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INCIDENCE, RISK FACTORS, ETIOLOGY, AND ANTIBIOTIC THERAPY OF PNEUMONIA: A GLOBAL AND REGIONAL REVIEW

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Abstract: Background; Pneumonia remains a leading cause of morbidity and mortality worldwide, particularly affecting children under five years and older adults. The burden is disproportionately higher in low- and middle-income countries, especially in South Asia and Central Asia.

Objective; This review summarizes global and regional pneumonia epidemiology, key risk factors, bacterial etiology, and current antibiotic treatment approaches, with emphasis on South Asia and Central Asia.

Methods; A narrative review was conducted using published global reports and peer-reviewed literature to synthesize evidence on pneumonia burden, causative organisms, and management strategies.

Results; Pneumonia accounts for a significant proportion of global infectious deaths, with highest incidence in LMICs. Major risk factors include malnutrition, lack of immunization, indoor air pollution, overcrowding, and chronic comorbidities. Common bacterial pathogens include Streptococcus pneumoniae, Haemophilus influenzae, Staphylococcus aureus, and Gram-negative bacilli. In South and Central Asia, disease burden is compounded by delayed healthcare access and rising antimicrobial resistance. Standard treatment includes amoxicillin for children and macrolides or beta-lactams for adults, though resistance is increasingly limiting effectiveness.

Conclusion; Pneumonia remains a major preventable global health problem. Strengthening vaccination coverage, addressing modifiable risk factors, and ensuring rational antibiotic use are essential to reduce disease burden, particularly in South Asia and Central Asia.

Keywords; Pneumonia; Epidemiology; Risk factors; Bacterial infections; Antibiotic therapy

Introduction

Pneumonia is a severe respiratory infection affecting the lung parenchyma and remains a major global public health concern. It contributes substantially to morbidity and mortality across all age groups, particularly among children under five years and older adults in low- and middle-income countries (LMICs), where access to healthcare is often limited[1]. The burden is further exacerbated by socioeconomic disparities, delayed healthcare access, and inadequate preventive strategies. Pathophysiologically, pneumonia develops when infectious agents overcome host defense mechanisms, resulting in inflammation and consolidation of lung tissue. Clinically, pneumonia is classified into community-acquired pneumonia (CAP), hospital-acquired pneumonia (HAP), and ventilator-associated pneumonia (VAP), each differing in microbial etiology and clinical outcomes.

The disease burden is compounded by factors such as malnutrition, indoor air pollution, lack of immunization, and comorbid conditions including chronic respiratory diseases, diabetes, and immunosuppression[2,3]. In addition to health consequences, pneumonia imposes a significant economic burden due to hospitalization costs, productivity loss, and long-term complications.

Despite the availability of effective vaccines against Streptococcus pneumoniae and Haemophilus influenzae type b, pneumonia continues to cause preventable deaths, indicating gaps in vaccine coverage and healthcare delivery[4]. Emerging challenges such as antimicrobial

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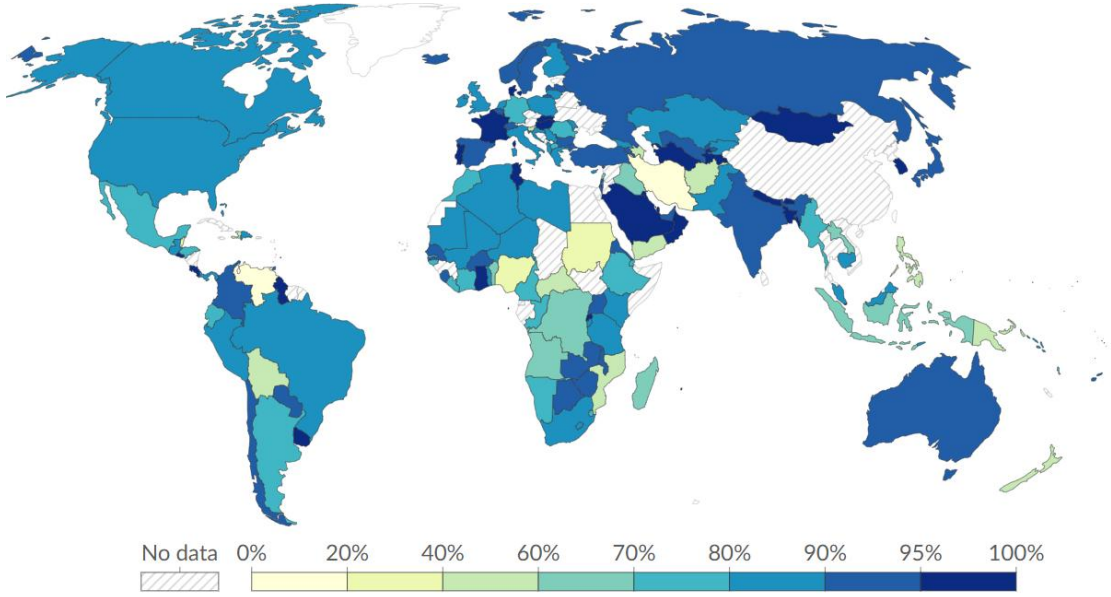
resistance and changing pathogen patterns further complicate management, particularly in South Asia and Central Asia[5].



Fig; Share of one-year-olds vaccinated against Streptococcus pneumoniae, 2024

Share of one-year-olds who have received the third dose of pneumococcal conjugate (PCV3).

This review aims to provide a comprehensive overview of pneumonia incidence globally and regionally, along with an analysis of risk factors, bacterial etiology, and current antibiotic treatment strategies.

Pathophysiology of Pneumonia

Pneumonia occurs when pathogenic microorganisms overcome the host's respiratory defense mechanisms and invade the lower respiratory tract[27]. Normal defenses include mucociliary clearance, cough reflex, and immune responses. Once these are impaired, pathogens reach the alveoli and initiate infection[28].

Alveolar macrophages respond by releasing cytokines such as IL-1, IL-6, and TNF-α, leading to recruitment of neutrophils and inflammation[29]. Increased vascular permeability results in accumulation of protein-rich exudate within alveoli.

This exudate causes alveolar consolidation, impairing gas exchange and producing ventilation–perfusion mismatch and hypoxemia[30]. Severe cases may progress to systemic inflammation and sepsis[31].

Classically, pneumonia progresses through four stages[32]: congestion, red hepatization, gray hepatization, and resolution.

Flowchart: Pathophysiology of Pneumonia

Entry of Pathogen (Inhalation / Aspiration)
↓
Failure of Host Defenses
↓
Alveolar Colonization
↓
Macrophage Activation (IL-1, IL-6, TNF-α)
↓
Neutrophil Recruitment
↓
Inflammation & Exudate

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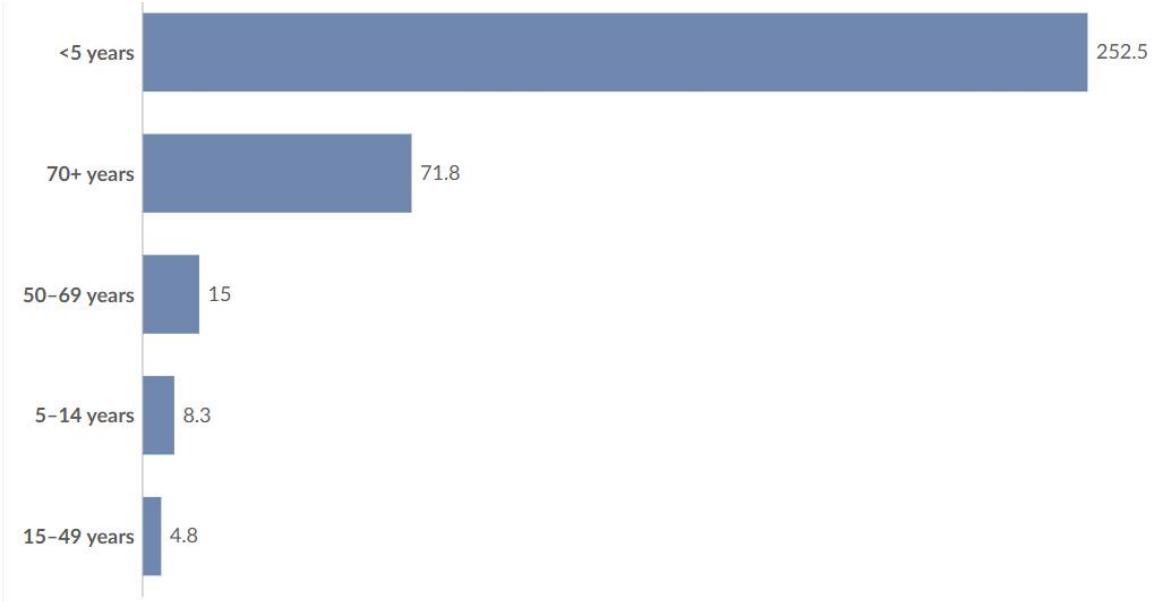
↓
Alveolar Consolidation
↓
V/Q Mismatch
↓
Hypoxemia ± Systemic Effects

Incidence of Pneumonia: Global Perspective

Globally, pneumonia accounts for approximately 14% of deaths among children under five years, resulting in an estimated 740,000 deaths annually[6]. The incidence in children is about 0.22 episodes per child per year[7]. Among adults aged ≥ 65 years, incidence and mortality increase significantly[8].

Incidence in South Asia and Central Asia

South Asia contributes nearly 40% of global childhood pneumonia cases[9]. Incidence ranges from 0.25–0.36 episodes per child annually[10]. Central Asian countries such as Uzbekistan and Kazakhstan also report high incidence rates linked to socioeconomic factors[11].



Fig; Death rate from pneumonia, by age, Uzbekistan, 2023

The estimated annual death rate from pneumonia and other lower respiratory tract infections per 100,000 people in each age group.

Risk Factors

- Undernutrition[12]
- Lack of exclusive breastfeeding[13]
- Indoor air pollution[14]
- Overcrowding[15]
- Comorbidities (e.g., HIV, chronic lung disease)[16]
- Incomplete immunization[17]
- Advanced age and chronic illness[18]

Bacterial Etiology

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- Streptococcus pneumoniae[19]
- Haemophilus influenzae type b[20]
- Staphylococcus aureus, Klebsiella pneumoniae[21]

Gram-negative organisms are more common in South and Central Asia[22].

Antibiotic Therapy

WHO recommends amoxicillin for childhood pneumonia[23]. Adult treatment includes macrolides, beta-lactams, or fluoroquinolones[24]. Antimicrobial resistance remains a major challenge[25], requiring stewardship programs[26]

Conclusion

Pneumonia remains a major global health concern, particularly in South and Central Asia. Addressing risk factors, improving vaccination, and ensuring rational antibiotic use are essential to reduce disease burden.

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