



Pneumonia in Geriatric Patients: Focus on Etiology, Clinical Features, Diagnosis, and Prevention

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Abstract

Background: *Pneumonia remains a frequent respiratory disease that occurs in people of all ages; however, its impact is particularly significant in geriatric population. It leads to severe complications and increased mortality rates. The clinical features in the elderly may be atypical, thus causing difficulties in the diagnostic process and possible treatment delays.*

Aim of the study: *The study was designed to provide an overview of pneumonia, focusing on differences in the clinical picture, diagnosis, and prevention in the elderly.*

Material and Methods: *The article is based on 51 articles published between 2008 and 2023, found in electronic databases Google Scholar and PubMed.*

Results: *Age-related changes in immune and respiratory systems such as impaired cough reflex, reduced lung function, or lower immune cell production lead to increased susceptibility to infections. Comorbidities, including chronic obstructive pulmonary disease, diabetes mellitus, and heart diseases, increase the risk of pneumonia significantly. Radiographic examinations and laboratory tests are useful tools in differentiating pneumonia from other conditions. Vaccination is proven to perform a crucial role in pneumonia prevention.*

Conclusions: *This review synthesizes the existing knowledge of pneumonia in the elderly including epidemiology, risk factors, symptoms, and management. By enhancing the understanding of pneumonia in geriatric patients, healthcare professionals are able to improve diagnostic accuracy and tailor treatment strategies to reduce the burden of the disease.*

Key words: *pneumonia, streptococcus pneumoniae, vaccination, aged*

Introduction

The diverse clinical picture, presence of comorbidities, and often severe course of the disease make pneumonia in elderly patients a significant diagnostic and therapeutic problem. It is still the most frequent infectious cause of death in elderly patients [1, 2, 3].

The increased incidence of pneumonia among older patients is due to the physiological aging of the respiratory system and the presence of changes in the immune system. Changes in the respiratory system include decreased cough reflex, reduced chest wall mobility and lung compliance. Mucociliary clearance is also impaired, and thus the airway defense mechanism is disturbed [4, 5]. Pneumonia occurring in old age intensifies the impaired functioning of the respiratory system and consequently leads to respiratory failure [4].

It is estimated that about 45% of all episodes of community-acquired pneumonia (CAP) occur in patients over 65 years of age [5]. The incidence of CAP in this age group ranges from 8 to 18.2 cases per 1,000 people [4]. This discrepancy results from the geographic location, season of the year, used diagnostic criteria, studied population, and access to health care [3, 6]. Studies have shown that in the geriatric population, CAP is more common in men compared to women [7]. The need for hospitalization due to CAP is nine times higher in patients aged 65–79 and 25 times higher in patients over 80 years old than in patients aged 18–40 [4]. In Poland, in 2019, there were 215,700 cases of CAP in patients over 65 years of age, of which 38,200 required hospital treatment [8]. In the United States, in 2017, pneumonia together with influenza was the eighth cause of death among patients over 65 years of age, while according to the data of the Central Statistical Office in Poland in 2018, pneumonia in this age group was the fourth most common cause of death [8, 9]. In 2019, the number of deaths due to pneumonia among patients over 70 years of age was 264.7 per 100,000 people [10]. Mortality among older patients hospitalized for pneumonia is about 20%, rising to 50–70% when pneumonia develops in patients who are hospitalized for other diseases [2].

Identification of the etiological factor responsible for pneumonia in elderly patients is not always possible. The reason is the early introduction of antibiotic

therapy and the co-occurring disorders of consciousness and impaired expectoration, which make it difficult to collect sputum for microbiological examination. It is estimated that an adequate amount of sputum is obtained from less than 40% of geriatric patients [4, 11]. *Streptococcus pneumoniae* is the most frequently identified etiological agent responsible for CAP in the elderly. It has been shown that pneumococcal pneumonia is diagnosed in over 50% of CAP cases among patients over 65 years of age [1, 4]. The second pathogen often detected in this group of patients is *Hemophilus influenzae*, which is often found in patients with chronic obstructive pulmonary disease (COPD), followed by respiratory viruses such as coronavirus or influenza [4, 11]. Less frequently identified causative agent of CAP is *Moraxella catarrhalis* or methicillin-sensitive *Staphylococcus aureus* (MSSA), while *Mycoplasma pneumoniae* has been shown to be more common in younger age groups [1, 11]. Gram-negative bacteria such as *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, or *Burkholderia cepacia* are more likely to be responsible for cases of hospital-acquired pneumonia (HAP) [1]. Aspiration pneumonia is more often caused by several pathogens, both aerobic and anaerobic [2].

Aim of the Study

This study aims to summarize the current knowledge of pneumonia in geriatric population, concentrating on clinical features, diagnostic process and vaccination.

Material and Methods

The analysis is based on 51 publications available in the PubMed and Google Scholar databases, published between 2008 and 2023, concerning the etiology, clinical features, diagnosis, and prevention of pneumonia in elderly patients. Keywords such as "pneumonia", "elderly", "diagnosis", "etiology", "streptococcus pneumoniae", "vaccination" were used. The articles included original research papers and review articles. Official guidelines were also taken into consideration.

Risk Factors

Comorbidities such as lung diseases (especially COPD) and cardiovascular diseases, chronic liver diseases, and diabetes are among the factors that increase the risk of developing pneumonia in the elderly. It is estimated that the presence of comorbidities increases the risk of developing CAP by two to four times [8, 11]. Important risk factors are also immune disorders occurring in patients with asplenia, during immunosuppression, as well as in patients with spherocytosis, malignant tumors and chronic kidney diseases [8]. It has been proven that the risk factors for CAP are male sex, malnutrition, dehydration, staying in long-term care facilities, as well as air pollution, alcoholism, and smoking, both active and passive [4, 10, 11]. One study estimated that in 2019 active smoking contributed to 150,000 deaths due to pneumonia, while passive smoking contributed to 73,000 deaths in patients over 70 years of age [10]. There is also an increased risk of pneumonia when using antipsychotic or anticholinergic drugs [4]. Moreover, it has been shown that the use of inhaled and systemic corticosteroids, proton pump inhibitors, oral antihistamines (H1-blockers), and hypnotics, mainly benzodiazepines, predisposes to recurrent pneumonia [12, 13]. Risk factors for aspiration pneumonia in the elderly include male sex, long-term oxygen therapy, sputum suction, presence of a gastrostomy or nasogastric tube, prolonged supine position, swallowing disorders, dehydration, impaired consciousness, and the use of opioid drugs that reduce the cough reflex [14, 15]. An increased risk of aspiration pneumonia caused by anaerobic bacteria occurs in patients with dental caries or periodontal disease, as well as in the presence of disintegrating neoplastic lesions in the oral cavity or within the respiratory tract [14].

Changes in the Immune System in the Elderly

Aging involves many changes in the human body, including the immune system. There is a greater susceptibility to infections and their more severe course, more frequent occurrence or progression of autoimmune diseases, development of cancer or impaired response to vaccinations, as well as

impaired wound healing, or recurrence of latent infections such as shingles [16, 17, 18].

Physiological aging of the human immune system includes a slowdown in the production and reduction of the total number and quality of immune cells. An increase in the level of circulating pro-inflammatory cytokines (mainly IL-1b, IL-6, IL8, TNFa, IFNc, and CRP) is observed as well [3, 4]. Chronic pro-inflammatory state results in greater activation of induced cell death and contributes to the onset of many chronic age-related diseases [20, 21].

An analysis of morphology changes in the elderly compared to children and adults, in addition to white blood cells (WBC) total number decrease, showed that, regardless of gender, there is a significantly lower percentage of cytotoxic CD8 T lymphocytes (responsible for cell-mediated immunity) and a decrease in B lymphocytes (humoral immunity dependent on antibodies) [20]. B and T lymphocytes are components of adaptive immunity, dysfunction of which is the most common problem among the elderly [21]. The decrease in lymphopoiesis results firstly from the aging of hematopoietic stem cells, which no longer proliferate as intensively, and from changes in the levels of cell division regulators. Hormonal changes, such as a decrease in growth hormone and IGF-1 levels, may also contribute to lower production of immune cells. The ability to proliferate B-progenitor cells in the bone marrow and T-cell precursors in the thymus is also reduced [19]. Although, the exact mechanism of how aging of progenitor cells affects the division processes is not yet well understood. It is postulated that multifaceted changes at the cellular level include gradual shortening of telomeres, damage at the DNA level, weakened DNA repair mechanisms, and many different signaling pathways and their regulators [16, 17, 19].

The aging process affects not only hematopoietic or progenitor cells, but also mature cells of the immune system, impairing their quality [17, 19]. Despite the fact that the percentage of innate immune cells—neutrophils, monocytes/macrophages, NK cells, and dendritic cells—may increase with age, their function becomes impaired. This dysfunction includes defective activation, for example as a result of Toll-like receptors (TLRs) impairment. The TLRs expression is important for the response to, e.g., *Streptococcus pneumoniae*. Other

significant changes are abnormal migration, lower cytotoxicity, or reduced protection against apoptosis [18, 21].

The longer people live, the more and more different antigens they encounter. Thus, the body's immune system produces effector and memory cells from the so-called naive cells, which have a high proliferation capacity. Thanks to this, subsequent contact with the antigen evokes a quick and effective immune response. Exposure to many pathogens provides a diverse pool of memory cells. On the other hand, chronic stimulation to the same antigens can deplete the pool of naive immune cells, as a result T cell diversity decreases significantly. An increase in the number of memory T cells is believed to be a feature of aging [19]. Decreased production of naive T cells is also a result of thymic atrophy [18]. In addition, cytokine production and function of regulatory T cells are impaired [17, 19]. Moreover, B cells show impaired class recombination, as well as dysfunctions secondary to deficiencies and disorders in cytokine production by T cells [19]. Older people, therefore, produce significantly fewer antibodies with lower affinity to stimulation [18]. According to research, the metabolism of mature lymphocytes also changes. Aging lymphocytes are characterized by an increase in energy demand, which leads to chronic oxidative stress [17].

These disorders of the immune system are certainly one of the components of high mortality due to respiratory diseases such as pneumonia [21]. However, the identification of the processes responsible for the aging of the immune system is expected to provide valuable information for improving weakened immunity in seniors. Research shows that lifestyle changes that include physical activity, sleep, maintaining optimal nutrition, and even some pharmacological measures are effective strategies [18].

Symptoms of Pneumonia in the Elderly

Pneumonia in older people is characterized by a different course, which makes it a significant diagnostic problem. In the elderly, an oligosymptomatic course of pneumonia is common. Furthermore, the incidence of atypical symptoms increases while the incidence of typical symptoms decreases. Cough and dyspnea are common symptoms, but sometimes they are falsely considered

to be an exacerbation of a chronic disease [22]. Fever is rare, and sometimes a decreased body temperature is observed. Pneumonia in old age can be manifested by falls, functional impairment, weakness, loss of appetite, dehydration or exacerbation of chronic diseases, such as respiratory or cardiovascular diseases [22, 23]. Disorders of consciousness result from cerebral hypoxia associated with poorer lung ventilation, as well as disturbances in fluid and electrolyte balance. Consciousness disorders are characterized by abrupt onset, undulating course, disturbances in attention, thinking, consciousness, and activity. Delirium may present as delusions and agitation in the hyperactive form, or as drowsiness and hypoactivity in the hypoactive form. Sometimes, there is also a mixed form in which periods of excitation and decreased activity alternate [24]. In older age groups, pneumonia presents more often with tachypnea, while chills, increased sweating, headaches, and myalgia are more common symptoms in younger patients [22, 23, 25]. Due to the more frequent coexistence of other diseases, crackling sounds are a less specific symptom in the elderly. What is more, in the elderly, there may be no chest X-ray changes typical of pneumonia. In addition, leukocytosis is often absent in elderly patients [22]. It has been observed that the absence of leukocytosis is associated with a higher risk of death, while the level of CRP does not correlate with the severity of the disease [23]. The prevalence of pneumonia symptoms in different age groups is shown in Table 1 [22, 24].

Table 1. Comparison of symptom prevalence in different age groups

Symptom	Comparison of prevalence in different age groups
cough	slightly more common in younger age groups (90% of patients aged 18–44 vs 84% of patients aged ≥ 75)
dyspnea	slightly more common in younger age groups (75% vs 66%)
pleurodynia	more frequently reported in younger age groups, this may be due to the difficulty in describing the pain by elderly people, especially in patients with impaired consciousness
fever	more common in younger age groups (85% vs 53%)
disorder of consciousness	more common in older age groups
chills, excessive sweating	more common in younger age groups (85% vs 52% for chills, 83% vs 45% for excessive sweating)
muscle pain, headache	more common in younger age groups (72% vs 36% for muscle pain, 67% vs 25% for headache)
anorexia	more common in younger age groups (77% vs 64%)
tachypnea	tachypnea is common regardless of the patient's age
tachycardia	more common in younger age groups, this may be due to the use of beta-blockers and weakening of autonomic function in the elderly
auscultatory changes	crackling sounds are less specific in the elderly

Unless multidrug-resistant bacteria are implicated as pathogens of pneumonia in the elderly, the use of narrow-spectrum antibiotics is usually sufficient [26]. Empiric therapy should be implemented in patients with clinical features of pneumonia that are confirmed by radiological examination [27]. Antibiotic therapy should be selected depending on the medical history and physical examination as well as current recommendations [25]. It is also important to remember to adjust the dose of the drug to the patient's renal function and consider drug interactions [25, 27].

Patients with hypotension who require vasopressors and with respiratory failure who need mechanical ventilation should be admitted to the intensive care unit (ICU). In other patients, the American Thoracic Society/Infectious Diseases Society of America (ATS/IDSA) criteria should be used to qualify for ICU admission [27].

Table 2. Recommended treatment in relation to the clinical features

Clinical features	Recommended treatment
outpatient setting, patient with no comorbidities	amoxicillin/macrolides/doxycycline
outpatient setting, patient with comorbidities	combination therapy with beta-lactam+ macrolide, or monotherapy: respiratory fluoroquinolones
inpatients, no ICU admission	combination therapy: beta-lactam +macrolide, or monotherapy: respiratory fluoroquinolones
patients with ICU admission, no Pseudomonas or MRSA risk factors	beta-lactam+ macrolide/ beta-lactam+ respiratory fluoroquinolone
suspicion of empyema or lung abscess	beta-lactam or betalactamase inhibitor or combination therapy with cephalosporin+ clindamycin

The duration of antibiotic treatment should be based on the clinical stability of the patient. Antibiotic treatment should be discontinued after 5 days if the clinical stability criteria are met by the patient. Recommended treatment is presented in Table 2 [27].

In patients with pneumonia, it is significant to implement rehabilitation early in order to prevent complications of immobilization and to improve the quality of life and further functioning of the patient [24]. In the study by Jose et al., inpatient rehabilitation with physical exercise has been shown to improve the quality of life, functional capacity, increase the strength of peripheral muscles, and reduce dyspnea, compared to patients who were only receiving respiratory physiotherapy [28].

Diagnosis of Pneumonia

The most common classification is division to CAP and HAP. A subtype of HAP is ventilator-associated pneumonia (VAP) [29].

The clinical picture has an important role in the initial diagnosis of pneumonia. According to the ATS/IDSA, the diagnosis of HAP and VAP should take into account the presence of fever, productive cough, and new lung infiltrates on chest imaging [30]. In outpatient practice, the CRB-65 scale is used – a tool used to assess the need to refer a patient with CAP to hospital treatment. It assesses confusion, respiratory rate, and blood pressure. An additional point is also given to patients over 65 years of age. If the score is 1 or more, general practitioners should consider referral to hospital. Patients with a score of 0 have a low risk of death, so they can be managed on an outpatient basis. An undoubted advantage of this scale is the lack of the need to perform laboratory tests, as in the case of CURB-65 or pneumonia severity index (PSI), which shortens the decision-making time [31]. However, the ATS/IDSA guidelines recommend the use of PSI rather than CRB-65, due to more effective identification of low-risk patients and predicting mortality [32].

Computed tomography remains the gold standard in imaging diagnostics, but X-ray remains the routinely used examination due to lower radiation, lower costs, and no need to describe it by a radiologist [29, 33]. In recent years, studies have also been conducted on the usefulness of ultrasound in the diagnosis of pneumonia, which has the advantages of no exposure to radiation, no need to transport the patient, and lower costs than in the case of X-ray [33]. In one of the studies conducted on patients with multiple diseases, with an average age of about 83 years, it was proven that lung ultrasonography (LUS) showed a higher sensitivity (92%) and specificity (94%) than X-ray with its sensitivity of 47% and specificity of 93% [34]. Also in another study conducted on a group of elderly people with CAP, it was proven that in the case of LUS, the sensitivity is 99% and the specificity is 98.7%, and chest X-ray is 56.5% and 100% [35].

Among laboratory tests, determination of CRP and PCT levels is particularly common. Especially PCT, which increases in the presence of bacterial infection, is of great importance when deciding on antibiotic therapy [36]. The ATS/IDSA

guidelines recommend that in addition to inflammatory markers, the clinical picture should also be taken into account [32].

In addition, one should not forget that the increase in inflammatory parameters may result from the presence of an inflammatory process located outside the lungs [36].

ATS/IDSA recommends that sputum and blood cultures should be performed only among patients with CAP that treated empirically against *Pseudomonas aeruginosa* or methicillin-resistant *Staphylococcus aureus* (MRSA) or with a severe course of the disease. However, in the case of HAP, these methods should be used routinely in all patients [30, 32]. Sputum culture should be considered when it is possible to obtain a sufficient amount of sample from the patient [36]. Another limitation is also the possibility of contamination with flora from the oropharyngeal cavity, which may result in a false positive test result [37].

Detection of the presence of antigens in the urine is used in the case of *Streptococcus pneumoniae* and *Legionella pneumophila* infections, using the ELISA method [29, 38]. In the case of *Legionella* infection, antigens can be detected as early as 24 hours after the onset of symptoms, and the severity of the disease correlates positively with the probability of detecting these antigens [38]. An undoubted advantage of antigen tests is the short waiting time for the result [29]. Antigen tests are also used in the case of suspected Sars-CoV-2 infection – but they only detect active infection, not the recovery process. The material is collected from the nasopharynx or urine. In the case of suspected COVID-19, the detection of the genetic material of the virus by PCR is considered the most effective method [39].

Serological methods are used when an infection of the *Mycoplasma pneumoniae* but also of Sars-CoV-2 etiology is suspected [36, 39]. Determining the level of antibodies allows differentiating whether we are dealing with an acute infection or with a recovery period [36].

Bronchoscopy has not been routinely used in the diagnosis of pneumonia; however, it may be considered in immunosuppressed patients or in patients not responding to treatment, from whom it is not possible to obtain sputum for examination [29]. One study also tested the usefulness of pepsin and amylase

levels in bronchoalveolar lavage (BAL) in suspected aspiration pneumonia. Pepsin levels greater than 7.45 ng/mL were shown to have 87.2% sensitivity and 59.95% specificity, and amylase levels greater than 204 U/L had 77.1% sensitivity and 84.2% specificity [40].

Quick diagnosis based also on the appropriate selection of diagnostic methods reduces the risk of complications. As a result of pneumonia, there is a risk of complications not only related to the respiratory system, such as parapneumonic pleural effusion, empyema, acute respiratory distress syndrome, or respiratory failure. There may also be cardiovascular disorders such as arrhythmias or heart failure, hematological complications in the form of leukopenia, thrombocytopenia, but also thrombocytosis or neurological – delirium or change of mental status [41].

Vaccination

Nowadays, due to better health access and greater patient's awareness, life expectancy has increased. Vaccination has a significant role in this process. As a result, it has been possible to reduce the incidence and mortality of diseases that used to cause death of children and seniors [42]. Developments in medicine and technology have made it easier to access information, so older patients are more likely to opt for vaccinations.

The difficulty in convincing undecided patients is a concern that arises today. The crucial importance of geriatricians and family doctors in resolving this problem, should be emphasized.

As is known, there are various factors causing pneumonia. Currently, we are able to defend/protect ourselves through vaccines against certain bacteria and viruses [43].

Due to age and associated diseases, the elderly are susceptible to developing viral and bacterial infections. They are also at risk for respiratory complications, especially pneumonia [44].

The most common cause of CAP is the bacteria *Streptococcus pneumoniae*, commonly known as pneumococcus [45]. According to Centers for Disease Control and Prevention (CDC) guidelines, pneumococcal vaccines are

recommended for adults aged 65 or over without comorbidities and comorbid adults aged less than 65 (Figure 1) [46].

In countries where universal pneumococcal vaccination has been introduced in the population of children under the age of 2, a decrease in the incidence of invasive pneumococcal disease has been observed in the non-vaccinated adult population, especially in those aged ≥ 65 years [47]. The disease carrier rate ranges from 10% in adults to 60% in children [45]. Therefore, it is worth emphasizing that vaccinating children helps to protect not only them but also their community.

In Poland, the following vaccines are used against pneumococci: 23-valent polysaccharide vaccine (PPSV23) and two types of conjugated vaccine: 10-valent pneumococcal conjugate vaccine (PCV10) and 13-valent pneumococcal conjugate vaccine (PCV13). PPSV23 contains the serotypes present in PCV13 (excluding 6A) and additionally contains 11 new serotypes (2, 8, 9N, 10A, 11A, 12F, 15B, 17F, 20, 22F, and 33F) [48].

In a clinical trial called CAPITA (Community-Acquired Pneumonia immunization Trial in Adults), the PCV13 effectiveness was tested. More than 84,000 people aged ≥ 65 years participated in the study. The 46% and 45% effectiveness of PCV13 was proven in preventing pneumococcal CAP and pneumococcal CAP without bacteraemia, respectively. The 75% effectiveness in preventing invasive pneumococcal disease (IPD) caused by vaccine serotypes was shown as well. The vaccine seems to be sufficient for 4–5 years. In addition, PCV13 effectiveness was similar in the subgroups of people with or without comorbidities [49].

In a case-control study conducted in 14 hospitals from 2013 to 2015 in the Republic of Korea, the effectiveness of PPSV23 against IPD and non-bacteraemic pneumococcal pneumonia (NBPP) in all patients ≥ 65 years old was 28.5% and 10.2%, respectively. However, considering only patients aged 65–74 years, PPSV23 effectiveness was 57.4% for IPD and 35.0% for NBPP [50].

Official national immunization program for the year 2023 is a guideline for vaccination of adults in Poland. In the group of patients 65 years of age and older, vaccination should be carried out following the scheme: one dose of PCV13 conjugate vaccine and one dose of PPSV23 polysaccharide vaccine at an interval of at least one year [51].

The German Standing Committee on Vaccination (STIKO) currently recommends PPSV23 for co-morbid patients and for everyone over 60 years of age. Revaccination is possible after 6 years at the earliest. Immunosuppressed patients and those with chronic liver and renal failure should be vaccinated with PCV13 before receiving PPSV23. The advised interval between both vaccines is 6–12 months [52].

Researchers still argue about the effectiveness of PPSV23. In two clinical studies mentioned by Falkenhorst et al., combined efficacy in preventing pneumococcal pneumonia was 64%. Contrary to this, Heo et al. showed PPSV23 as non-effective [53].

PPSV23 showed effectiveness in preventing IPD but did not protect against non-invasive disease. In addition, it is worth mentioning that it is not effective in children under 2 years of age [42]. PPSV23 does not induce the immunologic memory due to lack of T cell stimulation [52].

Vaccinology is one of the fastest growing fields of medicine. Thus, newer pneumococcal conjugate vaccines such as PCV15 and PCV20 were accepted between 2021 and 2022 in Europe and the US. However, they are not commonly used yet [52].

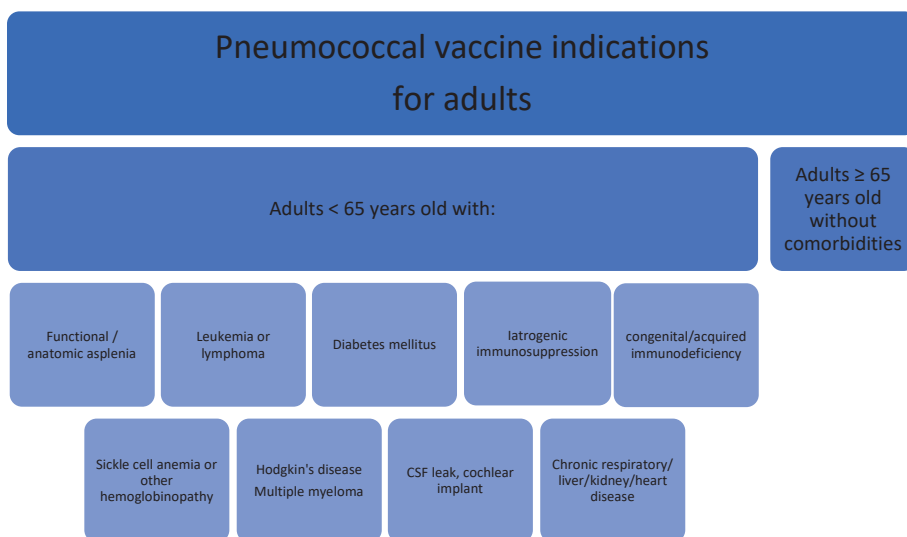


Figure 1. Pneumococcal vaccine indications for adults

Data from England claim that PPV23 coverage in 2021 in the group of adults aged 65 or more was 70.6% [54]. According to CDC, in the United States, the vaccination coverage in 2020 among population aged ≥ 65 years was 67.5% [55]. In Switzerland, pneumococcal vaccination coverage in 2020 in the same age group was 9.6%. In Germany, coverage among the population aged 60 or more reached 51%. Studies showed that in France the coverage is different between elderly groups with or without risk factors – around 20% and 3%, respectively [56].

Conclusions

Pneumonia in the elderly is the main cause of death due to infectious diseases. Characteristic for this group of patients are changes in the respiratory system that impair its functioning, frequent coexistence of accompanying diseases, and the presence of risk factors favoring the occurrence of the disease. As a consequence, there is not only an increase in morbidity, but also in the frequency of hospitalization and the number of deaths compared to the younger age group. *Streptococcus pneumoniae* is the most common etiologic factor responsible for more than half of CAP cases in the elderly. Older people are more exposed to a severe course of pneumonia, as a result of the physiological aging of their immune system. The changes that occur include cell dysfunction, lower WBC number, and chronic inflammation.

Pneumonia in seniors often has an oligosymptomatic course. The diagnostic process is additionally hindered by the fact that leukocytosis often does not occur in older age groups and it is difficult to find new changes on X-ray images. In addition, crackles due to comorbidities are less specific. The basis of treatment is antibiotic therapy, but physiotherapy is extremely important as it improves the physical capacity and quality of life.

In the diagnosis of pneumonia, the clinical picture and a properly performed physical examination are important. CRB- and CURB-65 or PSI scales are often used. X-ray, CT, and ultrasound of the lungs are part of imaging diagnostics. Other methods include determination of CRP and PCT levels, blood and sputum cultures, antigen tests, detection of antibodies, or PCR genetic

material. Properly selected diagnostics reduce the risk of complications not only from the respiratory system, but also from hematological, cardiovascular, and neurological ones.

The subject of pneumococcal vaccination is extensive. Multiple studies, programs, and guidelines in this field are currently being developed. Different countries evolve their own vaccine recommendations. At the moment, PCV13 vaccine is in widespread use due to high effectiveness in preventing, e.g., invasive pneumococcal disease. PPSV23 vaccine, of which effectiveness is equivocal, is recommended in comorbid patients.

List of abbreviations

ATS – American Thoracic Society

BAL – bronchoalveolar lavage

CAP – community-acquired pneumonia

CAPiTA – Community-Acquired Pneumonia immunization Trial in Adults

CDC – Centers for Disease Control and Prevention

COPD – chronic obstructive pulmonary disease

HAP – hospital-acquired pneumonia

ICU – intensive care unit

IDSA – Infectious Diseases Society of America

IPD – invasive pneumococcal disease

LUS – lung ultrasonography

MRSA – methicillin-resistant *Staphylococcus aureus*

MSSA – methicillin-sensitive *Staphylococcus aureus*

NBPP – non-bacteraemic pneumococcal pneumonia

PCV10 – 10-valent pneumococcal conjugate vaccine

PCV13 – 13-valent pneumococcal conjugate vaccine

PPSV23 – 23-valent polysaccharide vaccine

PSI – pneumonia severity index

TLRs – Toll-like receptors

VAP – ventilator-associated pneumonia

WBC – white blood cells

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Conflict of interest statement

The authors declare no conflict of interest.

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