



# Community Acquired Pneumonia: Update in Pediatric Age Group

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## Abstract

Pneumonia is the leading infectious and preventable cause of death in under five children. It can be caused by viruses, bacteria or fungi. It can be prevented by immunization, adequate nutrition and improving environmental factors. Its incidence can be reduced by simple interventions, and treated with low-cost, low-tech medication and care including antibiotics for bacterial cause and other symptomatic relief.

**Keywords:** Community Acquired Pneumonia (CAP); Underfive Children; Amoxicillin; Amoxicillin plus Clavulanic acid

## Introduction

Infectious diseases remain a leading cause of underfive deaths. Lower respiratory infections (18.7%), diarrhea (15.7%), malaria (15.8%) comprise the leading causes of under-five deaths globally among children aged 1 to 59 mo [1]. India accounted for 783,314 under five deaths in 2020 with mortality rate of 33 deaths per 1000 live births [2]. Killing more than 14 children every hour of pneumonia, 126,535 children in 2018 [3].

Pneumonia is classified as [4]

1. Community acquired pneumonia (CAP) – acquired outside the hospital environment in a previously healthy immune competent subject. The patient should not have been hospitalized within 14 days prior to the onset of symptoms.
2. Nosocomial pneumonia - pneumonia acquired within hospital setting more than 48 hours after hospitalization [hospital-acquired pneumonia (HAP)] or more than 48 to 72 hours after endotracheal intubation [ventilator associated pneumonia (VAP)].
3. Recurrent Pneumonia – two episodes of pneumonia in 1 year or 3 episodes in any time frame.
4. Aspiration Pneumonia – due to aspiration of foreign materials in the lower airways.

## Etiology

The pneumonia is caused by several microorganisms including bacteria, virus, mycoplasma and fungi [5]. The etiology of pneumonia differs age wise. Pneumonia in less than 3 mo is commonly caused by gram negative bacteria. Between 3 mo of age to 5 y of age, besides viruses, the common bacterial organisms are gram positive organisms like streptococcus pneumonia (most common), Haemophilus influenzae (in up to 2 y of age), Staphylococcus aureus (relatively less common). For more than 5 years, common organisms are Streptococcus pneumonia, Mycoplasma pneumonia and Staphylococcus aureus. Cause of pneumonia in immunocompromised children especially those living with HIV is commonly Pneumocystis jiroveci [6-8]. In India, Respiratory syncytial virus (24.1%) is the most common pathogens identified from children with CAP and among bacterial causes S. pneumoniae is most common organism (5.7%) followed by M. pneumoniae (4.3%) and H. influenzae (0.8%) [9].

## Pathology [10-12]:

Different organisms show different pathologic patterns of lung involvement. Viral infection can occur in three pathologic patterns as bronchiolitis, interstitial pneumonia, and parenchymal infection. Its characteristic features are neutrophilic infiltration in the lumen of the airway with lymphocytic infiltration of the interstitial and parenchyma of the lungs. Histologically, giant cell formation and viral inclusion within the nucleus of the respiratory cells leads to injury of the respiratory epithelium in form of

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swelling, abnormal secretion and cellular debris which results in air trapping due to obstructed or obliterated small airways and thickened septa, causing ventilation-perfusion mismatch ultimately leading to atelectasis, interstitial edema, and hypoxemia. Bacterial infection can occur in five pathologic patterns as lobar pneumonia (e.g., *S. pneumoniae*); bronchopneumonia (e.g., *S. pyogenes* and *S. pneumoniae*); necrotizing parenchymal pneumonia (e.g., *S. aureus* and *S. pneumoniae*); caseating granulomatous disease (e.g., *M. tuberculosis*); and peri-bronchial and interstitial disease with secondary parenchymal infiltration, which usually occurs when viral pneumonia is complicated by bacterial infection.

Lobar pneumonia can be differentiated from bronchopneumonia as former show parenchymal infection, inflammation, and consolidation of a lobe or a segment of a lobe whereas later show primary infection of the airways and surrounding interstitium.

### Clinical features [7,13,14]

Symptoms of viral and bacterial pneumonia are similar. However, viral pneumonia may have more numerous symptoms than bacterial. Symptoms of pneumonia include fever, tachypnea (WHO defines tachypnea according to age as: <2 mo: >60 breaths/min; 2 to 12 mo: >50 breaths/min; >1 to 5 y: >40 breaths/min; ≥5 y: >20 breaths/min), lower chest wall indrawing (retractions), nasal flaring and use of accessory muscles. Severely ill child may have cyanosis, poor feeding, unable to drink, vomiting, unconsciousness, hypothermia and convulsions.

Signs of pneumonia include rhonchi, scattered crackles, and diminished breath sounds. Other signs may also be present like wheezing (more common in viral infections), abdomen distention (from swallowed air), abdomen pain (common in lower lobe pneumonia), liver seemed enlarged (as of downward displacement).

### Risk factors

Most healthy children can fight the infection with their natural defences but there are factors that affect incidence in the community in developing countries. They can be divided as definite, likely or possible causes [15]. Definite causes include lack of immunization (especially diphtheria, pertussis, pneumonia, measles, polio, BCG, influenza), malnutrition, low birth weight ( $\leq 2500$ gm), non-exclusive breastfeeding (during the first 4 months of life), air pollution, and crowding. Likely or possible causes may include parental smoking, zinc deficiency, mother's experience as a care giver and education, concomitant diseases (e.g., diarrhea, heart disease, asthma), and vitamin A deficiency,

### Complications [7,13]

Include pleural effusion and empyema, lung abscess, bronchopleural fistula, necrotizing pneumonia, acute respiratory distress syndrome (ARDS), extrapulmonary infection (meningitis, arthritis, pericarditis, osteomyelitis, and endocarditis), hemolytic uremic syndrome, and sepsis.

### Diagnosis

The diagnosis of pneumonia can be made by proper history and physical examination. The clinical setting and the severity of the illness define the diagnostic approach. The diagnosis of pneumonia is considered in infants and children who present with respiratory complaints viz cough, tachypnea, retractions, and abnormal lung examination in community practice in doubt diagnosis can be confirmed on chest radiographs or lung ultrasonography [16]. The peripheral white blood cell (WBC) count can differentiate viral from bacterial pneumonia i.e. in viral pneumonia it is normal or elevated ( $<20,000/\text{mm}^3$ ) with a lymphocyte predominance in contrast in bacterial pneumonia it is elevated ( $15,000\text{--}40,000/\text{mm}^3$ ) with a granulocyte predominance [7].

WHO (2014) recommend management of pneumonia by classifying into three categories:

- Category “no pneumonia” includes children with cough and cold,
- Category “pneumonia” include child with fast breathing and/or chest in-drawing and
- Category “severe pneumonia or very severe pneumonia” include children with general danger signs (not able to drink, persistent vomiting, convulsions, lethargic or unconscious, stridor in a calm child or severe malnutrition) along with fast breathing with or without chest retractions [14].

### Treatment

The WHO advise for children age 2-59 mo as observation for 5 d in home care under category “no pneumonia” and for category “pneumonia” domiciliary treatment including oral amoxicillin, at least  $40\text{mg}/\text{kg}/\text{dose}$  twice daily for 5 d with a follow up on 3rd d. Symptomatic relief include soothing the throat and relieving the cough with a safe remedy. If wheezing present (or disappeared after rapidly acting bronchodilator), give an inhaled bronchodilator for 5 d (if not available oral salbutamol may be tried). If coughing for more than 14 d or recurrent wheeze, refer for possible TB or asthma assessment. Advise mother about danger signs so as when to return immediately. Child failing the first-line treatment by 3rd d should be referred to facility equipped with appropriate second line treatment i.e. parenteral. In areas with low HIV prevalence treatment is given for 3 d, if chest in drawing is not present. Similarly, child with category “severe pneumonia” is treated with parenteral ampicillin ( $50\text{mg}/\text{kg}$ ), or

benzyl penicillin (50,000 units/kg) IM/IV every 6 h and gentamicin (7.5 mg/kg IM/IV once a day) for at least 5 d as first line drugs. Ceftriaxone should be used as second line drug. In HIV-infected and -exposed infants and children with chest in drawing or severe pneumonia, the first line is ampicillin/penicillin plus gentamicin or ceftriaxone, whereas second line is ceftriaxone alone. For suspected *Pneumocystis jiroveci* pneumonia (PCP) aged from 2 mo up to 1y additional cotrimoxazole should be given empirically [14]. There are other alternative antibiotics like co-amoxiclav, cefpodoxime, cefaclor, erythromycin, azithromycin, clarithromycin, chloramphenicol and levofloxacin can be used for pneumonia [17]. In a recent study conducted at tertiary care centre double-blind randomized controlled trial compared cure rate with 5 d oral amoxicillin vs amoxicillin plus clavulanic acid in children aged 6 to 36 mo with CAP, presenting with the clinical features consistent with the diagnosis of CAP. Patients were given oral Amoxicillin or Amoxicillin plus Clavulanic Acid for 5 d and followed at 48h, 5th d and 2 mo. The cure rate of CAP in amoxicillin plus clavulanic acid group was significantly higher as compared to amoxicillin group (93.88% vs 79.17%, p 0.013). The chances of cure rate increased by 15.3% for children receiving oral amoxicillin plus clavulanic acid. Only mild side effects like diarrhea (22.1%), nausea (9.6%), vomiting (5.7%), and maculo-papular rash (2.9%) were found in both groups. All the cured children were followed up to 2 mo and none of the children had recurrence. These findings suggest that amoxicillin plus clavulanic acid be used in the WHO treatment plan for community acquired pneumonia.

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