# Epidemiology of community acquired pneumonia

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## Abstract

Despite efforts in prevention worldwide including recent advances in vaccine therapy, childhood community acquired pneumonia (CAP) remains a major cause of morbidity and mortality both in the developed and the developing world.

Traditionally, qualifying the aetiology of CAP proved to be fraught with challenges particularly due to low yields from blood and sputum specimens. In recent years however, new advances in techniques such as enzyme-linked immunosorbent assay and polymerase chain reaction have dramatically improved detection rates of both bacteria and viruses. In addition to qualifying the true burden of disease by known organisms such as *Streptococcus pneumoniae* it has led to the identification of organisms such as human bocavirus which have not previously been associated with CAP.

This article aims to provide a brief update to the clinician on the current epidemiology of CAP in this post-vaccination era. It is based on a combination of recommendations from existing clinical practice guidelines, recent systematic reviews and the current literature.

**Keywords** children; community acquired pneumonia; epidemiology; guidelines; infection; prevalence

## Definition

Childhood community acquired pneumonia (CAP) can be defined as an infection affecting an individual under the age of 16 years whose lungs are inflicted by a spectrum of pathogens acquired outside a hospital setting. This subsequently results in inflammation of the affected lung tissue. Clinically, it can be defined as the presence of signs and symptoms of pneumonia such as fever, tachypnoea and cough in a previously well child. In young children these symptoms may be non-specific.

Currently in spite of the limitations in its accuracy, chest X-rays remain the mainstay for diagnosis of childhood CAP. Radiographic findings of consolidation are typically used to verify the diagnosis in developed countries. This is not absolute, as good clinical assessment may precipitate empirical treatment for CAP with no further investigations. In the developing world, with difficulties in obtaining an X-ray, more emphasis is placed on clinical assessment.

Whilst the inclusion of a responsible pathogen is ideal in the definition of CAP, current techniques have yet to obtain sufficient sensitivity to detect all relevant organisms. Consequently, a significant proportion of cases have no pathogen identified, findings mirrored in many prospective epidemiological studies involving numerous specimen types such as blood and sputum. This raises assumptions and poses challenges on adopting an evidence-based approach to managing CAP, in particular on appropriate antibiotic and/or antiviral use. Resultantly, measurements such as blood white cell count and C - reactive protein are utilized as proxies to guide us on the nature and severity of the infection. Whilst these are regarded as useful measurements they do not necessarily allow us to direct our treatment towards specific pathogens. This commonly results in viral pneumonia being treated unnecessarily with antibiotics. This stratifies a clear need for better diagnostic methods.

## Background

In spite of recent advances in vaccination therapies, environmental modification and treatment of underlying diseases that have been promoted extensively over the past decade, childhood CAP continues to be attributable to significant morbidity and mortality worldwide. CAP affects up to 450 million people a year in all regions of the world. Disproportionally, childhood CAP affects up to 156 million children per year and leads up to 4 million deaths per year.

CAP has continued to be estimated as the leading single cause of childhood mortality in the world with recent data suggesting that the number of children with severe CAP is increasing worldwide. Difficulties continue to persist in producing evidence-based estimates, due in part to the absence of a simple investigation that has full accuracy to identify all children with CAP, variances in CAP case definition, the low specificity of verbal autopsies in CAP, similarity in clinical picture between pneumonia and malaria, difficulties in differentiation between CAP and neonatal sepsis and diagnosis based on clinical assessment and no verification by chest X-rays (Figure 1).

Whilst no country is spared from the morbidity and mortality of CAP, disproportionally 95% of these episodes occur in developing countries (Figure 1). It remains the leading cause of death amongst children in low-income countries with just 15 countries of the world accounting for 74% (115.3 million episodes) of these episodes. Currently, more than half of the world's annual new CAP cases are concentrated in India (43 million), China (21 million), Pakistan (10 million), Bangladesh, Indonesia and Nigeria (6 million each).

CAP is attributable to a combination of exposure to risk factors related to the host, the environment and the resulting infection (Table 1). Some risk factors such as parental smoking are common to both developed and developing countries whilst others such as malnutrition and lack of immunizations which are specific to developing countries have exacerbated the disparity in the worldwide burden of CAP.

Though the incidence of CAP varies widely amongst developing countries, developed regions such as North America and Europe share similar incidence figures. For example, the annual incidence of CAP in children under 5 years of age in North America is 34–40

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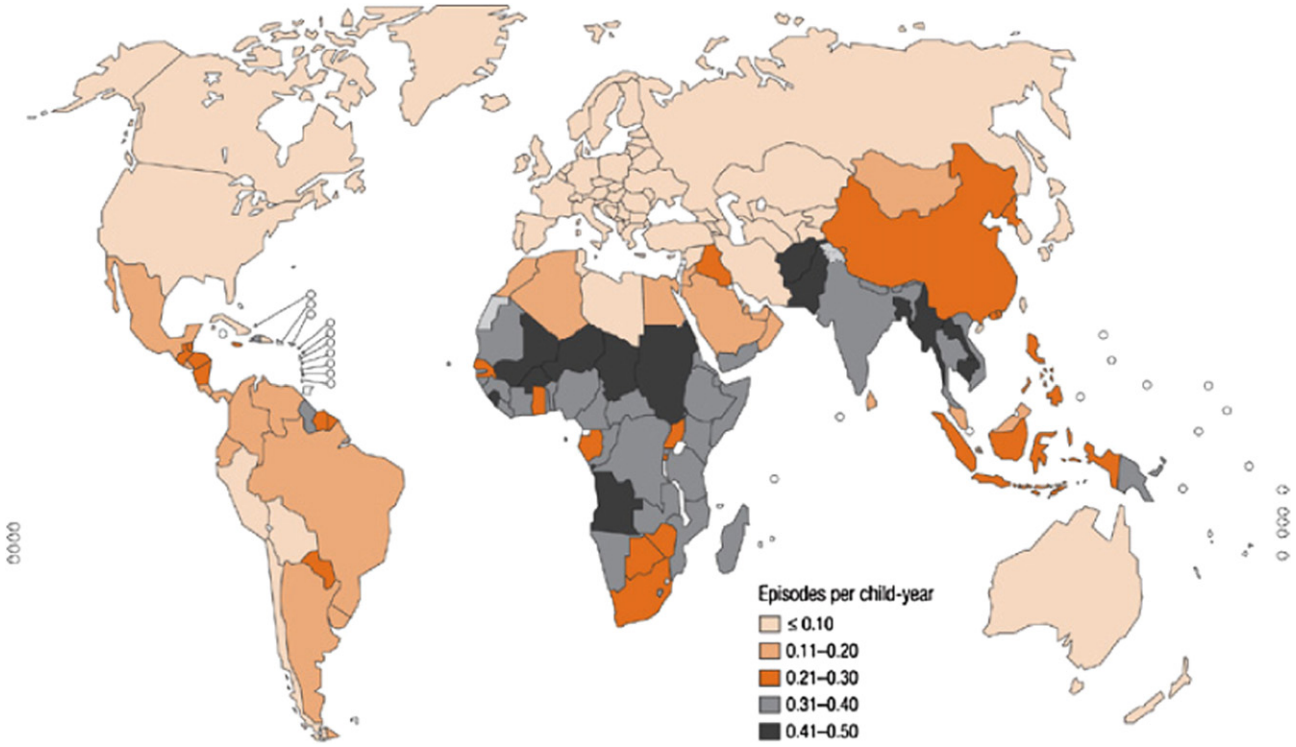


**Figure 1** Incidence of childhood clinical pneumonia at the country level.
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**Risk factors related to the host and the environment that affects incidence of childhood clinical pneumonia in the community**

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|---|---|
| Definite | Malnutrition |
| | Low-birth-weight |
| | Non-exclusive breastfeeding (during the first 4 months of life) |
| | Lack of measles immunization (within the first 12 months of life) |
| | Indoor air pollution |
| | Crowding |
| Likely | Parental smoking |
| | Zinc deficiency |
| | Mother's experience as a caregiver |
| | Concomitant diseases (e.g. diarrhoea, heart disease, asthma) |
| Possible | Mother's education |
| | Day-care attendance |
| | Rainfall (humidity) |
| | High altitude (cold air) |
| | Vitamin A deficiency |
| | Birth order |
| | Outdoor air pollution |

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**Table 1**

cases per 1000 per year. This strongly correlates with the incidence in Europe, where in Finland the incidence is 36 cases per 1000 children per year. In the United Kingdom (UK), the incidence figures are lower at 1.44 cases per 1000 per year in children over 1 year of age. Whilst our incidence may seem small in comparison to Europe and North America, note that these rates are derived from a regional hospital-based audit excluding children under 1 year of age and those treated in the community where a significant proportion of cases may lie but where data is more difficult to collect.

CAP continues to be seen commonly in children younger than 5 years of age. To illustrate, in Finland the incidence falls from 36 to 16.2 cases per 1000 per year in children older than 5 years of age. Worldwide, CAP is attributable to 28–34% of all deaths in children in this age group. The World Health Organization estimates that one in three newborn infant deaths occur due to pneumonia. Alongside this, other risk factors for long term morbidity and mortality from CAP include prematurity, low-birth-weight, immunocompromised children and those known to have underlying conditions such as cystic fibrosis, congenital heart disease and asthma. Incidentally, previous upper respiratory tract infections (URTIs) are also independently associated with childhood CAP with a strong correlation of an increasing number of URTIs leading to a rise in CAP episodes, possibly due to higher infection susceptibility.

## Aetiology

CAP is caused by a wide variety of organisms both bacterial and viral. Due to the absence of accurate, fast and widely available affordable diagnostic tools, the identification of the causative