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Pneumococcal infection in adults: burden of disease

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Abstract

To overview the present global burden of pneumococcal disease is important because new preventive measures such as the pneumococcal conjugate vaccine 13 are currently being evaluated. Pneumococcal disease is roughly divided into non-invasive and invasive disease. The burden of non-invasive pneumococcal disease in adults is mainly determined by community-acquired pneumonia. Pneumococcal pneumonia has high incidence rates and carries a high mortality risk, especially in the elderly. Within the cluster of invasive pneumococcal diseases, pneumonia also represents the most common infectious source. Incidence and mortality rates of both non-invasive and invasive disease have changed as a result of pneumococcal vaccination in children. However, especially elderly patients with comorbidities remain vulnerable to morbidity and mortality caused by pneumococcal disease. The current review summarizes the current knowledge on the epidemiology including outcome of the main clinical forms of pneumococcal disease, with a special focus on elderly patients. Furthermore, the economic burden and future vaccine strategies are briefly discussed.

Keywords: Community-acquired pneumonia, disease burden, elderly, incidence, invasive pneumococcal disease, outcome, pneumococcal conjugate vaccine, pneumococcal pneumonia, *Streptococcus pneumoniae*

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Introduction

Pneumococcal disease (PD) can be divided into non-invasive and invasive disease (Fig. 1) [1]. Considering the global burden of PD is especially important, because new preventive measures such as the pneumococcal conjugate vaccine (PCV)13 are currently being evaluated. To assess future effects, we aim to give an extensive overview of the current burden of PD in adults. From that perspective, incidence and mortality rates are described in pneumococcal pneumonia (PP) and invasive pneumococcal disease (IPD). Effects of the introduction of PCV7 vaccination in children on these rates are also illustrated. Subsequently, because the PD burden is especially high in the elderly, this age group will be highlighted separately. Finally, the economic burden of PD is described and future vaccine strategies are briefly discussed.

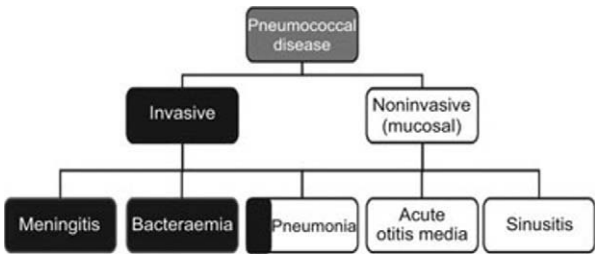

FIG. 1. Classification of pneumococcal disease [1].

Non-invasive Pneumococcal Disease

Non-invasive PD can principally be divided into sinusitis, acute otitis media and community-acquired pneumonia (CAP). As the burden of disease in adults is mainly determined by CAP, we will focus on CAP in this review.

Aetiology of CAP

In daily practice, a microbiological diagnosis is made in only about 20% of CAP. This can rise up to 60% when extensive and costly diagnostic testing is performed [2].

Aetiological fractions of the most common pathogens in CAP are summarized in Fig. 2 [3]. Accordingly, in a large European review, *Streptococcus pneumoniae* was the most frequently isolated pathogen in CAP (35% overall, ranging from 12 to 68% between various countries) [4]. This was true for all settings, including outpatients, hospital-treated patients and intensive care unit-treated patients [4]. Both European and worldwide meta-analyses generally confirmed these findings and estimated the prevalence of *S. pneumoniae* in CAP to be 19.3% and 27.3%, respectively. [5, 6]. A recent study specifically investigated CAP in outpatients and also found that *S. pneumoniae* was the most frequent pathogen (35.1% of cases with an established aetiological diagnosis) [7]. Similarly, *S. pneumoniae* was the most frequent pathogen causing CAP in younger patients (18–65 years) and patients with nursing-home-acquired-pneumonia [8,9].

In conclusion, *S. pneumoniae* is the most important pathogen in CAP in various different settings, indicating that epidemiological data on CAP in many cases mirror the situation in PP.

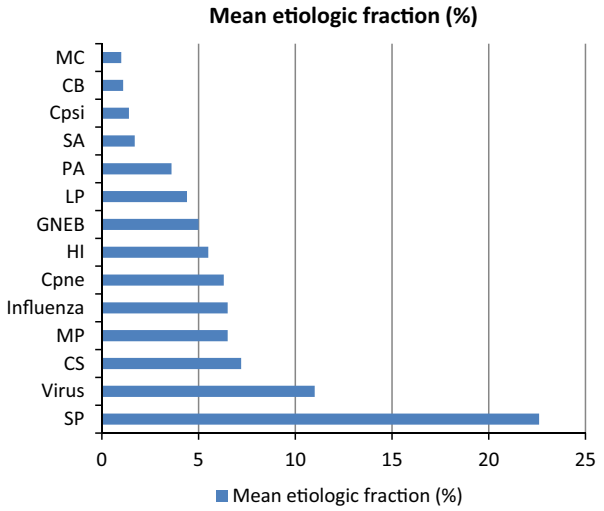

FIG. 2. Mean aetiological fraction of community-acquired pneumonia pathogens in adults admitted to the hospital. Abstracted and modified from European Respiratory Society guidelines on lower respiratory tract infections [3]. SP, *Streptococcus pneumoniae*; HI, *Haemophilus influenzae*; LP, *Legionella pneumophila*; MC, *Moraxella catarrhalis*; SA, *Staphylococcus aureus*; GNEB, Gram-negative enteric bacilli; PA, *Pseudomonas aeruginosa*; MP, *Mycoplasma pneumoniae*; CS, *Chlamydia* species (all); CPne, *Chlamydophila pneumoniae*; CPsi, *Chlamydophila psittaci*; CB, *Coxiella burnetii*.

Incidence of CAP

In Europe, incidence rates for CAP range from 1.6 per 1000 in Spain to 11.6 per 1000 in Finland [10,11]. Reports from England and Germany show intermediate rates (2.0 and 3.7–10.1 per 1000, respectively) [12,13]. It is not known whether these differences are related to study design or to actual differences between populations. In the USA, incidence rates for CAP requiring hospitalization were estimated to be 2.7 per 1000 in a large cohort [14]. Reliable data on incidence rates of CAP in other parts of the world are scarce. The few studies from the Asian-Pacific region report incidence rates from 0.2 to 0.9 per 1000, but these are probably underestimated [15].

Some recently published studies report an increase of hospital admissions due to CAP of about 30% in the last decade, suggesting that the annual incidence rates might have increased [12,16]. On the other hand, a study from the USA presented opposing findings, with the number of CAP hospitalizations declining by 54.8 per 100 000 annually after the initiation of PCV7 vaccination, leading to 168 000 fewer hospitalizations per year [17].

Outcome of CAP

In the USA, pneumonia was the eighth leading cause of death in 2004 and caused 1.3 million hospitalizations in 2005 [18].

Roughly, mortality rates can be divided into short-term (in-hospital or 30-day mortality) and longer-term mortality.

Short-term mortality. Risk factors for short-term mortality in CAP are shown in Table 1 [19–21]. In Europe, reported short-term mortality of CAP varied between <1% and 48% [4]. This great variability depends on multiple factors, including demographic differences, comorbid conditions, ambulatory versus hospitalized patients and time to follow up.

The mean short-term mortality in CAPNETZ, a large German competence network for CAP, was 8.6% (varying from 0.8% in outpatients to 12.2% in hospitalized patients)

TABLE 1. Risk factors for short-term mortality in community-acquired pneumonia (CAP) and invasive pneumococcal disease [19–21].

Community-acquired pneumonia	Invasive pneumococcal disease
Male gender	Male gender
Neoplastic disease	Solid malignancy
Neurological disease	Increasing age
Bacteraemia	Liver disease
Leucopenia	Renal disease
Multilobar infiltrate	Chronic pulmonary disease
Pleuritic chest pain	Higher Charlson Index
Hypothermia	Nursing home residence
Systolic hypotension	High acute physiology score
Tachypnoea	Mechanical ventilation
Diabetes mellitus	Alcohol abuse
	Smoking