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Pneumococcal vaccination in older adults – a useful, but underused weapon

Brankica Filipić*

Department of Microbiology and Immunology, University of Belgrade – Faculty of Pharmacy, Vojvode Stepe 450, 11221 Belgrade, Serbia

*Corresponding author: Brankica Filipić, e-mail: brankica.filipic@pharmacy.bg.ac.rs

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Abstract

Streptococcus pneumoniae is a Gram-positive coccus with a characteristic oval shape, microscopically most often grouped in pairs (diplococci). It is encapsulated microorganism responsible for a variety of infections in humans, which can be categorized into non-invasive and invasive forms. Although pneumococcal conjugate vaccines (PCVs) and the 23-valent pneumococcal polysaccharide vaccine (PPSV23) are widely recommended for routine use in older adults and adults with underlying conditions across many countries, infections caused by *S. pneumoniae* continue to impose a major burden on patients and healthcare systems, and invasive diseases can leave neurological consequences and have a fatal outcome. Key challenges include infections caused by serotypes not present within vaccines and suboptimal vaccination coverage among older adults, even in developed countries. PCVs differ from PPSV23 as capsular polysaccharides are conjugated with a carrier protein, while PPSV23 contains 23 purified capsular polysaccharides. In addition, an important difference between PPSV23 and PCVs is that PPSV23 induces T-cell independent humoral immune response, while, in contrast, conjugate vaccines induce T-cell dependent immune response leading to the formation of specific antibodies and memory B-cells. The pneumococcal vaccination schedule recommended for adults aged between 19 and 64 and those over the age of 65 depends on chronic medical conditions. In 2021, the United States approved two new vaccines, PCV15 and PCV20, while in 2024, the Food and Drug Administration approved PCV21 for adult use. Despite available vaccines, vaccination coverage in adults remains low, indicating that vaccination, as the most crucial preventive measure, is not being applied sufficiently. To raise awareness of adult vaccination, educational campaigns providing evidence-based information addressing misinformation about vaccines and actively involving healthcare workers in primary care settings to promote vaccination are also essential.

Key words: pneumococcal vaccination, older adults, conjugate vaccines, polysaccharide vaccine

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Introduction

Streptococcus pneumoniae (also known as pneumococcus) is an encapsulated commensal bacterium that often colonizes the upper respiratory tract in humans. The capsule is composed of a variety of polysaccharide structures, with at least 100 distinct serotypes that help the bacteria to evade the host immune system (1). Due to its high prevalence of colonization, it can cause both invasive and non-invasive diseases, with millions of infections and more than a million deaths recorded annually, particularly in children under the age of 5 and older adults (2, 3). In terms of both health outcomes and economic costs, these diseases represent a notable burden on patients, healthcare systems, and society with the impact being particularly severe when pneumococcal disease affects older adults, when compared to children (4). About 90% of all cases of invasive pneumococcal disease and 96% of related deaths in the United States are seen in older adults (5). Active Bacterial Core Surveillance (ABCs) research shows that the mortality rate from invasive pneumococcal disease increases progressively with age, particularly in the following groups: 65 – 69, 70 – 74, 75 – 79, 80 – 84, 85 – 90, and those over 90 years of age (6).

Different types of pneumococcal conjugate vaccines (PCVs), along with the 23-valent pneumococcal polysaccharide vaccine (PPSV23), are routinely recommended for older adults in numerous countries around the world. Although the introduction of pneumococcal vaccines has led to a substantial decrease in disease incidence, pneumococcal infections continue to place a significant burden on patients and healthcare systems for various reasons. Key contributors include infections caused by serotypes of the bacterium not covered by vaccines and inadequate vaccination rates among older adults (7, 8). Despite well-established vaccination programs in many developed countries, there is still a gap in immunization rates among older adults (9). According to a vaccination coverage survey, just 58% of older adults in Canada reported receiving a pneumococcal vaccine, which is significantly below the national target of the 80% vaccination coverage for adults aged 65 and older. By comparison, pneumococcal vaccine uptake in the United States of America (USA) was 59% in 2017, well under the 90% goal for 2020. In Europe, vaccination rates were notably lower, as just 18% of older adults (65 and above) across eight high-income countries (France, Czech Republic, Austria, Greece, Portugal, Italy, Germany, Spain), reported receiving a pneumococcal vaccine (10).

In light of the heightened risk of disease and death in older adults, along with other individuals with comorbidities and those who are immunocompromised, there is an urgent need for targeted interventions to increase pneumococcal vaccination coverage (9, 11).

Diseases caused by *Streptococcus pneumoniae*

Streptococcus pneumoniae is a Gram-positive bacterium that leads to a broad spectrum of illnesses in humans. Infections with *S. pneumoniae* occur worldwide, most commonly during the winter and early spring and this human-specific pathogen spreads from one host to another through aerosolized particles and potentially via contact with

objects contaminated by mucosal secretions (12). The diseases caused by *S. pneumoniae* can be classified into:

a) Non-invasive forms of the disease, such as sinusitis, middle ear infection (otitis media) or pneumonia (without bacteraemia), also known as pneumococcal pneumonia, including community-acquired pneumonia and
b) Invasive forms of pneumococcal diseases (IPDs), which include conditions such as bacteraemia, pneumonia (with bacteraemia), meningitis, endocarditis, and sepsis, are primarily caused by the spread of *S. pneumoniae* from the nasopharynx to other parts of the body. The presence of pneumococcal bacteria in the nasopharynx is a key factor in the development of these severe diseases, as the bacteria can spread to the lungs, brain, and bloodstream, leading to serious infections like pneumonia, meningitis, and sepsis (13, 14).

Asymptomatic carriage is wide-ranging, with prevalence reported between 11% and 93%. The differences in the prevalence of carriage are determined by several factors, including environment, age, the presence of upper respiratory infections, and the target population (15).

The key virulence factor of *S. pneumoniae* is a polysaccharide capsule and more than 100 serotypes of this human pathogen have been identified, with 23 serotypes accounting for 80 – 90% of invasive infections (which is why the 23-valent vaccine was developed among the first). The unique polysaccharide capsule of *S. pneumoniae* plays a crucial role in its ability to evade the defence mechanisms of the immune system, making it a major virulence factor (16). The antigenic nature of capsular polysaccharides is the basis for the identification of more than 100 distinct serotypes of pneumococci. Type-specific antibodies against capsular polysaccharides help defend against infections caused by the corresponding serotype. They interact with the complement system to coat pneumococci, promoting their recognition and uptake by immune cells, leading to bacterial elimination. Furthermore, antibodies targeting certain pneumococcal capsular polysaccharides may also react with similar serotypes and different bacterial strains, providing protection against a wider array of serotypes (17).

High-risk populations for pneumococcal disease include:

- Children under the age of 5, particularly those under 2 years of age;
- Individuals aged 65 and above;
- Immunocompromised individuals (e.g., people with HIV, cancer, or those on immunosuppressive therapy);
- Those suffering from chronic illnesses (such as cardiovascular diseases, diabetes, long-term kidney disorder, etc.) (18).

The diagnosis of pneumococcal disease is typically confirmed through microscopy and Gram staining, which reveal lancet-shaped Gram-positive diplococci. Additionally, to identify pneumococci, fresh emulsified sputum can be mixed with antiserum, which causes capsule swelling, known as the quelling reaction. *S. pneumoniae* can be isolated from blood or other sterile fluids, such as cerebrospinal fluid (CSF), middle ear fluid,

joint fluid, or peritoneal fluid. The sample can be cultivated on blood agar, and pneumococci present typical grey colonies with alpha-hemolysis and with a button or mucoid appearance. The classical microbiological identification of *S. pneumoniae* depends on its susceptibility to optochin (ethylhydrocupreine hydrochloride) and its solubility in sodium deoxycholate (bile salt). *S. pneumoniae* ferments inulin, which differentiates it from other streptococci (19). Additionally, a urinary antigen test, utilizing an immunochromatographic membrane method, can detect the C-polysaccharide antigen of *S. pneumoniae* (17).

However, with the implementation of regular vaccination in children using the pneumococcal conjugate vaccine (PCV), following the recommendations of the World Health Organization (WHO) from 2007, the incidence of pneumococcal disease in the paediatric population has significantly decreased (20, 21). On the other hand, although vaccines for pneumococcal disease are available for adults, vaccination coverage in this population remains low, even in developed countries (11).

The issues with vaccination coverage among at-risk individuals and older adults are evident even in our country. In the Republic of Serbia, the 23-valent pneumococcal polysaccharide vaccine (PPSV23) is recommended for individuals at high risk. According to the 2022 immunization report of the Institute of Public Health of Serbia "Dr Milan Jovanović Batut", only 4,697 doses of PPSV23 were administered to high-risk individuals. One of the conclusions of the report is that primary care physicians did not administer the vaccine to all eligible patients, despite the broad range of indications for vaccine use outlined in the regulations for high-risk groups. Therefore, pneumococcal vaccination with the PPSV23 vaccine was not carried out as planned, despite highlighting the inadequate implementation during 2022 (22).

The Economic and Healthcare Impact of Diseases Caused by *S. pneumoniae*

In Europe and the USA, *S. pneumoniae* is the leading pathogen responsible for community-acquired pneumonia (CAP) in adults (11). The incidence of community-acquired pneumonia in Europe varies depending on the region, age, and sex. However, it rises considerably with age and occurs more frequently in men than in women (23). Although community-acquired pneumonia is classified as a non-invasive pneumococcal disease, studies suggest that non-invasive pneumococcal diseases represent a significant burden on the healthcare system (24). Furthermore, it has been estimated that the incidence of adults aged 50 and above that are hospitalized due to pneumococcal pneumonia, far exceeds the incidence of hospitalized adults with invasive forms of pneumococcal diseases in the USA (24).

A 2019 study in the USA, involving 91.5 million adults aged over 50, reported 502,600 cases of pneumococcal pneumonia, 29,500 cases of invasive pneumococcal disease, and 25,400 deaths attributed to pneumococcal diseases (6). In adults, pneumococcal meningitis and bacteraemia are less common than in children, but the mortality rate in these conditions is exceptionally high in older adults, even with timely

and appropriate treatment. Pneumococcal meningitis leads to death in 1 in 6 older adults, while bacteraemia results in death in 1 in 8 infected older adults (25).

A study in the USA involving 88,182 hospitalized adult patients due to non-invasive CAP and IPDs showed a mortality rate of 8.3%, with an average hospitalization cost of $9,791 per patient. In this study, 59.8% of the patients were over the age of 65, and this group exhibited a higher mortality rate (24).

It can be concluded that both non-invasive and invasive pneumococcal diseases in adults not only carry a high risk of unfavourable outcomes but also impose a substantial burden on the healthcare system and economic system of a country.

Pneumococcal Vaccines Approved for Adult Use and Prevention

Vaccination, as the most effective and cost-efficient preventive measure, is undoubtedly the most significant public health strategy for preventing pneumococcal diseases. Two primary types of pneumococcal vaccines are available: the 23-valent pneumococcal *polysaccharide* vaccine (PPSV23) and pneumococcal *conjugate* vaccines (PCVs) (26).

The PPSV23 vaccine was licenced in the USA in 1983 and has been recommended for individuals aged 2 and above with various comorbidities and all adults aged 65 and older. The first conjugate pneumococcal vaccine (PCV) received approval for use in the United States in 2000. The primary distinction between the polysaccharide vaccine (PPSV23) and conjugate vaccines lies in how they stimulate the immune response. PPSV23 triggers T-cell-independent B-cell activation, which does not promote the formation of immunological B-cell memory. In contrast, conjugate vaccines elicit T-cell-dependent response, which involve the interaction of specialized CD4+ T-cells, called follicular helper T-cells (Tfh), upon which activated helper T-cells interact with B-cells. Once activated, B-cells proliferate and differentiate into plasma cells and memory B-cells. Plasma cells produce antibodies specific to the antigen, while memory B-cells provide long-term immunity (17, 27). PCVs differ from PPSV23 in that their capsular polysaccharides are attached to a carrier protein, such as a non-toxic form of diphtheria toxin (DT), tetanus toxoid, meningococcal outer membrane protein complex, or protein D (PD) from *Haemophilus influenzae.* Currently, the commercially available PCV13, PCV20 and PCV21 use the diphtheria CRM197 protein as their carrier. Unlike the polysaccharide vaccine (PPSV23), which contains only pure polysaccharides, the polysaccharide antigens in PCVs are linked to a carrier protein. This conjugation results in a stronger and longer-lasting immune response (28).

The PPSV23 vaccine contains 23 serotypes of purified capsular polysaccharides (1, 2, 3, 4, 5, 6B, 7F, 8, 9N, 9V, 10A, 11A, 12F, 14, 15B, 17F, 18C, 19F, 19A, 20, 22F, 23F, and 33F) (Figure 1) with 25 μg of each antigen within vaccine formulation. PPSV23 is given through either an intramuscular or subcutaneous injection. Each dose contains phenol as a preservative, but it does not include any adjuvants or antibiotics (29). Over 80% of healthy adults who receive the PPSV23 vaccine produce antibodies against the vaccine’s serotypes, with this immune response typically occurring within 2 to 3 weeks.

However, older adults and individuals with chronic conditions or immune deficiencies may experience a weaker response. In healthy adults, antibody levels remain elevated for at least 5 years, whereas in those with certain health conditions, the decline occurs more quickly. Children under the age of 2 usually show a limited antibody response to PPSV23 (30).

Vaccine	Serotype coverage																														
	4	6B	9v	14	18C	19F	23F	1	3	5	6A	7F	19A	22F	33F	10A	11A	12F	15B	8	9N	2	17F	20	15A	15C	16F	20A	23A	23B	24F	31	35B
PPSV23	■	■	■	■	■	■	■	■	■	■		■	■	■	■	■	■	■	■	■	■	■	■	■									
PCV13	■	■	■	■	■	■	■	■	■	■	■	■	■																				
PCV15	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■																		
PCV20	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■													
PCV21									■		■	■	■	■	■	■	■	■		■	■		■		■	■	■	■	■	■	■	■	■

Figure 1. Capsular serotypes in pneumococcal vaccines (44)
Slika 1. Kapsularni serotipovi u različitim pneumokoknim vakcinama (44)

Different studies have provided varying estimates of the clinical effectiveness of PPSV23. Typically, the vaccine offers 60% to 70% protection against IPDs caused by the serotypes included in the vaccine formulation. The effectiveness of PPSV23 is reduced in immunocompromised individuals. Studies comparing asymptomatic pneumococcal carriage rates before and after vaccination have found no significant reduction in carriage among those who received the vaccine (31).

In 2014, the Advisory Committee on Immunization Practices (ACIP) expanded its recommendations to include the 13-valent PCV13 vaccine alongside PPSV23 for routine vaccination of all adults aged 65 and above (26).

PCV13 contains 13 serotypes of *S. pneumoniae* (1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F, and 23F) (Figure 1), with each serotype conjugated to CRM197, a nontoxic form of diphtheria toxin. The vaccine also includes aluminium phosphate as an adjuvant. PCV13 is given via intramuscular injection, and the vaccine does not contain any antibiotics or preservatives (32).

The approval processes for PCV13 in adults varied between the US Food and Drug Administration (FDA) and the European Medicines Agency (EMA). In 2011, the FDA authorized PCV13 for the prevention of pneumonia and IPDs caused by the serotypes included in the vaccine, specifically for adults aged 50 and above. This approval was based on immunogenicity studies comparing the immune responses to PCV13 and PPSV23 (33). In the European Union, PCV13 was approved in 2011 solely for the prevention of IPDs in adults aged 50 and above (34). The European Medicines Agency (EMA) also determined that the effectiveness of PPSV23 against non-invasive CAP had not been consistently demonstrated, which led to the decision not to approve the pneumonia indication based on immunobridging between PCV13 and PPSV23. However, after positive trial results were published in 2014/2015, the EMA expanded the approval of PCV13 to include the prevention of pneumococcal CAP caused by the vaccine serotypes in adults (35). The summary of the vaccination strategy for specific chronic medical conditions is provided in Table I (17, 36–40).

Table I The recommended vaccination schedule for PCV13 and PPSV23 in adults aged 19 – 64 and those aged 65 and above with chronic underlying conditions

Tabela I Preporučen raspored vakcinacije PCV13 i PPSV23 vakcinama kod odraslih između 19 i 64 godine i starijih odraslih iznad 65 godina sa različitim hroničnim stanjima/oboljenjima

Chronic medical conditions/disease	**Vaccination schedule recommended for 19 – 64 years**	**Vaccination schedule recommended for ≥ 65 years**
• Heart disease (chronic); • Lung disease (chronic); • Diabetes; • Alcohol use disorder; • Chronic liver conditions, including cirrhosis; • Current smoking; • Asthma.	• Single dose PPSV23	• A single dose of PCV13 followed by one dose of PPSV23 after 5 years
• Leak of cerebrospinal fluid; • Cochlear implant.	• A single dose of PCV13 followed by one dose of PPSV23 after 8 weeks	• One dose of PCV13, followed by a dose of PPSV23 after 8 weeks, and a second dose of PPSV23 after 5 years (if any PPSV23 was administered before the age of 65).
• Functional and anatomical asplenia, including conditions like sickle cell disease and other hemoglobinopathies; • Conditions that weaken the immune system.	• One dose of PCV13, followed by a dose of PPSV23 after 8 weeks, and a second dose of PPSV23 after 5 years (if any PPSV23 was administered before the age of 65)	• One dose of PCV13, followed by a dose of PPSV23 after 8 weeks, and a second dose of PPSV23 after 5 years (if any PPSV23 was administered before the age of 65)

In 2021, PCV15 and PCV20 were developed successively and licensed for adults in the United States, and PCV21 was approved by the United States Food and Drug Administration (FDA) in June 2024 (40). PCV15 includes the 13 serotypes found in the 13-valent pneumococcal conjugate vaccine (PCV13), along with two additional serotypes, 22F and 33F (Figure 1). These are conjugated to the diphtheria CRM197 protein and formulated with an aluminium phosphate adjuvant. By covering key serotypes responsible for invasive pneumococcal disease (IPD) in adults, PCV15 offers the potential to meet significant medical and public health needs, providing broader protection against the leading serotypes linked to pneumococcal disease globally (41). PCV20 contains all the serotypes found in PCV13, with the addition of seven more serotypes (8, 10A, 11A, 12F, 15B, 22F and 33F) (Figure 1). The immunogenicity of PCV20 in adults has been confirmed through an extensive clinical trial program, which showed that a single intramuscular dose of the vaccine elicited robust immune responses to all 20 *S. pneumoniae* serotypes included in the vaccine formulation (42). PCV21 also

contains pneumococcal polysaccharides which account for 74–94% of IPD in adults aged 65 and above (43). It covers serotypes 3, 6A, 7F, 19A, 22F, 33F, 8, 9N, 10A, 11A, 12F, 17F, and 20A, which are included in PCV20 and PPSV23. Additionally, it covers serotypes 15A, 15C, 16F, 23B, 24F, 31, and 35B, which have not been included in any authorized pneumococcal vaccine to date (Figure 1). PCV21 received approval in the United States in June 2024 and was recommended for preventing adult IPD and pneumococcal pneumonia on June 27, 2024 (44).

In countries where conjugate vaccines PCV15, PCV20, and PCV21 are approved, according to the U.S. Centers for Disease Control and Prevention (CDC) recommendations, all persons over 50 years of age who have not previously received any pneumococcal vaccine or have an unknown history of pneumococcal vaccination, may receive PCV15, PCV20, or PCV21. If a person over 50 years of age receives PCV15, one dose of PPSV23 can be administered one year later, upon which the vaccination is considered to be complete. If an older person receives PCV20 or PCV21, regardless of which of these two vaccines is received, an additional dose of PPSV23 is not recommended (45).

The introduction of PCV vaccines has clearly reduced the incidence of invasive pneumococcal diseases. However, in the post-PCV era, there has been an observed increase in the prevalence of IPD caused by non-vaccine serotypes of pneumococci due to the replacement phenomenon. Serotype replacement happens when successful existing clones expand, or new "escape" clones emerge through capsular recombination. Capsular switching is a strategy used by pneumococci to evade vaccine-induced immunity by acquiring capsular locus genes from non-vaccine serotype pneumococci. Strains from the same clonal lineage expressing different serotypes are often interpreted as pneumococci that have undergone capsular transformation. These recombinant strains can acquire a donor *cps* locus along with additional genetic material, facilitating their adaptation to environmental changes (46). As such, PCV15, PCV20 and PCV21 have been implemented with additional serotypes to further decrease the IPD burden in the older population (47).

Pneumococcal vaccination is not recommended for individuals who have had an allergic reaction to any pneumococcal conjugate vaccine (including PCV13, PCV15, PCV20 or PCV21) or PPSV23, as well as to any vaccine containing diphtheria toxoid (DT), such as DTaP, since DT is an ingredient in PCVs. While adverse reactions to vaccines are relatively common, they are usually mild and may include symptoms like pain, swelling, redness at the injection site, fever, loss of appetite, fatigue, headache, muscle aches, joint pain, and chills. Severe allergic reactions, including anaphylaxis, are very rare (17).

In addition to its importance for preventing pneumococcal diseases, vaccination is crucial for combating antimicrobial resistance (AMR) in *S. pneumoniae*. According to a WHO report, *S. pneumoniae* is recognized as one of the four priority pathogens due to its high rate of AMR, for which vaccines are already available. In line with the WHO’s goal

of achieving the greatest impact on reducing AMR through vaccination, increasing coverage of pneumococcal vaccination with existing vaccines is essential (48).

Besides vaccination, general preventive measures should be applied, such as isolating patients with penicillin-resistant strains and disinfecting respiratory secretions in both home and hospital settings (49).

Strategies to Increase the Pneumococcal Vaccination Coverage

Although immunization can result in a considerable decrease in both morbidity and mortality, pneumococcal vaccination coverage among older adults remains low. Therefore, it is crucial to create and implement strategies designed to enhance vaccination coverage.

Three primary approaches to enhance vaccination coverage include:

1. Educational campaigns – Disseminating educational materials that provide evidence-based information about the importance of vaccination, indications for vaccination, the protection provided by vaccination, vaccine safety, and the number of doses required. An important aspect is addressing and correcting misinformation related to vaccination. Educational campaigns can be mass communication campaigns (via media) or involve trained healthcare professionals.
2. Vaccination prioritization – Engaging with decision-makers to prioritize vaccination for selected vulnerable groups and ensuring financial resources are allocated for prioritizing vaccination, aiming to expand the distribution and accessibility of vaccines.
3. Primary healthcare interventions – Involving general practitioners, family doctors, and pharmacists, who can use their existing patient contacts to promote vaccination. Interventions can include sending vaccination reminders to healthcare workers and/or patients, offering financial incentives to healthcare workers who administer vaccines, and encouraging healthcare workers to discuss vaccination with patients (9, 50).

The comprehensive implementation of these strategies is likely to yield the best results. In developing countries, the availability of vaccines and financial incentives to healthcare workers administering vaccines have been shown to be the two most effective interventions for increasing vaccination coverage (50).

Conclusion

The use of licensed vaccines, some of which have been available for over 40 years, is undoubtedly the most effective and cost-efficient tool for preventing both non-invasive and invasive forms of pneumococcal disease, especially in vulnerable populations. However, a question arises: is this tool being fully utilized? Research has shown that around 90% of all cases of invasive pneumococcal disease and 96% of pneumococcal-

related deaths occur in the adult population. Despite this, vaccination coverage in this group remains low, indicating that vaccination, as the most important preventive measure, is not being sufficiently applied. Since both invasive and non-invasive pneumococcal diseases are common causes of morbidity and mortality among adults and represent a significant burden on healthcare and economic systems, strategies to increase vaccination coverage in adults are essential. The most important measure is, of course, the availability and adequate distribution of vaccines. However, to increase awareness about the availability of vaccines for adults, educational campaigns which provide evidence-based information, addressing misinformation about vaccination, and active involvement of healthcare workers in primary healthcare settings in promoting vaccination are also necessary.

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Declaration of Competing Interest

The author reports no potential conflicts of interest.

Author contributions

BF:conceptualization, investigationvisualization,, writing - original draft and writing - review & editing.

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Pneumokokna vakcinacija kod odraslih osoba – korisno, ali nedovoljno upotrebljeno oružje

Brankica Filipić*

Katedra za mikrobiologiju i imunologiju, Univerzitet u Beogradu – Farmaceutski fakultet, Vojvode Stepe 450, 11221 Beograd, Srbija

*Autor za korespondenciju: Brankica Filipić, e-mail: brankica.filipic@pharmacy.bg.ac.rs

Kratak sadržaj

Streptococcus pneumoniae je Gram-pozitivna koka karakterističnog ovalnog oblika, mikroskopski najčešće grupisana u parove (diplokoke). Virulentni sojevi produkuju kapsulu i mogu uzrokovati širok spektar bolesti kod ljudi, koje se klasifikuju u neinvazivne i invazivne forme. Iako su dva tipa vakcina protiv pneumokoka – konjugovane pneumokokne vakcine (PCV) i 23-valentna pneumokokna polisaharidna vakcina (PPSV23) – preporučene za rutinsku primenu kod odraslih u mnogim zemljama, pneumokokne infekcije i dalje značajno opterećuju zdravstveni sistem, a invazivna oboljenja mogu ostaviti neurološke posledice i imati fatalan ishod. Glavni izazovi uključuju infekcije uzrokovane serotipovima koji nisu obuhvaćeni vakcinama i nizak obuhvat vakcinacijom među starijim odraslim osobama, čak i u razvijenim zemljama. PCV vakcine se razlikuju od PPSV23 jer su kapsularni polisaharidi konjugovani sa proteinskim nosačem, dok PPSV23 sadrži 23 prečišćena kapsularna polisaharida. Takođe, važna razlika između PPSV23 i PCV vakcina je ta što PPSV23 izaziva T-ćelijski nezavisnu aktivaciju B limfocita, dok, s druge strane, konjugovane vakcine izazivaju T-celijski zavisnu aktivaciju B limfocita, što može dovesti do imunološke memorije B-ćelija. Preporučeni raspored vakcinacije protiv pneumokoka za odrasle osobe starosti 19 – 64 godine ili starije od 65 godina zavisi od pratećih hroničnih bolesti. Sjedinjene Američke Države su 2021. godine odobrile dve nove vakcine, PCV15 i PCV20, a 2024. godine, Američka agencija za hranu i lekove odobrila je PCV21 za primenu kod odraslih. Uprkos dostupnim vakcinama, obuhvat vakcinacijom kod odraslih je i dalje nizak, što ukazuje na to da vakcinacija, kao najvažnija preventivna mera, nije dovoljno primenjena. Da bi se povećala svest o vakcinaciji odraslih, neophodne su edukativne kampanje koje pružaju informacije zasnovane na naučnim dokazima, razrešavanje dezinformacija u vezi sa vakcinama, kao i aktivno angažovanje zdravstvenih radnika u primarnoj zdravstvenoj zaštiti u promociji vakcinacije.

Ključne reči: pneumokokna vakcina, odrasle osobe, konjugovane vakcine, polisahardina vakcina