**Pediatric Pulmonology**

### **Acute Bronchiolitis**

#### **Overview**

Acute bronchiolitis is an acute viral infection of the lower respiratory tract that primarily affects infants and young children under 24 months of age. It is characterized by **inflammation**, **edema**, **increased mucus production**, and **necrosis** of the epithelial cells lining the small airways (bronchioles), leading to **airway obstruction** and **respiratory distress**. The most common causative agent is **respiratory syncytial virus (RSV)**, responsible for the majority of cases worldwide, especially during seasonal epidemics in winter months (December to February in the northern hemisphere, May to July in the southern hemisphere). Other viruses such as **rhinovirus**, **adenovirus**, **human metapneumovirus**, and **parainfluenza virus** can also cause bronchiolitis. Bronchiolitis is a significant cause of infant morbidity globally, with approximately **150 million new cases** reported worldwide annually. Around **2-3% of affected infants** require hospitalization due to **respiratory distress** or complications.

#### **Epidemiology of Acute Bronchiolitis**

##### **Global Burden and Incidence**

Acute bronchiolitis stands as one of the most significant respiratory illnesses affecting infants and young children worldwide. Each year, it accounts for approximately **150 million new cases** globally, with a substantial proportion occurring in low- and middle-income countries where access to healthcare may be limited. Hospitalization rates are highest among infants under **12 months**, particularly those between **2 and 6 months** of age, reflecting both the vulnerability of this age group and the severity of the disease during early infancy.

##### **Age and Population Distribution**

The disease predominantly affects children under **two years of age**, with the highest incidence seen in infants younger than **six months**. Age is a critical factor: younger infants not only experience bronchiolitis more frequently but are also at greater risk for severe disease requiring hospitalization or intensive care. This age-related risk is closely tied to the **immaturity of the infant immune system** and the **small caliber of their airways**, which are more susceptible to obstruction from **inflammation** and **mucus**.

##### **Seasonality and Geographic Variation**

Bronchiolitis exhibits marked seasonality, with peak incidence during the winter months in temperate climates—typically from **November to March** in the northern hemisphere and **May to July** in the southern hemisphere. This pattern closely mirrors the seasonal circulation of **respiratory syncytial virus (RSV)**, the primary causative agent. In tropical regions, the seasonality may be less pronounced or may correspond with **rainy periods**, highlighting the influence of environmental factors on viral transmission.

##### **Causative Agents and Viral Epidemiology**

**RSV** is responsible for up to **70–80% of bronchiolitis cases** during peak season, but other viruses—including **rhinovirus**, **human metapneumovirus**, **parainfluenza**, **adenovirus**, and **influenza**—also contribute, sometimes as co-infections. The predominance of **RSV** is important epidemiologically, as it drives the timing and magnitude of annual outbreaks, influences the risk of severe disease, and shapes prevention strategies such as the use of **monoclonal antibodies** in high-risk infants.

##### **Risk Factors and Vulnerable Populations**

Several factors increase the risk of both acquiring bronchiolitis and developing severe disease:

* **Prematurity**: Infants born before **37 weeks gestation** have less developed lungs and immune defenses, making them especially vulnerable.
* **Chronic lung disease**: Conditions like **bronchopulmonary dysplasia** amplify susceptibility and severity.
* **Congenital heart disease**: Children with underlying cardiac anomalies are at higher risk for complications.
* **Immunodeficiency**: Both primary and secondary immunodeficiencies heighten the risk of severe infection and poor outcomes.
* **Environmental exposures**: **Passive tobacco smoke exposure**, **crowded living conditions**, and **attendance at daycare** increase both incidence and severity by facilitating viral transmission and impairing airway defenses. The interplay between these risk factors is crucial. For example, a premature infant exposed to tobacco smoke faces a compounded risk due to both intrinsic lung immaturity and extrinsic airway irritation. Socioeconomic status also plays a role, with children in **lower-income settings** experiencing higher rates of both infection and hospitalization, partly due to increased exposure and reduced access to preventive care.

##### **Hospitalization and Outcomes**

Hospital admission rates for bronchiolitis vary by region and population, but in developed countries, about **2–3% of all infants** with bronchiolitis require hospitalization. Of those admitted, a small but significant fraction may need **intensive care**, particularly those with underlying health conditions or very young age. Mortality from bronchiolitis is rare in high-resource settings but remains a concern in areas with limited healthcare access, where supportive interventions may not be readily available.

##### **Long-Term Epidemiological Implications**

There is growing recognition that severe bronchiolitis in infancy, especially when caused by **RSV**, is associated with an increased risk of **recurrent wheezing** and the development of **asthma** later in childhood. This relationship suggests that the epidemiology of bronchiolitis has implications that extend beyond the acute illness, influencing the long-term respiratory health of affected children.