very unwell, a cough and shortness of breath. Pneumonia is one of the most common causes of death worldwide. The word pneumonia is rooted in the ancient Greek word *pneumon* ("lung"). Therefore, pneumonia can be understood as "lung disease." Clinically, it manifests as an inflammation of the parenchyma and alveolar spaces in 1 or both lungs, primarily attributed to infections, though not exclusively. Among the infectious causes of pneumonia, bacteria, viruses, fungi, and parasites are prominent. Bacterial pneumonia has a significant impact on the overall morbidity and mortality rates of those with pneumonia. Various classification methods exist for organizing pneumonia, with the National Institutes of Health (NIH) system being the most widely embraced. This system categorizes pneumonia into community-acquired, hospital-acquired, and atypical pneumonia, further stratified based on severity. Continued research and a deeper understanding of the pathophysiology of pneumonia are critical for developing targeted treatments and improving patient outcomes. As such, this article aims to delve into the diagnostic approaches for pneumonia, highlighting the clinical evaluations, laboratory tests, imaging studies, Treatment and other methodologies employed in its identification.

Keywords: *Pneumonia, Epidemiology, Infection, Diagnosis, Treatment.*

INTRODUCTION:

EPIDEMIOLOGY OF PNEUMONIA:

According to World health organization report 2022, Pneumonia is the single largest infectious cause of death in children worldwide. Pneumonia killed 740 180 children under the age of 5 in 2019, accounting for 14% of all deaths of children under 5 years old but 22% of all deaths in children aged 1 to 5 years. Pneumonia affects children and families everywhere, but deaths are highest in southern Asia and sub-Saharan Africa. Children can be protected from pneumonia, it can be prevented with simple interventions, and it can be treated with low-cost, low-tech medication and care. Pneumonia killed more than 808 000 children under the age of 5 in 2017, accounting for 15% of all deaths of children under 5 years. People at-risk for pneumonia also include adults over the age of 65 and people with preexisting health problems.

According to UNICEF in every 43 seconds one child dies due pneumonia. Pneumonia is the common infectious disease for children, with over 700,000

deaths among those under five Every year, around 2,000 per day. approximately 190,000 newborns. Most of these fatalities are preventable. Globally, pneumonia affects over 1,400 out of every 100,000 children each year, which translates to 1 case per 71 children. The highest rates of incidence are seen in South Asia, with 2,500 cases per 100,000 children, and in West and Central Africa, with 1,620 cases per 100,000 children. A research study indicate that mortality rates differ among racial and ethnic groups. For instance, a study of 30 of the largest cities in the U.S. revealed that Black individuals had a 16% higher mortality rate from influenza and pneumonia compared to white individuals.

Kazakhstan's Department of Sanitary and Epidemiological Control reported a significant rise in pneumonia cases for the first half of 2024, with 49,704 incidents. This marks a 19.2% increase compared to the same period in 2023, which saw 40,144 cases. Last year, the total number of pneumonia cases reached 123,910.

RISK FACTORS OF PNEUMONIA:

As per National heart, lung and blood institution main risk factor's are in pneumonia are age, Medical condition, Life style and environment.

Age: Children- risk is higher for premature babies Due to their under developing immune systems. Newborn and 1year old babies are at high at risk rather than 5-year-old kids. **Adults-** The risk of pneumonia increases significantly for those aged 65 and older, with the risk becoming higher as age advances. An 80-year-old is at a greater risk compared to a 65-year-old.

Medical Conditions:

Medical and health Conditions that suppress immune system and chronic diseases are play important role in risk of pneumonia such as, acquired immunodeficiency syndrome/ *Human immuno deficiency virus* infection, organs and Bone marrow transplant, pregnancy. chemotherapy and consumption of steroid medications, Diabetes which suppress the immune system.

Asthma, cystic fibrosis, Chronic obstructive pulmonary disease (COPD), such lung diseases also responsible to increase the pneumonia risk.

Other Medical condition or disease that impair swallowing or coughing can significantly increase the risk of pneumonia. This issue arises when food, saliva, or liquids mistakenly enter the lungs via windpipe instead of the esophagus. such as Parkinson's Disease, dementia and head injury.

Life style and habits:

Smoking is a significant risk factor for pneumonia because nicotine and other harmful chemicals in tobacco make it difficult to clear mucus from your airways. This can lead to increased chances of infection.

Consumption of Excessive alcohol also increases risk of pneumonia through reduce immune system function

Environment:

Exposure with the sick peoples with respiratory infection can greatly increase risk of acquire pneumonia. The bacteria and viruses that cause pneumonia can easily spread through the air when an infected person coughs or sneezes.

According to WHO (2022), air pollution in House /industries are environmental risk factors of pneumonia developing countries.

TYPES OF PNEUMONIA:

Pneumonia has over 30 known causes, which can be classified based on what triggers the illness. on the base on different criteria Pneumonia can be classified in such categories.

By causes:

Bacterial pneumonia- This type is caused by various bacteria. The most common are *Streptococcus pneumoniae*, *Staphylococcus aureus*, Group A *Streptococcus*, *Klebsiella pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, anaerobes, and gram-negative organisms.

Weakness due to weak immune system, age, poor health, causes spread of infection **bacteria from throat inters into lungs.** [Ada's knowledge team, 2024]

Viral Pneumonia: As per American lung association it Caused by viruses, like influenza or respiratory syncytial virus (RSV).

Fungal Pneumonia: it is mainly Caused by fungi such as *Cryptococcus*, *Histoplasmosis* and *Coccidioidomycosis*, which are often found in soil or bird droppings and infect respiratory system.

Aspiration Pneumonia: Aspiration pneumonia happens when food, liquid, or even vomit gets inhaled into the lungs instead of being properly swallowed into the stomach. This can lead to inflammation and infection in the lungs as a result.

By Place of Acquisition:

Community-Acquired Pneumonia (CAP): Contracted outside of healthcare environments.

Hospital-Acquired Pneumonia (HAP): Developed during a hospital stay.

Healthcare-Associated Pneumonia (HCAP): Picked up in settings like nursing homes.

Ventilator-Associated Pneumonia (VAP): Occurs in patients using ventilators.

On the basis of severity:

Mild Pneumonia: Requires minimal treatment, often manageable at home. **Moderate Pneumonia:** Might necessitate hospitalization and intensive care.

Severe Pneumonia: Demands urgent medical attention, typically in an ICU.

By Lung Region Affected: Lobar Pneumonia: Impacts a significant, continuous area of one lung lobe.

Bronchopneumonia: Affects scattered areas in both lungs. **Interstitial Pneumonia:** Involves the spaces between the alveoli.

SYMPTOMS OF PNEUMONIA:

The symptoms of pneumonia can vary greatly depending on the cause and the individual affected.

- 1. Bacterial Pneumonia's symptoms: as per American lung association symptoms include** Cough: Can be dry or produce phlegm, High Fever: Often accompanied by chills. (up to 105 F or 40.55 C), Shortness of Breath: May occur during normal activities or even while resting. Chest Pain: Sharp or stabbing pain that worsens with deep breaths or coughing. Fatigue: A general feeling of tiredness or weakness. Sweating and Shaking Chills: Due to the body's response to infection. Nausea and vomiting, especially in small children. Confusion- especially in older people

- 2. Viral Pneumonia-** Dry cough, Muscle Pain, Weakness, Head ache

Groups: Symptoms in different age groups:

Babies and Young Children- Rapid or noisy breathing. Difficulty feeding or loss of

appetite. Unusually tired or less active. Vomiting, restlessness, or difficulty drinking.

Older Adults: high fever, confusion or delirium, slight cough or difficulty breathing.

PATHOGENESIS:

The lung serves as a habitat for a diverse microbiome rather than being a sterile environment. This normal lung microbiome includes various bacterial species that can significantly influence the onset of pneumonia, such as *Streptococcus spp.* and *Mycoplasma spp.* (Beck et al., 2015). Typically, these microorganisms are controlled by the pulmonary host defenses. However, when these defenses are compromised, externally introduced pathogenic microorganisms can proliferate, displacing the normal flora. This can also facilitate the overgrowth of certain resident flora, ultimately leading to infection. There is a growing interest in understanding the role of antecedent viral respiratory tract infections, as they can act as catalysts for disrupting the normal lung microbiome. Consequently, bacterial pathogens may seize the opportunity to establish themselves more readily (Branger J. et al., 2004).

Pathogenic bacteria possess various virulence factors that enable them to evade host immune responses. For example, *Streptococcus pneumoniae* uses polysaccharide capsules, *Mycoplasma pneumoniae* has adhesion proteins, and *Legionella pneumophila* utilizes pili associated with biofilm formation (Sattar SBA et al., 2024).

Upon bacterial invasion, alveolar macrophages initiate host inflammatory responses to limit bacterial spread within the human host. These inflammatory responses are the primary drivers of the clinical manifestations observed in bacterial pneumonia. Cytokines are released in response to the inflammatory reaction, triggering a cascade that results in constitutional symptoms. For instance, interleukin-1 (IL-1) and tumor necrosis factor (TNF) are associated with fever, a common symptom of bacterial pneumonia (Montón C. et al., 1998).

Chemokine-like interleukin-8 (IL-8) and colony-stimulating factors such as granulocyte colony-stimulating factor (G-CSF) promote chemotaxis and neutrophil maturation, leading to leukocytosis. Other cytokines, including interleukin-9 (IL-9) and interleukin-13 (IL-13), enhance mucin production, resulting in purulent secretions that aid in bacterial inactivation (J Xiang et al., 2008; Sattar SBA et al., 2024).

Proinflammatory cytokines cause leakage of the alveolar-capillary membrane at the site of inflammation, aiding the migration of host leukocytes to the area of bacterial infection in the lungs. This leakage can impair gas exchange and contribute to fibrosis, reducing lung compliance and causing progressive and severe dyspnea (J Dellamonica et al., 2011).

DIAGNOSIS OF PNEUMONIA:

Clinical Evaluation:

Clinical evaluation is a crucial first step in the diagnosis of pneumonia. It involves a detailed assessment of the patient's medical history, presenting symptoms, and a thorough physical examination. This evaluation helps clinicians identify the presence of pneumonia and guide further diagnostic testing and treatment. The diagnostic process begins with a thorough clinical evaluation, where healthcare providers assess the patient's medical history and symptoms such as cough, fever, shortness of breath, and chest pain. Physical examination includes listening for abnormal lung sounds like crackles or rales, indicating fluid in the lungs.

Medical History:

The clinical evaluation begins with obtaining a comprehensive medical history, which includes:

Symptom Onset and Duration: Understanding when the symptoms started and how they have progressed over time. **Previous Respiratory Infections:** History of recent respiratory illnesses or infections.

Exposure to Infected Individuals: Information about potential exposure to individuals with respiratory infections. **Risk Factors:** Identifying underlying conditions such as chronic obstructive pulmonary disease (COPD), asthma, diabetes, immunosuppression, or smoking history that may predispose the patient to pneumonia.

Presenting Symptoms: Patients with pneumonia typically present with the following symptoms:

Cough: Often productive, producing sputum that may be green, yellow, or bloody. **Fever:** Elevated body temperature, often accompanied by chills. **Shortness of Breath:** Difficulty breathing or rapid breathing. **Chest Pain:** Pleuritic chest pain that worsens with deep breathing or coughing. **Fatigue:** General feeling of tiredness or weakness. **Malaise:** General discomfort and feeling unwell.

Physical Examination: A thorough physical examination focuses on evaluating the respiratory system. Key components include:

Inspection: Observing the patient's overall appearance, including signs of respiratory distress such as rapid breathing, use of accessory muscles, and cyanosis (bluish coloration of the skin due to lack of oxygen). **Palpation:** Checking for tactile fremitus, which is the palpable vibration felt on the chest wall when the patient speaks. Increased fremitus may indicate lung consolidation. **Percussion:** Tapping on the chest to detect areas of dullness, which may suggest fluid or consolidation in the lungs.

Auscultation: Listening to the lungs with a stethoscope to detect abnormal lung sounds such as: **Crackles (Rales):** Crackling sounds indicating fluid in the alveoli. **Wheezing:** High-pitched sounds due to narrowed airways. **Decreased Breath Sounds:**

Reduced or absent breath sounds over affected areas. **Bronchial Breath Sounds:** Abnormal breath sounds heard over areas of consolidation. **Whispered Pectoriloquy:** Increased clarity of whispered words heard through the stethoscope over consolidated areas. Vital Signs: **Temperature:** Fever is a common finding. **Respiratory Rate:** Tachypnea (increased respiratory rate) may be present. **Heart Rate:** Tachycardia (elevated heart rate) can occur in response to infection. **Blood Pressure:** Hypotension (low blood pressure) may be seen in severe cases. **Oxygen Saturation:** Measured using pulse oximetry, which may show reduced oxygen levels in the blood.

Laboratory tests: are such as **Complete Blood Count (CBC):** Elevated white blood cell counts indicate an infection. **Blood Cultures:** Identify the causative pathogen, particularly in severe cases. **Sputum Culture and Gram Stain:** Help identify bacterial pathogens and their antibiotic sensitivities. **ABG:** Arterial blood gas analysis can identify hypoxia and respiratory acidosis. Severe hypoxia is indicated by pulse oximetry readings below 92%, and an elevated CRP level suggests a severe infection. Arterial blood gas analysis and biomarker evaluation, such as CRP levels, are crucial in diagnosing and managing pneumonia. These tools help clinicians assess the severity of the condition, monitor respiratory function, and make informed treatment decisions.

Imaging studies: Imaging studies are crucial for confirming the diagnosis:

Chest X-ray: The most common imaging study, revealing areas of lung consolidation as white patches.

Computed Tomography (CT) Scan: Provides a more detailed view of the lungs, useful in complex cases.

Microbiological Testing: Microbiological tests identify specific pathogens: **Polymerase Chain Reaction (PCR):** Detects genetic material of pathogens from respiratory samples. **Urine Antigen Tests:** Useful for detecting bacteria like *Legionella pneumophila* and *Streptococcus pneumoniae*. Biomarker Analysis: Biomarkers aid in distinguishing bacterial infections:

Procalcitonin: Elevated levels indicate bacterial infection, distinguishing it from other causes. **C-Reactive Protein (CRP):** Rises in response to inflammation and infection.

TREATMENT OF PNEUMONIA:

Pneumonia treatment depends on the type of pneumonia (bacterial, viral, or fungal), the severity of the infection, and the patient's overall health. The primary goals are to cure the infection, relieve symptoms, and prevent complications.

Bacterial Pneumonia: Antibiotics: The choice of antibiotics for bacterial pneumonia depends on several factors, including the type of bacteria causing the infection, the patient's age, medical history, and local antibiotic resistance patterns. Here are some commonly used antibiotics for treating bacterial pneumonia: **Macrolides:** Azithromycin (Zithromax)

and Clarithromycin (Biaxin). **Tetracyclines:** Doxycycline. **Fluoroquinolones:** Levofloxacin (Levaquin). **Beta-lactams:** Amoxicillin or Amoxicillin/Clavulanate (Augmentin). Duration: It's crucial to complete the entire course of antibiotics, even if symptoms improve.

Viral Pneumonia: Treatment for viral pneumonia primarily focuses on supportive care and antiviral medications when appropriate. Here are some commonly used medications:

Antiviral Medications: **Oseltamivir (Tamiflu):** Used for influenza pneumonia. **Remdesivir:** Used for COVID-19 pneumonia. **Acyclovir:** Used for varicella (chickenpox) and herpes simplex pneumonia.

Ganciclovir: Used for CMV (Cytomegalovirus) pneumonia in immunocompromised patients.

Supportive Care: **Acetaminophen (Tylenol):** To reduce fever and relieve pain. **Ibuprofen (Advil, Motrin):** To reduce fever and inflammation. **Cough Suppressants:** To manage severe cough. **Oxygen Therapy:** For patients with severe respiratory symptoms.

Fungal Pneumonia: Fungal pneumonia is treated with antifungal medications, which target the specific fungi causing the infection. **Fluconazole (Diflucan):** Often used for infections caused by *Candida* species and *Cryptococcus neoformans*. **Voriconazole (Vfend):** Effective against *Aspergillus* species and other molds. **Itraconazole (Sporanox):** Used for various fungal infections, including *Histoplasma capsulatum*. **Amphotericin B:** Used for severe fungal infections, including *Pneumocystis jirovecii* pneumonia (PCP), especially in immunocompromised patients.

CONCLUSION:

Pneumonia is a significant global health concern due to its high morbidity and mortality rates. Understanding the various etiologies, including bacterial, viral, and fungal pneumonia, is critical for accurate diagnosis and effective treatment. The cornerstone of bacterial pneumonia treatment involves antibiotic therapy, with commonly used classes including macrolides, tetracyclines, fluoroquinolones, and beta-lactams.

Viral pneumonia requires antiviral medications and supportive care, while antifungal agents are necessary to treat fungal pneumonia. Advancements in diagnostic techniques, including laboratory tests, imaging studies, and biomarker analysis, are crucial for identifying the causative pathogen and determining the severity of the infection. Furthermore, the development of new vaccines and updated treatment guidelines continue to play a pivotal role in reducing the burden of this disease.

Early detection, appropriate use of antibiotics, and comprehensive supportive care are essential to improve patient outcomes. Ongoing research and a deeper understanding of pneumonia's pathophysiology will contribute to more effective prevention, treatment, and management strategies in the future.

CONFLICT OF INTEREST: No

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