Pneumococcal Vaccine

AHFS Class: 80:12 — Vaccines (tofc-80)

Pneumococcal Vaccine *(AHFS DI)*

Pneumococcal 13-valent Conjugate Vaccine (Diphtheria CRM_{197} Protein) **Pneumococcal 15-valent Conjugate Vaccine** **Pneumococcal 20-valent Conjugate Vaccine** **Pneumococcal 21-valent Conjugate Vaccine** **Pneumococcal Vaccine, Polyvalent**

Alert:

On January 5, 2026, the US Department of Health and Human Services (HHS) announced the approval of a revised US childhood and adolescent immunization schedule (https://www.cdc.gov/vaccines/hcp/imz-schedules/child-adolescent-age.html (https://www.cdc.gov/vaccines/hcp/imz-schedules/child-adolescent-age.html)). Under the revised recommendations, CDC continues to organize the childhood immunization schedule in three distinct categories (Immunizations Recommended for All Children, Immunizations Recommended for Certain High-Risk Groups or Populations, and Immunizations Based on Shared Clinical Decision-Making) but changes individual vaccine placement within those categories. For additional information, see https://www.hhs.gov/press-room/cdc-acts-presidential-memorandum-update-childhood-immunization-schedule.html (https://www.hhs.gov/press-room/cdc-acts-presidential-memorandum-update-childhood-immunization-schedule.html) .

Introduction

Pneumococcal vaccine is an inactivated (polysaccharide) vaccine[105,129,181,207,208,218,] that is commercially available in the US as 2 different vaccine types: pneumococcal conjugate vaccine (pneumococcal 15-valent conjugate vaccine,[207,] pneumococcal 20-valent conjugate vaccine,[208,] and pneumococcal 21-valent vaccine)[218,] and pneumococcal vaccine polyvalent (pneumococcal 23-valent vaccine; PPSV23; Pneumovax® 23).[129,] All of the vaccines contain capsular antigens extracted from *Streptococcus pneumoniae* and are used to stimulate active immunity to pneumococcal infection.[105,129,181,207,208,218,]

Uses

▪ Prevention of Pneumococcal Disease

Pneumococcal vaccines are used to stimulate active immunity for the prevention of diseases caused by *Streptococcus pneumoniae*.[129,181,205,207,208,218,219,220,] The clinical spectrum of pneumococcal infections ranges from noninvasive infections such as pneumonia, otitis media, and sinusitis to invasive diseases such as osteomyelitis, bacteremia, septic arthritis, and meningitis.[105,166,]*S. pneumoniae* is a major cause of serious or invasive illness and death worldwide.[105,166,] Adults who are immunosuppressed or have certain medical conditions including hematologic cancer, heart disease, liver disease, lung disease (including asthma), alcoholism, human immunodeficiency virus (HIV) infection, CSF leak, cigarette smoking, or have a cochlear implant are at increased risk for invasive pneumococcal disease.[105,166,] In children <5 years of age, *S. pneumoniae* has been a leading cause of bacterial meningitis.[166,]

Available pneumococcal vaccines in the US consist of 4 conjugate vaccines (PCV) and one polysaccharide vaccine.[129,181,207,208,218,] Pneumococcal conjugate vaccines are differentiated by the number of serotypes they provide protection against and include pneumococcal 15-valent conjugate vaccine (PCV15; Vaxneuvance®),[207,] pneumococcal 20-valent conjugate vaccine (PCV20; Prevnar 20®),[208,] and pneumococcal 21-valent conjugate vaccine (PCV21; Capvaxive®).[218,] Although pneumococcal 13-valent conjugate vaccine (PCV13; Prevnar 13®) is commercially available,[181,] this vaccine preparation is no longer recommended by US Centers for Disease Control and Prevention (CDC) as a preferred vaccine option.[222,] However, PCV13 may be used in certain situations when it is the only pneumococccal vaccine available.[220,] The only pneumococcal polysaccharide vaccine available in the US is pneumococcal vaccine polyvalent (PPSV23; Pneumovax® 23).[129,]

The pneumococcal vaccines have been formulated to stimulate active immunity to infection caused by *Streptococcus pneumoniae* serotypes contained in the specific vaccine product.[129,166,181,207,208,218,] The vaccines will *not* prevent pneumococcal infection caused by *S. pneumoniae* serotypes not represented in the vaccines.[129,181,207,208,218,]

Widespread use of pneumococcal conjugate vaccines in children has resulted in a decrease in transmission of vaccine-type strains and a decrease in the incidence of pneumococcal disease among unvaccinated children and adults.[166,] Since the first pneumococcal conjugate vaccine (PCV7) was licensed in the US, a dramatic reduction in the incidence of invasive pneumococcal disease attributable to serotypes of *S. pneumoniae* contained in the vaccines has been observed.[166,]

The currently available pneumococcal vaccines all contain capsular antigens extracted from *S. pneumoniae*; however, each preparation contains different amounts and forms of these antigens.[129,181,207,208,218,] PCV13 (Prevnar 13®) contains capsular antigens from 13 different serotypes of *S. pneumoniae* (serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F, 23F) conjugated to a T-cell dependent carrier protein (diphtheria CRM_{197} protein).[181,] PCV15 (Vaxneuvance®) contains capsular antigens from 15 different serotypes of *S. pneumoniae* (serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F, 22F, 23F, 33F) conjugated to a T-cell dependent carrier protein (diphtheria CRM_{197} protein).[207,] PCV20 (Prevnar 20®) contains capsular antigens from 20 different serotypes of *S. pneumoniae* (serotypes 1, 3, 4, 5, 6A, 6B, 7F, 8, 9V, 10A, 11A, 12F, 14, 15B, 18C, 19A, 19F, 22F, 23F, 33F) conjugated to a T-cell dependent carrier protein (diphtheria CRM_{197} protein).[208,] PCV21 (Capvaxive®) contains capsular antigens from 21 different serotypes of *S.pneumoniae* (serotypes 3, 6A, 7F, 8, 9N, 10A, 11A, 12F, 15A, 15B (de-O-acetylated prior to conjugation), 16F, 17F, 19A, 20A, 22F, 23A,

23B, 24F, 31, 33F, and 35B), each individually conjugated to a T-cell dependent carrier protein (diphtheria CRM197 protein).[218] PPSV23 (Pneumovax® 23) contains capsular antigens from 23 different serotypes of *S. pneumoniae* (serotypes 1, 2, 3, 4, 5, 6B, 7F, 8, 9N, 9V, 10A, 11A, 12F, 14, 15B, 17F, 18C, 19F, 19A, 20, 22F, 23F, 33F); these antigens are unconjugated.[129]

Pneumococcal conjugate vaccines are labeled by FDA for the prevention of invasive or noninvasive pneumococcal disease in different age groups, depending on the specific vaccine preparation.[181,207,208,218] PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), and PCV20 are labeled by FDA for use in adults and pediatric patients 6 weeks of age and older,[181,207,208] while PCV21 (Capvaxive®) is labeled by the FDA for use only in adults ≥18 years of age.[218] PPSV23 (Pneumovax® 23) is FDA-labeled for use in adults ≥50 years of age and in individuals ≥2 years of age who are at increased risk for pneumococcal disease.[129]

The CDC's Advisory Committee on Immunization Practices (ACIP) provides recommendations for pneumococcal vaccination and use of specific vaccine preparations based on a patient's age, previous vaccine doses received, and whether the patient has underlying medical conditions that increase their risk for pneumococcal disease.[199,211,212,213,216,217,219,220,222] Pneumococcal vaccination is recommended in all children younger than 5 years of age and all adults 50 years of age or older.[222] Vaccination is also recommended in individuals 5 through 49 years of age with certain risk conditions.[222] Risk conditions generally considered by CDC to be indications for pneumococcal vaccination include CSF leak; chronic liver, lung, heart, or kidney disease; cochlear implant; immunocompromising conditions (congenital or acquired asplenia, splenic dysfunction, congenital or acquired immunodeficiency, treatment with immunosuppressive drugs or radiation therapy, HIV infection, sickle cell disease or other hemoglobinopathy); and diabetes mellitus.[222] Consult CDC recommendations for additional information athttps://www.cdc.gov/pneumococcal/hcp/vaccine-recommendations/index.html (https://www.cdc.gov/pneumococcal/hcp/vaccine-recommendations/index.html)

Clinical Experience

PCV13 (Prevnar 13®).

In a US noninferiority study that evaluated the response to PCV13 (Prevnar 13®) and PCV7 (Prevnar®; no longer commercially available in the US) in healthy infants who received a 4-dose vaccination series (3 primary doses given at 2, 4, and 6 months of age and a fourth dose given at 12–15 months of age), responses to 10 of the 13 serotypes in PCV13 (Prevnar 13®) measured 1 month after the third dose met the primary endpoint criterion.[181] Approximately 87–98% of the infants had anticapsular IgG antibody concentrations of at least 0.35 mcg/mL for 12 of the 13 pneumococcal serotypes in the vaccine;[181] only 63.5% of the infants achieved an antibody concentration of at least 0.35 mcg/mL against serotype 3.[181] When determined 1 month after the third dose of PCV13 (Prevnar 13®), functional antibody responses as measured by anti-pneumococcal opsonophagocytic activity (OPA) were reported for all 13 vaccine serotypes.[181] These immunologic parameters generally indicated that PCV13 (Prevnar 13®) induced antibody concentrations comparable to those induced by PCV7 (Prevnar®) and protective against invasive pneumococcal disease.[181] When the immune response 1 month after the fourth dose of PCV13 (Prevnar 13®) was compared with the response 1 month after the third primary dose, geometric mean concentrations (GMCs) of anticapsular IgG antibody were higher for all 13 serotypes and geometric mean titers (GMTs) of functional antibody were greater for all 13 serotypes.[181] After the fourth dose of vaccine, antibody responses to 12 of the 13 serotypes met the primary endpoint criterion; the response to serotype 3 did not meet this criterion.[181]

The response to a single dose of PCV13 (Prevnar 13®) in children 5 through 17 years of age was evaluated in a US open-label study.[181] In children 5 through 9 years of age who had previously received at least 1 dose of PCV7 (Prevnar®), serotype-specific IgG concentrations measured 1 month after the PCV13 (Prevnar 13®) dose were noninferior to the response reported in toddlers 1 month after a fourth dose of pneumococcal vaccine (after the fourth dose of PCV7 (Prevnar®) for the 7 common serotypes and after the fourth dose of PCV13 (Prevnar 13®) for the 6 additional serotypes).[181] In children 10 through 17 years of age who had not previously received any pneumococcal vaccine, OPA GMTs 1 month after the PCV13 (Prevnar 13®) dose were noninferior to functional OPA antibody responses reported in children 5 through 9 years of age for 12 of 13 serotypes, but not for serotype 3.[181]

Immunogenicity of PCV13 (Prevnar 13®) in adults has been evaluated in various studies that included healthy adults and immunocompetent adults with stable underlying medical conditions or behaviors known to increase the risk of serious pneumococcal pneumonia and invasive pneumococcal disease (e.g., chronic cardiovascular disease, chronic pulmonary disease, renal disorders, diabetes mellitus, chronic liver disease, alcoholism, smoking).[181] In 2 noninferiority trials, the immune response to a single dose of PCV13 (Prevnar 13®) was compared with the immune response to PPSV23 (Pneumovax® 23) in previously unvaccinated adults 50 through 64 years of age or in adults 70 years of age or older who had received at least 1 dose of PPSV23 (Pneumovax® 23) at least 5 years previously.[181] PCV13 (Prevnar 13®) elicited functional OPA antibody responses in adults 60 through 64 years of age that were noninferior to those induced by PPSV23 (Pneumovax® 23) for the 12 serotypes in common to both vaccines; PCV13 also elicited functional OPA antibody GMTs in adults 50 through 59 years of age that were noninferior to the corresponding functional OPA antibody GMTs elicited by PCV13 (Prevnar 13®) in adults 60 through 64 years of age.[181] In adults 70 years of age who had received PPSV23 (Pneumovax® 23) at least 5 years previously, vaccination with PCV13 (Prevnar 13®) elicited immune responses that were noninferior to those elicited by revaccination with PPSV23 (Pneumovax® 23).[181]

PCV15 (Vaxneuvance®).

Efficacy of PCV15 (Vaxneuvance®) was evaluated in phase 2/3 randomized controlled trials comparing the immunogenicity of PCV15 with PCV13 in healthy infants and children, individuals 5–17 years of age with sickle cell disease, and individuals 6–17 years of age with HIV infection.[211,220] The outcomes compared 30 days after one or more doses of PCV were serotype-specific immunoglobulin G (IgG) GMC, proportion of participants meeting the serotype-specific IgG value of ≥0.35 µg/mL (response rate), and OPA GMTs in a subset of the study population.[211,220] PCV15 met criteria for noninferiority to PCV13 for the 13 shared serotypes, except for serotype 6A GMC ratio after the third dose.[211,220] PCV15 elicited statistically significantly higher immune response for serotype 3 than for PCV13, and PCV15 also met the noninferiority criteria compared with PCV13 for the two unique serotypes 22F and 33F.[211,220] Safety of PCV15 was assessed in seven randomized controlled trials that included 4,778 individuals 6 weeks–17 years of age who received at least one dose of PCV15; four of 4,540 children who received PCV15 developed serious adverse events that were considered to be vaccine-related.[211,220]

Immunogenicity and safety of PCV15 (Vaxneuvance®) were evaluated in phase 2/3 randomized controlled trials in healthy adults ≥50 years of age, adults 18–49 years of age who are Native American (a population with higher rates of invasive pneumococcal disease than the general US population) or have ≥1 risk condition for pneumococcal disease, and adults ≥18 years of age with HIV infection.[207] Serotype-specific functional antibody responses were measured 1 month after vaccination using an OPA assay. In one phase 3 study among adults ≥50 years of age, PCV15 met the noninferiority criteria compared with PCV13 for the 13 shared serotypes and

had statistically significantly greater response for shared serotype 3 and PCV15-unique serotypes 22F and 33F.[207,] Safety of PCV15 was assessed in seven randomized controlled trials that included 5,630 participants ≥18 years of age who received 1 dose of PCV15.[207,] The rates of serious adverse events within 6 months of vaccination were 2.5% among PCV15 recipients; however, no serious adverse events or deaths were considered to be related to the study vaccines.[207,]

PCV20 (Prevnar 20®).

Immunogenicity and safety of PCV20 compared with PCV13 and with PPSV23 for the seven additional serotypes included in PCV20 were evaluated in a phase 2 study in adults 60–64 years of age and in two phase 3 randomized controlled studies in adults ≥18 years of age.[219,] The PCV20 recipients elicited responses that met noninferiority criteria for all 13 serotypes in a phase 3 trial in adults ≥60 years of age compared to PCV13 recipients; however, PCV20 recipients appeared to have lower GMTs and included a lower percentage of seroresponders to 12–13 of the 13 PCV13-shared serotypes.[219,] Compared with PPSV23 recipients, PCV20 recipients had numerically higher GMTs and a higher percentage of seroresponders to 6 of 7 (excluding serotype 8) shared non-PCV13 serotypes and noninferiority criteria were met for those 6 serotypes.[219,] Safety of PCV20 was assessed in 6 clinical studies that included a total of 4,552 participants in immunocompetent adults ≥18 years of age.[219,] Participants included those who were naïve to pneumococcal vaccination and those who had previously received pneumococcal vaccination, and no serious adverse effects or deaths were found to be related to study vaccines.[219,]

In adults who received PPSV23 1 to 5 years prior to receiving PCV20, OPA GMTs to PCV20 were diminished compared with OPA GMTs in adults who received PCV13 at least 6 months prior to PCV20, and compared to OPA GMTs in those who received PCV13 followed by PPSV23, with the last dose of PPSV23 given at least 1 year prior to PCV20.[208,]

Safety and effectiveness of PCV20 against invasive pneumococcal disease was evaluated in healthy infants 6 weeks through 15 months of age in a phase 3 double-blind control trial.[208,221,] Patients were randomized in a 1:1 ratio to receive PCV20 or PCV13 at approximately 2, 4, 6 and 12–15 months of age.[208,221,] Co-primary immunogenicity objectives were demonstration of noninferiority of PCV20 compared with PCV13 by both serotype-specific IgG GMCs for the 20 serotypes one month after dose 4 and percentages of participants with predefined serotype-specific IgG concentrations for the 20 serotypes one month after dose 3.[221,] A key secondary objective was demonstration of noninferiority of PCV20 compared with PCV13 IgG GMCs 1 month after dose 3.[221,] IgG antibody responses following PCV20 were noninferior to those following PCV13 for 8 of the 13 matched serotypes and 6 of the 7 additional serotypes, as assessed by the percentage of participants meeting the predefined serotype-specific IgG concentration one month after dose 3.[208,221,] Additional IgG GMC data at one month after dose 3 and OPA data at one month after dose 3 support the effectiveness of PCV20 for each of the 6 serotypes that failed to meet the pre-specified noninferiority criterion.[208,221,] Additionally, at one month after dose 4 for each of the 13 matched serotypes, IgG GMCs in the PCV20 group were noninferior to the corresponding IgG GMCs in the PCV13 group.[208,221,] The 4-dose infant series of PCV20 had a safety profile similar to a PCV13 series.[221,]

PCV21 (Capvaxive®).

Immunogenicity and safety of PCV21 compared with PCV20 for the 10 shared and 11 unique serotypes were evaluated in a phase 3, double blind study in pneumococcal vaccine-naïve adults ≥18 years of age.[218,] The PCV21 recipients experienced responses that met noninferiority criteria for the 10 shared serotypes and induced greater OPA for 10 of the 11 serotypes (not 15C) unique to PCV21 in adults ≥50 years of age at 30 days postvaccination.[218,] In a second study, effectiveness of PCV21 in patients 18–49 years of age was assessed by comparing the OPA responses elicited by the vaccine in this age group to OPA responses in patients 50–64 years of age. PCV21 met the criteria for immunobridging y for each of the 22 serotypes.[218,] Immunogenicity was also assessed in a third phase 3 study in adults ≥50 years of age who were previously vaccinated with other pneumococcal vaccines at least 1 year prior to the study.[218,] Based on previous type of pneumococcal vaccination, the patients were divided into 3 cohorts: cohort 1: PPSV23, cohort 2: PCV13, or cohort 3: PPSV23 followed by or preceded by PCV13, PPVS23 preceded by PCV15, or PCV15 alone.[218,] The OPA responses were similar for the 3 cohorts of patients who previously received one or more pneumococcal vaccines and were also comparable for the common serotypes of the previous pneumococcal vaccines or higher for the unique serotypes.[218,]

A double blind study in 1,080 patients ≥50 years of age with or without a history of pneumococcal vaccination evaluated OPA responses to concomitant vaccine administration with PCV21 and quadrivalent influenza vaccine (QIV; Fluzone®).[218,] One vaccination group received PCV21 and quadrivalent inactivated influenza vaccine concomitantly, followed by placebo 30 days later (concomitant group).[218,] A second group received quadrivalent inactivated influenza vaccine and placebo concomitantly, followed by PCV21 30 days later (sequential group).[218,] Antibody responses were assessed 1 month after vaccination and noted concomitant administration to be noninferior to the OPA responses to PCV21 administered sequentially after quadrivalent inactivated influenza vaccine for 20 of 21 serotypes; the non-inferiority criterion was not met for serotype 23B.[218,] The OPA response to serotype 15B was not assessed for non-inferiority.[218,] Additionally, the influenza strain-specific hemagglutination inhibition (HAI) responses to QIV administered concomitantly with PCV21 were non-inferior to the HAI responses to QIV administered alone for 3 of 4 influenza strains (not A/H3N2).[218,]

Safety of PCV21 was assessed in 4 clinical studies with 4,556 adults ≥18 years of age receiving PCV21 and 2,021 receiving an active comparator vaccine.[218,] Serious adverse events were reported in 0.3% of patients receiving PCV21 and 0.3% of those receiving an active comparator vaccine.[218,]

PPSV23 (Pneumovax® 23).

A retrospective cohort analysis study based on the CDC pneumococcal surveillance system evaluated protective effectiveness against invasive infections caused by serotypes included in PPSV23.[129,] The analysis showed 57% effectiveness in individuals ≥6 years of age, 65 to 84% effectiveness among specific patient groups (e.g., persons with diabetes mellitus, coronary vascular disease, congestive heart failure, chronic pulmonary disease, and anatomic asplenia) and 75% effectiveness in immunocompetent individuals ≥65 years of age.[129,]

Clinical Perspective

Children 2 through 23 Months of Age.

ACIP recommends that *all* children 2 through 23 months of age (minimum age 6 weeks) receive *routine* pneumococcal vaccination with a 4-dose series using PCV15 (Vaxneuvance®) or PCV20 (Prevnar 20)®; vaccine doses should be administered at 2, 4, 6 and 12-15 months of age.[199,220,] If PCV13 is the only pneumococcal vaccine available when a child is scheduled to receive a PCV, PCV13 may be given as previously recommended.[220,] For children who received all recommended dosing and schedules with PCV13 or PCV15, a supplemental dose of PCV20 is not indicated.[220,]

Healthy Children 24 through 59 Months of Age Catch-up Vaccination.

Children younger than 5 years of age who miss their pneumococcal vaccinations or start the series later than recommended should receive recommended catch-up doses with PCV15 or PCV20; the number of doses and intervals between doses depend on the child's age when vaccination begins.[199,220,] In healthy children 24–59 months of age with an *incomplete* PCV vaccination status (using either PCV13, PCV15, or PCV20), a single dose of either PCV15 or PCV20 is recommended at least 8 weeks after the last PCV dose.[199,220,] In healthy children 24–59 months of age who completed a recommended PCV vaccination series with PCV13 (i.e., 4 doses of PCV13 or another age-appropriate PCV13 schedule), a supplemental dose of PCV15 or PCV20 is not indicated.[220,]

Children 24 through 71 Months of Age with Risk Condition.

In children 24 through 71 months of age with any risk condition (CSF leak, chronic liver disease, cochlear implant, immunocompromising condition, diabetes mellitus, congenital or acquired asplenia or splenic dysfunction, congenital or acquired immunodeficiency, disease or conditions treated with immunosuppressive drugs or radiation therapy, HIV infection, sickle cell disease or other hemoglobinopathy, chronic heart disease, chronic kidney disease, chronic lung disease, maintenance dialysis or nephrotic syndrome) who have not previously received a PCV or received any incomplete schedule of fewer than 3 doses by age 24 months, 2 doses of either PCV15 or PCV20 are recommended at least 8 weeks apart.[199,220,]

In children 24 through 71 months with any risk condition who have received 3 doses of PCV, all before 12 months, one dose of either PCV15 or PCV20 is recommended at least 8 weeks after the last PCV dose.[199,220,]

If only PCV13 is available when the child is scheduled to receive a PCV, PCV13 may be given as previously recommended.[220,]

Children 2 through 18 Years with Risk Condition.

In children 2 through 18 years of age with any risk condition who completed the recommended PCV series (with 1 or more doses of PCV20) before the age of 6 years, no additional doses of any pneumococcal vaccine are indicated.[199,220,] If the recommended PCV doses were completed using PCV13 and PCV15 (with no PCV20), either a dose of PCV20 or 1 or more doses of PPSV23 is recommended to complete the recommended vaccine series.[199,220,] If PPSV23 is used instead of PCV20 in children 2–18 years of age with an immunocompromising condition, either PCV20 or a second PPSV23 dose is recommended at least 5 years after the first PPSV23 dose.[220,] In children 6–18 years of age with any risk condition who have received PCV13 only at or after 6 years, either a dose of PCV20 or 1 or more doses of PPSV23 is recommended at least 8 weeks after the last PCV13 dose.[220,] When PPSV23 is used instead of PCV20 for children 6–18 years of age with an immunocompromising condition, either PCV20 or a second PPSV23 dose is recommended ≥5 years after the first PPSV23 dose. [220,]

In children 6 through 18 years of age with any risk condition who have not received any dose of PCV13, PCV15, or PCV20, a single dose of PCV15 or PCV20 is recommended at least 8 weeks after the most recent dose of pneumococcal vaccine.[199,220,] If PCV15 is used, it should be followed by a dose of PPSV23 at least 8 weeks after the last PCV dose, if not previously given.[220,]

In children <19 years of age who are hematopoietic stem cell transplant (HSCT) recipients, 4 doses of PCV20, starting 3–6 months after HSCT, are recommended.[220,] Administer 3 doses of PCV20 4 weeks apart starting 3–6 months after HSCT and then the fourth PCV20 dose ≥6 months after the third dose of PCV20 or ≥12 months after HSCT, whichever is later.[220,] If PCV20 is not available, 3 doses of PCV15 4 weeks apart, followed by a single dose of PPSV23 1 year after HSCT, can be administered.[220,] For patients with chronic graft versus host disease (GVHD) who are receiving PCV15, a fourth dose of PCV15 can be administered in place of PPSV23 because these children are less likely to respond to PPSV23.[220,]

Adults 50 Years of Age or Older.

Routine pneumococcal vaccination (with PCV15, PCV20, or PCV21) is recommended in adults 50 years of age or older who have never received any pneumococcal conjugate vaccine or whose vaccination history is unknown.[212,222,] If PCV15 is used initially, an additional dose of PPSV23 should be administered at least 1 year later (a minimum interval of 8 weeks may be considered in adults with an immunocompromising condition, cochlear implant, or CSF leak); if PPSV23 is not available, 1 dose of PCV20 or PCV21 may be given.[212,222,222,]

In adults 50 years of age or older who received PPSV23 only at any age, an additional dose of PCV15, PCV20, or PCV21 is recommended at least 1 year later.[212,222,] In adults 50 years of age or older who received PCV13 only at any age or PCV13 at any age and PPSV23 at less than 65 years of age, an additional dose of PCV20 or PCV21 is recommended at least 1 year later.[212,222,] In adults who received PCV13 at any age and PPSV23 at less than 65 years of age, an additional dose of PCV20 or PCV21 is recommended at least 5 years later.(212,222)

Shared decision-making is recommended in adults 65 years of age or older who have already completed a series with PCV13 and PPSV23 for determining whether to administer additional vaccine doses.[212,222,] CDC states that PCV20 or PCV21 may be administered if the individual has received both PCV13 (but not PCV15, PCV20, or PCV21) at any age and PPSV23 at or after the age of 65 years.[222,]

Adults 19 through 49 Years of Age with Immunocompromising Condition, CSF Leak, or Cochlear Implant.

In adults 19 through 49 years of age with an immunocompromising condition (chronic renal failure, congenital or acquired asplenia, congenital or acquired immunodeficiency, generalized malignancy, HIV infection, Hodgkin disease, iatrogenic immunosuppression, leukemia, lymphoma, multiple myeloma, nephrotic syndrome, sickle cell disease or other hemoglobinopathies, solid organ transplant), CSF leak, or cochlear implant who have not received any prior pneumococcal vaccines, a dose of PCV15, PCV20, or PCV21 is recommended; if PCV15 is given, an additional dose of PPSV23 (or, if PPSV23 is not available, PCV20 or PCV21) should be given at least 8 weeks later.[212,]

In adults 19 through 49 years of age with an immunocompromising condition, CSF leak, or cochlear implant who have received prior vaccination with PPSV23 only, an additional dose of PCV15, PCV20, or PCV21 is recommended at least 1 year later.[212,]

In adults 19 through 49 years of age with an immunocompromising condition, CSF leak, or cochlear implant who have received prior vaccination with PPSV13 only, an additional dose of PCV20 or PCV21 is recommended at least 1 year later.[212,]

In adults 19 through 49 years of age with an immunocompromising condition who received prior vaccination with PCV13 and 1 dose of PPSV23, an additional dose of PCV20 or PCV21 is recommended at least 5 years later.[212,]

In adults 19 through 49 years of age with a CSF leak or cochlear implant who received prior vaccination with PCV13 and 1 dose of PPSV23, an additional dose of PCV20 or PCV21 may be given at least 5 years later; alternatively, no additional vaccination may be given during this period of time and the pneumococcal vaccinations should be reviewed again when the patient turns 50 years of age. [212,]

Adults 19 through 49 Years of Age with Chronic Health Conditions.

In adults 19 through 49 years of age with chronic health conditions (e.g., alcoholism, chronic heart disease including congestive heart failure and cardiomyopathies, chronic liver disease, chronic lung disease including chronic obstructive pulmonary disease, emphysema, and asthma, cigarette smoking, diabetes mellitus) who have not received any prior pneumococcal vaccines, a dose of PCV15, PCV20, or PCV21 recommended; if PCV15 is given, an additional dose of PPSV23 (or, if PPSV23 is not available, PCV20 or PCV21) should be given at least 1 year later.[212,]

In adults 19 through 49 years of age with a chronic health condition who received prior pneumococcal vaccination with PPSV23 only, a dose of PCV15, PCV20, or PCV21 is recommended at least 1 year later.[212,]

In adults 19 through 49 years of age with a chronic health condition who received prior pneumococcal vaccination with PCV13 only, a dose of PCV20 or PCV21 is recommended at least 1 year later.[212,]

In adults 19 through 49 years of age with a chronic health condition who received prior pneumococcal vaccination with both PCV13 and PPSV23, no additional vaccines are recommended at this time and the pneumococcal vaccine recommendations should be reviewed again when the patient turns 50 years of age.[212,]

Dosage and Administration

▪ General

Patient Monitoring

Monitor all individuals who receive a pneumococcal vaccine for immediate adverse reactions according to CDC (ACIP) guidelines.[215,]

Dispensing and Administration Precautions

Appropriate medications and supplies for managing immediate allergic reactions *must* be immediately available in the event that an acute anaphylactic reaction occurs following administration of pneumococcal vaccines.[181,207,208,215,]

Syncope may occur following administration of parenteral vaccines, especially in adolescents.[215,] Patients should be seated or lying down during vaccination.[215,] Observe vaccine recipients (especially adolescents) for 15 minutes after vaccination.[215,] If syncope develops, observe patients until symptoms resolve.[215,]

▪ Administration

Pneumococcal 13-valent conjugate vaccine (PCV13; Prevnar 13®), pneumococcal 15-valent conjugate vaccine (PCV15; Vaxneuvance®),[207,] pneumococcal 20-valent conjugate vaccine (PCV20; Prevnar 20®),[208,] and pneumococcal 21-valent conjugate vaccine (PCV-21; Capvaxive®)[218,] are administered *only* by intramuscular (IM) injection.[181,]

Pneumococcal vaccine, polyvalent (pneumococcal 23-valent vaccine; PPSV23; Pneumovax® 23) is administered *only* by IM or subcutaneous injection.[129,]

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV-21 (Capvaxive®), and PPSV23 (Pneumovax® 23) should *not* be diluted or mixed with any other vaccine or solution.[129,181,208,215,218,]

PCV13 (Prevnar 13®) or PCV15 (Vaxneuvance®) should *not* be administered concomitantly with PPSV23 (Pneumovax® 23).[199,213,] When these vaccines are indicated, PPSV23 (Pneumovax® 23) should be administered sequentially *after* the recommended age-appropriate regimen of PCV13 (Prevnar 13®) or PCV15 (Vaxneuvance®), if possible.[199,205,] However, PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV21 (Capvaxive®), or PPSV23 (Pneumovax® 23) may be given simultaneously with other age-appropriate vaccines during the same healthcare visit.[105,207,208,218,] When multiple vaccines are administered during a single healthcare visit, each parenteral vaccine should be given with a different syringe and at different injection sites, and injection sites should be separated by at least 1 inch (if anatomically feasible) to allow appropriate attribution of any local adverse effects that may occur.[105,215,]

PCV13 (Prevnar 13®) should be stored at 2–8°C;[181,] after shipping, the vaccine may arrive at temperatures ranging from 2–25°C.[181,] PCV13 (Prevnar 13®) should not be frozen.[215,181,] Since the vaccine contains an aluminum adjuvant,[215,181,] exposure to freezing temperatures causes irreversible loss of vaccine potency.[215,]

PCV15 (Vaxneuvance®) should be stored at 2–8°C and should not be frozen.[207,]

PCV20 (Prevnar 20®) should be stored at 2–8°C;[208,] after shipping, the vaccine may arrive at temperatures ranging from 2–25°C.[208,] PCV20 (Prevnar 20®) should not be frozen.[208,] Store syringes horizontally in the refrigerator to minimize the resuspension time.[208,]

PCV21 (Capvaxive®) should be stored at 2–8°C and should not be frozen.[218,] Protect from light.[218,]

PPSV23 (Pneumovax® 23) should be stored at 2–8°C.[129,]

IM Administration

Depending on patient age, IM injections should be made into the anterolateral muscles of the thigh or deltoid muscle of the arm.[215] In infants and children 6 weeks to 2 years of age, IM injections should preferably be made into the anterolateral thigh;[215] alternatively, the deltoid muscle can be used in those 1 through 2 years of age if muscle mass is adequate.[215] In adults, adolescents, and children 3 years of age or older, IM injections should preferably be made into the deltoid muscle.[215]

To ensure delivery into muscle, IM injections should be made at a 90° angle to the skin using a needle length appropriate for the individual's age and body mass, thickness of adipose tissue and muscle at the injection site, and injection technique.[215]

IM injections should *not* be made into the gluteal area or any area where there may be a major nerve trunk.[181,215] If the gluteal muscle is chosen for infants younger than 12 months of age because of special circumstances (e.g., physical obstruction of other sites), it is *essential* that the clinician identify anatomic landmarks prior to injection.[215]

Because apnea has been reported following IM vaccination in some infants born prematurely, decisions regarding use of IM vaccines in such infants should be based on consideration of the individual infant's medical status and potential benefits and possible risks of vaccination.[181,207]

Subcutaneous Administration

Subcutaneous injections should be made at a 45° angle using a 5/8 inch, 23- to 25-gauge needle.[215]

Subcutaneous injections should be made into the upper-outer triceps area or anterolateral thigh for infants <12 months of age.[215] In adults, adolescents, and children ≥12 months of age, subcutaneous injections should be made into the upper-outer triceps area.[215]

Specific Vaccine Formulations

Pneumococcal 13-valent Conjugate Vaccine (PCV13; Prevnar 13®).

PCV13 (Prevnar 13®) is administered *only* by IM injection.[181] The vaccine should *not* be administered subcutaneously or intradermally.[215]

PCV13 (Prevnar 13®) is commercially available in single-dose prefilled syringes.[181] After attaching a sterile needle, the entire contents of the prefilled syringe should be administered IM.[181]

PCV13 (Prevnar 13®) must be shaken vigorously immediately prior to administration to obtain a uniform, white suspension.[181] The vaccine should be discarded if it cannot be resuspended or if particulate matter or discoloration are present.[181]

Pneumococcal 15-valent Conjugate Vaccine (PCV15; Vaxneuvance®).

PCV15 (Vaxneuvance®) is administered *only* by IM injection.[207] The vaccine should *not* be administered subcutaneously or intradermally.[215]

PCV15 (Vaxneuvance®) is commercially available in single-dose prefilled syringes.[207] After attaching a sterile needle, the entire contents of the prefilled syringe should be administered IM.[207]

PCV15 (Vaxneuvance®) must be shaken vigorously immediately prior to administration to obtain a uniform, opalescent suspension.[207] The vaccine should be discarded if it cannot be resuspended or if particulate matter or discoloration is present.[207]

Pneumococcal 20-valent Conjugate Vaccine (PCV20; Prevnar 20®).

PCV20 (Prevnar 20®) is administered *only* by IM injection.[208] The vaccine should *not* be administered subcutaneously or intradermally.[215]

PCV20 (Prevnar 20®) is commercially available in single-dose prefilled syringes.[208] After attaching a sterile needle, the entire contents of the prefilled syringe should be administered IM.[208]

PCV20 (Prevnar 20®) must be shaken vigorously immediately prior to administration to obtain a uniform, white suspension.[208] The vaccine should be discarded if it cannot be resuspended or if particulate matter or discoloration is present.[208]

Pneumococcal 21-valent Conjugate Vaccine (PCV21; Capvaxive®).

PCV21 (Capvaxive®) is administered *only* by IM injection.[218]

PCV21 (Capvaxive®) is commercially available as a colorless, clear to opalescent solution in single-dose prefilled syringes.[218] The vaccine should not be used if particulate matter or discoloration is present.[218]

Pneumococcal 23-valent Vaccine (PPSV23; Pneumovax® 23).

PPSV23 (Pneumovax® 23) is administered by IM or, alternatively, by subcutaneous injection.[129] The vaccine should *not* be administered IV or intradermally.[129]

PPSV23 (Pneumovax® 23) is commercially available in single-dose prefilled syringes and single-dose vials.[129] If a single-dose prefilled syringe is used, a sterile needle should be attached to the syringe according to the manufacturer's instructions and the entire contents of the prefilled syringe administered IM.[129] If a vial is used, withdraw 0.5 mL of the vaccine from the vial using a sterile needle and syringe free of preservatives, antiseptics, and detergents.[129]

PPSV23 (Pneumovax® 23) should be inspected visually for particulate matter and discoloration prior to administration.[129] The vaccine should be a clear colorless solution and should not be administered if it contains particulates or appears discolored.[129]

▪ Dosage

The dosage schedule (i.e., number of doses) and specific pneumococcal vaccine administered vary depending on age, immunization status, and presence of medical conditions that increase the risk of pneumococcal disease.[105,129,181] *The age-appropriate recommendations for the specific preparation used should be followed.*[129,181,207,208,218]

Medically stable preterm infants (i.e., gestational age less than 37 weeks), regardless of birthweight, should be vaccinated at the usual chronologic age using the usual dosage and dosage schedules.[215,]

Interruptions resulting in an interval between doses longer than recommended should not interfere with the final immunity achieved; there is no need to administer additional doses or start the vaccination series over.[215,]

Each IM dose of PCV13 (Prevnar 13®) in infants and children 6 weeks of age or older, adolescents, and adults consists of the entire contents (0.5 mL) of the commercially available single-dose prefilled syringe.[181,]

Each IM dose of PCV15 (Vaxneuvance®) in infants and children 6 weeks of age or older, adolescents, and adults consists of the entire contents (0.5 mL) of the commercially available single-dose prefilled syringe.[207,]

Each IM dose of PCV20 (Prevnar 20®) in infants and children ≥6 weeks of age, adolescents, and adults consists of the entire contents (0.5 mL) of the commercially available single-dose prefilled syringe.[208,]

Each IM dose of PCV21 (Capvaxive®) in adults consists of the entire contents (0.5 mL) of the commercially available single-dose prefilled syringe.[218,]

Each IM or subcutaneous dose of PPSV23 (Pneumovax® 23) in children 2 years of age or older, adolescents, and adults consists of the entire contents (0.5 mL) of the commercially available single-dose prefilled syringe or 0.5 mL from a single-dose vial.[129,]

▪ Special Populations

Hepatic Impairment

No specific dosage recommendations.[129,181,207,208,218,]

Renal Impairment

No specific dosage recommendations.[129,181,207,208,]

Geriatric Patients

No specific dosage recommendations.[129,181,207,208,218,]

Cautions

▪ Contraindications

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), and PCV21 (Capvaxive®) are contraindicated in individuals who have had a severe allergic reaction (e.g., anaphylaxis) to any ingredient in the formulation or to any vaccine containing diphtheria toxoid.[181,207,208,218,]

PPSV23 (Pneumovax® 23) is contraindicated in individuals with a history of anaphylactic/anaphylactoid reactions or severe allergic reaction to any ingredient in the formulation.[129,]

▪ Warnings/Precautions

Sensitivity Reactions

Allergic reactions.

Prior to administration of PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV21 (Capvaxive®) or PPSV23 (Pneumovax® 23), all known precautions should be taken to prevent adverse reactions, including a review of the patient's history with respect to health status, possible sensitivity to the vaccine, and similar vaccines.[219,]

Allergic reactions, including anaphylactic/anaphylactoid reactions,[129,181,207,208,] rash,[129,181,207,] urticaria,[129,181,207,208,] bronchospasm,[181,208,] erythema multiforme,[129,181,] and angioedema,[129,181,] have been reported with pneumococcal vaccines. Epinephrine and other appropriate agents and equipment should be available for immediate treatment if an anaphylactic or other serious allergic reaction occurs following vaccination.[181,207,208,218,]

The patient and/or the patient's parent or guardian should be informed of the benefits and risks of immunization with PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV21 (Capvaxive®) or PPSV23 (Pneumovax® 23).[129,181,207,] Patients and/or the patient's parent or guardian also should be instructed to report any severe or unusual adverse reactions to their healthcare provider.[129,181,207,208,219,] Clinicians or individuals can report any adverse reactions that occur following vaccination to VAERS at 800-822-7967 or https://vaers.hhs.gov/index (https://vaers.hhs.gov/index) .[129,181,207,208,219,]

Other Warnings and Precautions

Individuals with Altered Immunocompetence.

Like other inactivated vaccines, PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV21 (Capvaxive®), and PPSV23 (Pneumovax® 23) may be administered to individuals immunosuppressed as a result of disease or immunosuppressive therapy; however, immune responses to the vaccines may be diminished or suboptimal in these individuals.[129,181,207,208,218,]

If possible, pneumococcal vaccines should be administered at least 2 weeks prior to initiation of immunosuppressive therapy or deferred until at least 3 months after immunosuppressive therapy is discontinued or at least 6 months following therapy with anti-B cell agents (e.g., rituximab).[215,]

Since antibody response may be impaired after splenectomy, the US Public Health Service Advisory Committee on Immunization Practices (ACIP) and American Academy of Pediatrics (AAP) recommend that vaccination with pneumococcal vaccines be completed at least 2 weeks prior to elective splenectomy, if possible.[105,215]

Apnea in Premature Infants.

Apnea has been observed following intramuscular vaccination with PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), and PCV20 (Prevnar 20®) in some infants that were born prematurely.[181,207,208] Consider the individual infant's medical status and the potential benefits and possible risks of vaccination when deciding when to administer an intramuscular (IM) vaccine.[181,207,208]

Concomitant Illnesses.

The decision to administer or delay vaccination in an individual with a current or recent acute illness depends on the severity of symptoms and etiology of the illness.[129,215]

ACIP, AAP, and other experts state that minor acute illness, such as mild diarrhea or mild upper respiratory infection (with or without fever), usually does not preclude vaccination.[105,215] However, vaccination of individuals with moderate or severe acute illness (with or without fever) generally should be deferred until they have recovered from the acute phase of the illness.[105,215] This precaution avoids superimposing adverse effects of the vaccine on the underlying illness or mistakenly concluding that a manifestation of the underlying illness resulted from vaccination.[215]

The manufacturer of PPSV23 (Pneumovax® 23) states that vaccination should be deferred in individuals with moderate or severe acute illness.[129]

The manufacturer of PPSV23 (Pneumovax® 23) states that the vaccine should be administered with caution in individuals with severely compromised cardiovascular and/or pulmonary function in whom a systemic reaction could pose a substantial risk.[129]

Limitations of Vaccine Effectiveness.

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV21 (Capvaxive®), and PPSV23 (Pneumovax® 23) may not protect all vaccine recipients against pneumococcal disease.[129,181,207,208,218]

Pneumococcal vaccines will *not* prevent pneumococcal infection caused by *Streptococcus pneumoniae* serotypes not represented in the vaccines.[129,181,207,208,218]

Primary immunization with the usually recommended age-appropriate vaccination regimen before an expected exposure to pneumococcal infection ensures the highest level of protection.[105]

The manufacturers of PCV13 (Prevnar 13®) and PCV15 (Vaxneuvance®) state that effectiveness of the vaccines have not been established in premature infants,[181,207,208] children with sickle cell disease,[181,207] or in individuals with hematopoietic stem cell transplant,[181] or HIV infection.[181,207]

Although ACIP and AAP recommend use of PPSV23 (Pneumovax® 23) in individuals with CSF leaks, the manufacturer of PPSV23 (Pneumovax® 23) states that the vaccine may not be effective in preventing pneumococcal meningitis in patients who have chronic CSF leakage resulting from congenital lesions, skull fractures, or neurosurgical procedures.[129]

Antigens in PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), and PCV20 (Prevnar 20® are conjugated to a carrier protein[181,207,208] and conjugated antigens are more immunogenic in infants and young children than the unconjugated antigens in PPSV23 (Pneumovax® 23).[220]

Improper Storage and Handling.

Improper storage or handling of vaccines may reduce vaccine potency resulting in reduced or inadequate immune responses in vaccinees.[215] Consult the CDC recommendations and best practices for storage and handling of vaccines.[215]

All vaccines should be inspected upon delivery and monitored during storage to ensure that the appropriate temperature is maintained.[215] Vaccine that has been mishandled or has not been stored at the recommended temperature should not be administered.[215]

Specific Populations

Pregnancy.

Data are insufficient to date regarding use of pneumococcal vaccines in pregnant females to inform vaccine-associated risks during pregnancy.[129,181,207,208,218]

ACIP states that the safety of PPSV23 during the first trimester of pregnancy has not been evaluated, although no adverse consequences have been reported among newborns whose mothers were inadvertently vaccinated during pregnancy.[216]

Animal developmental and reproduction studies in female rabbits using PCV13 (Prevnar 13®) at doses 20 times the human dose based on body weight did not reveal evidence of fetal harm or impaired female fertility.[181] There are no adequate and well-controlled studies using PCV13 (Prevnar 13®) in pregnant females.[181]

Animal reproduction studies have not been conducted with PPSV23 (Pneumovax® 23).[129] It is not known whether PPSV23 (Pneumovax® 23) can cause fetal harm when administered to a pregnant females or can affect reproductive capacity.[129] PPSV23 (Pneumovax®) should be administered during pregnancy only when clearly needed.[129]

ACIP, AAP, and other experts state that PPSV23 (Pneumovax® 23) may be used when indicated in pregnant females at increased risk for pneumococcal disease.[105] ACIP has not addressed pregnancy recommendations for PCV15, PCV20, or PCV21 at this time.[216]

AAP states that pneumococcal vaccination generally should be deferred during pregnancy, but the risk of severe pneumococcal disease in a pregnant female who has not received PPSV23 (Pneumovax® 23) within the previous 5 years and has an underlying medical condition that increases the risk of invasive pneumococcal disease should prompt immunization with PPSV23 (Pneumovax® 23).[105]

Lactation.

It is not known if antigens contained in PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV21 (Capvaxive®), or PPSV23 (Pneumovax® 23) are distributed into milk.[129,181,207,208,218,] The developmental and health benefits of breastfeeding should be considered along with the mother's clinical need for vaccination and any potential adverse effects on the breastfed child from the vaccine or from the underlying maternal condition (the susceptibility to disease prevented by the vaccine).[129,181,207,208,218,]

ACIP states that, because inactivated vaccines do not multiply within the body, they should not pose any unusual problems for lactating women or their infants.[215,]

Pediatric Use.

Safety and efficacy of PCV13 (Prevnar 13®) have not been established in infants younger than 6 weeks of age.[181,]

The manufacturer of PCV13 (Prevnar 13®) states that the immune response to the vaccine in preterm infants has not been adequately studied to date.[181,] Although the vaccination schedule differed from the US recommended schedule, there is some evidence from a study in preterm infants (gestational age less than 37 weeks) that immunoglobulin G (IgG) antibody responses to some of the pneumococcal vaccine serotypes were lower after the third and fourth vaccine dose compared with responses in term infants (gestational age 37 weeks or greater).[181,]

The manufacturer of PCV15 (Vaxneuvance®) states that the immune responses and safety profile in preterm infants receiving a 4-dose series were similar to those observed in term infants in clinical studies.[207,] However, the effectiveness of PCV15 (Vaxneuvance®) in premature infants has not been established.[207,]

Safety of PCV20 (Prevnar 20®) has been established in individuals 6 weeks through 17 years of age.[208,] The effectiveness of PCV20 for the prevention of invasive disease caused by *S.pneumoniae* serotypes 1, 3, 4, 5, 6A, 6B, 7F, 8, 9V, 10A, 11A, 12F, 14, 15B, 18C, 19A, 19F, 22F, 23F, and 33F has been established in individuals 6 weeks through 17 years of age.[208,] The effectiveness of PCV20 for the prevention of otitis media caused by serotypes 4, 6B, 9V, 14, 18C, 19F, and 23F also has been established in individuals 6 weeks through 5 years of age.[208,] However, the effectiveness of PCV20 for the prevention of pneumonia has not been established in individuals younger than 18 years of age.[208,] The safety and effectiveness of Prevnar 20 have not been established in individuals younger than 6 weeks of age.[208,]

Safety and efficacy of PCV21 (Capvaxive®) have not been established in individuals younger than 18 years of age.[218,]

Safety and efficacy of PPSV23 (Pneumovax® 23) have not been established in children younger than 2 years of age.[129,] Such children may not have a satisfactory antibody response to PPSV23 (Pneumovax® 23).[129,]

Geriatric Use.

Antibody responses to PCV13 (Prevnar 13®) in adults 65 years of age or older are lower compared with antibody responses in adults 50 through 59 years of age.[181,] There are no overall differences in safety outcomes in adults 65 years of age or older compared with adults 50 through 59 years of age.[181,]

Several clinical studies evaluating PPSV23 (Pneumovax® 23) included individuals 65 years of age or older.[129,] In one study, the rate of vaccine-related systemic adverse effects was similar following primary vaccination and revaccination in adults 50–64 years of age, but was higher following revaccination than primary vaccination in those 65 years of age or older.[129,] The possibility that some older adults may exhibit a higher frequency and/or greater severity of adverse reactions to the vaccine cannot be ruled out.[129,]

Clinical studies of PCV15 (Vaxneuvance®) included individuals who were 65 years and older, and individuals who were 75 years and older.[207,] No clinically meaningful differences in the safety profile or immune responses were observed in the groups of older individuals (65–74 years and ≥75 years of age) when compared to younger individuals.[207,]

In safety studies of PCV20 (Prevnar 20®) in adults, 26.7% were 65 years of age and older and 1.7% were 80 years of age and older.[208,] Prevnar 20® recipients 70–79 years of age and ≥80 years of age had lower antibody responses for all pneumococcal serotypes compared to Prevnar 20® recipients 18–49, 50–59, and 60–64 years of age.[208,]

In safety studies of PCV21 (Capvaxive®) in adults, 32.6% were 65 years of age and older and 7.4% were 75 years of age and older.[218,] PCV 21 (Capvaxive®) recipients ≥65 years of age had lower opsonophagocytic activity (OPA) responses for all pneumococcal serotypes compared to PCV21 recipients <65 years of age.[218,]

▪ Common Adverse Effects

Local Effects with Pneumococcal 13-valent Conjugate Vaccine (PCV13; Prevnar 13®): The most common adverse effects reported with PCV13 (Prevnar 13®) are local reactions at the injection site, including pain/tenderness, redness, and swelling.[181,] In infants who received a 4-dose immunization series of PCV13 (Prevnar 13®) at 2, 4, 6, and 12–15 months of age in 3 US safety studies, tenderness at the injection site was reported in 59–65% of infants after each of the first 3 vaccine doses and in 58% after the fourth dose; tenderness interfered with limb movement in 8–10% and 7% of these infants, respectively.[181,] Redness was reported in 24–37% of infants after the first 3 vaccine doses and in 42% after the fourth dose.[181,] Swelling at the injection site was reported in 20–27% of infants after the first 3 vaccine doses and in 32% after the fourth dose.[181,] When a dose of PCV13 (Prevnar 13®) was administered to adults 50–64 years of age who were previously unvaccinated (had not received PPSV23 [Pneumovax® 23]), local reactions at the injection site, including pain (69–89%), redness (12–20%), and swelling (10–22%), were commonly reported and limitation of arm movement was reported in 24–41%.[181,] When a dose of PCV13 (Prevnar 13®) was administered to previously vaccinated adults 68 years of age or older (had received PPSV23 [Pneumovax® 23] at least 3–5 years prior to study enrollment), pain, redness, swelling, and limitation of arm movement were reported in 51–52%, 11–14%, 10–13%, and 11–16%, respectively.[181,] Dermatitis, urticaria, and pruritus at the injection site were reported during postmarketing experience with PCV13 (Prevnar 13®).[181,]

Systemic Effects with Pneumococcal 13-valent Conjugate Vaccine (PCV13; Prevnar 13®): In infants who received a 4-dose immunization series of PCV13 (Prevnar 13®) at 2, 4, 6, and 12–15 months of age in 3 US safety studies, fever (38°C or greater) occurred in 24–37% of infants after each of the first 3 doses; fever was reported in 32% after the fourth dose.[181,] Irritability was reported in 80–86%, increased sleep in 58–72%, and decreased sleep in 43–47% of infants after each of the first 3 doses; after the fourth dose, these effects were reported in 80, 49, and 45%, respectively.[181,] Decreased appetite was reported in 48% of infants after each of the first 3 doses of PCV13 (Prevnar 13®) and in 51% after the fourth dose.[181,] Diarrhea, vomiting, and rash have been reported in greater than 1% of infants and children receiving PCV13 (Prevnar 13®) in clinical studies.[181,] Adverse reactions occurring in less than 1% of infants and children receiving the vaccine included crying, hypersensitivity reaction

(e.g., facial edema, dyspnea, bronchospasm), seizures (e.g., febrile seizures), and urticaria or urticaria-like rash.[181] When a dose of PCV13 (Prevnar 13®) was administered to adults 50–64 years of age who were previously unvaccinated (had not received PPSV23 [Pneumovax® 23]), fatigue occurred in 51–63%, headache in 50–66%, chills in 20–24%, muscle pain in 22–62%, joint pain in 14–32%, rash in 9–17%, decreased appetite in 15–25%, vomiting in 3–7%, and fever in 2–4%.[181] When a dose of PCV13 (Prevnar 13®) was administered to previously vaccinated adults 68 years of age and older (had received PPSV23 [Pneumovax® 23] at least 3–5 years prior to study enrollment), fatigue occurred in 34%, headache in 24–26%, chills in 8%, muscle pain in 12–37%, joint pain in 10–13%, rash in 7–8%, decreased appetite in 10–11%, vomiting in 1–2%, and fever in 1%.[181] Lymphadenopathy in the region of the injection site, cyanosis, pallor, hypotonia, anaphylactic/anaphylactoid reactions (including shock), angioedema, erythema multiforme, and apnea were reported during postmarketing experience with PCV13 (Prevnar 13®).[181]

Local Effects with PCV15 (Vaxneuvance®): The most commonly reported local adverse reactions reported in infants receiving a 4-dose series at 2, 4, 6, and 12 through 15 months of age were injection-site pain (25.9–40.3%), injection-site induration (13.2–15.4%), injection-site erythema (13.7–21.4%), and injection-site swelling (11.3–13.4%).[207] Reported local adverse reactions in children and adolescents 2 through 17 years of age vaccinated with a single dose were injection-site pain (54.8%), injection-site swelling (20.9%), injection-site erythema (19.2%), and injection-site induration (6.8%).[207] The most commonly reported adverse reactions in adults 18–49 years of age were injection-site pain (75.8%), injection-site swelling (21.7%), and injection-site erythema (15.1%).[207] The most commonly reported adverse reactions in adults ≥50 years of age were injection-site pain (66.8%), injection-site swelling (15.4%), and injection-site erythema (10.9%).[207]

Systemic Effects with PCV15 (Vaxneuvance®): The most commonly reported systemic adverse reactions reported in infants receiving a 4-dose series at 2, 4, 6, and 12 through 15 months of age were irritability (57.3–63.4%), somnolence (24.2–47.5%), fever ≥38.0°C (13.3–20.4%), and decreased appetite (14.1–19.0%).[207] Reported systemic reactions in children and adolescents 2 through 17 years of age vaccinated with a single dose were myalgia (23.7%), fatigue (15.8%), and headache (11.9%).[207] The most commonly reported systemic reactions in adults 18–49 years of age were fatigue (34.3%), myalgia (28.8%), headache (26.5%), and arthralgia (12.7%).[207] The most commonly reported systemic reactions in adults ≥50 years of age were myalgia (26.9%), fatigue (21.5%), headache (18.9%), and arthralgia (7.7%).[207]

Local Effects with PCV20 (Prevnar 20®): The most commonly reported local adverse reactions reported in infants receiving a 4-dose series at 2, 4, 6, and 12 through 15 months of age were pain at the injection site (>30%) and injection site redness (>20%) and swelling (>10%).[208] Reported local reactions in children and adolescents 15 months through 17 years of age vaccinated with a single dose were pain at the injection site (>50%) and injection site redness and swelling (>10%).[208] In adults 18–59 years of age, the most commonly reported local adverse reactions were pain at the injection site (>70%) and injection site swelling (10%).[208] In adults ≥60 years of age, the most commonly reported local adverse reaction was pain at the injection site (>50%).[208]

Systemic Effects with PCV20 (Prevnar 20®): The most commonly reported systemic adverse reactions reported in infants receiving a 4-dose series at 2, 4, 6, and 12 through 15 months of age were irritability (>60%), drowsiness (>30%), decreased appetite (>20%), and fever (>10%).[208] Reported systemic reactions in children and adolescents 15 months through 17 years of age vaccinated with a single dose were irritability (>60% in individuals <2 years of age), drowsiness (>40% in individuals less than 2 years of age), fatigue and muscle pain (>20% in individuals 2 years of age and older), decreased appetite (>20% in individuals less than 2 years of age), headache (>10% in individuals 5 years of age and older), and fever (>10% in individuals less than 2 years of age).[208] In adults 18–59 years of age, the most commonly reported systemic reactions were muscle pain (>50%), fatigue (>40%), headache (>30%), and arthralgia(>10%).[208] In adults ≥60 years of age, the most commonly reported systemic reactions were muscle pain and fatigue (>30%), headache (>20%), and arthralgia (>10%).[208]

Local Effects with PCV21 (Capvaxive®): In adults 18–49 years of age, the most commonly reported local adverse reactions were pain at the injection site (73.1%), injection site erythema (13.8%), and injection site swelling (13.3%).[218] In adults ≥50 years of age, the most commonly reported local adverse reaction was pain at the injection site (41.2%).[218]

Systemic Effects with PCV21 (Capvaxive®): In adults 18–49 years of age, the most commonly reported systemic adverse reactions were fatigue (36.0%), headache (27.5%), and myalgia (16.4%).[218] In adults ≥50 years of age, the most commonly reported systemic reactions were fatigue (19.7%) and headache (11.0%).[218]

Local Effects with Pneumococcal 23-valent Vaccine (PPSV23; Pneumovax® 23): The most common adverse effects reported after initial vaccination with PPSV23 (Pneumovax® 23) are local reactions at the injection site, including pain/soreness/tenderness (60%),[129] swelling/induration (20%), and erythema (16%).[129] Following revaccination with PPSV23 (Pneumovax® 23) approximately 3–5 years after the initial vaccine dose, the most common local adverse effects were pain/soreness/tenderness (77%), swelling (40%), and erythema (35%).[129] Injection site reactions generally resolved within 5 days after vaccination.[129] Data from one study in adults indicate that the incidence of adverse effects at the injection site in those 50–64 years of age is similar following initial vaccination (73%) and revaccination (80%).[129] However, the incidence of injection site reactions is higher following revaccination than following initial vaccination in those ≥65 years of age.[129] There have been postmarketing reports of cellulitis or cellulitis-like reactions, warmth at the injection site, decreased limb mobility, and peripheral edema in the injected extremity following administration of PPSV23 (Pneumovax® 23).[129]

Systemic Effects with Pneumococcal 23-valent Vaccine (PPSV23; Pneumovax® 23): The most common systemic adverse effects reported after initial vaccination with PPSV23 (Pneumovax® 23) are headache (18%), asthenia/fatigue (13%), and myalgia (12%).[129] Following revaccination with PPSV23 (Pneumovax® 23) approximately 3–5 years after the initial vaccine dose, the most common systemic adverse effects were headache (18%), asthenia/fatigue (18%), and myalgia (17%).[129] Rash,[129] urticaria,[129] and erythema multiforme[129] have been reported following vaccination with PPSV23 (Pneumovax® 23).[129] Anaphylactoid reactions,[129] serum sickness,[129] and angioedema[129] also have been reported.[129] Other systemic reactions reported following vaccination with PPSV23 (Pneumovax® 23) during clinical studies or postmarketing experience include fever,[129] chills,[129] arthralgia,[129] arthritis,[129] malaise,[129] diarrhea,[129] dyspepsia,[129] nausea,[129] and vomiting.[129] In addition, there have been postmarketing reports of lymphadenitis,[129] lymphadenopathy,[129] thrombocytopenia (in patients with stabilized idiopathic thrombocytopenic purpura),[129] hemolytic anemia (in patients who have had other hematologic disorders),[129] and leukocytosis.[129] There also have been postmarketing reports of adverse nervous system effects, including paresthesia,[129] radiculoneuropathy,[129] Guillain-Barré syndrome,[129] and febrile seizures.[129] Data from one study in adults indicate that the incidence of systemic adverse effects in those 50–64 years of age is similar following initial vaccination (36%) and revaccination (38%).[129] However, the incidence of systemic reactions is higher following revaccination than following initial vaccination in those ≥65 years of age.[129]

Drug Interactions

▪ Acetaminophen

In infants receiving vaccination with pneumococcal 13-valent conjugate vaccine (PCV13; Prevnar 13®), acetaminophen for prophylaxis (first dose given at the time of each vaccine dose and additional doses given every 6–8 hours) reduced the antibody response to some pneumococcal vaccine serotypes following the third dose of PCV13 (Prevnar 13®) compared with antibody responses in infants who received antipyretics only as needed for treatment.[181,] Reduced antibody responses were not observed after the fourth dose of PCV13 (Prevnar 13®) in those receiving acetaminophen prophylactically.[181,]

ACIP states that evidence does not support the use of antipyretics before or at the time of vaccination; however, antipyretics can be used for treatment of fever and local discomfort that might occur following vaccination.[215,]

▪ Immune Globulins

There is no evidence that immune globulin (immune globulin IM [IGIM], immune globulin IV [IGIV]) or specific hyperimmune globulin (hepatitis B immune globulin [HBIG], rabies immune globulin [RIG], tetanus immune globulin [TIG], varicella zoster immune globulin [VZIG]) interferes with the immune response to inactivated vaccines.[215,] The ACIP states that inactivated vaccines such as pneumococcal vaccines may be given simultaneously with (using different syringes and different injection sites) or at any interval before or after immune globulin or specific hyperimmune globulin preparations.[215,]

▪ Immunosuppressive Agents

Individuals receiving immunosuppressive therapy (e.g., alkylating agents, antimetabolites, corticosteroids, radiation) may have diminished or suboptimal antibody responses to pneumococcal vaccines.[215,208,] Pneumococcal vaccination should be administered before initiation of chemotherapy, or before treatment with other immunosuppressive drugs; administration during chemotherapy or radiation therapy should be avoided.[215,] If possible, pneumococcal vaccines should be administered at least 2 weeks prior to initiation of immunosuppressive therapy.[215,] Individuals receiving chemotherapy with anti-B cell antibodies (e.g., rituximab) should wait at least 6 months after this therapy before being vaccinated with non-live vaccines; some experts recommend waiting longer than 6 months for some anti-B cell antibodies.[215,] However, if patients require therapy for chronic inflammatory conditions, this therapy should not be delayed because of past administration of pneumococcal vaccines.[215,] If pneumococcal vaccines are administered during chemotherapy, the patient should be revaccinated after immune competence is regained; however, revaccination after chemotherapy or radiation therapy is considered unnecessary if the previous vaccination occurred before therapy.[215,]

▪ Vaccines

Although specific studies may not be available regarding concurrent administration with each antigen, simultaneous administration of PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV21 (Capvaxive®) or PPSV23 (Pneumovax® 23) with many other age-appropriate vaccines during the same health-care visit in most cases is not expected to affect immunologic responses or adverse reactions to any of the preparations.[105,215,219,] However, each parenteral vaccine should be administered using a different syringe and different injection site.[105,215,]

Diphtheria and Tetanus Toxoids and Pertussis Vaccines

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar®), or PPSV23 (Pneumovax® 23) may be administered concurrently with diphtheria and tetanus toxoids and acellular pertussis vaccine adsorbed (DTaP) using different syringes and different injection sites.[105,181,207,]

In clinical studies evaluating PCV13 (Prevnar 13®) in infants, the pneumococcal vaccine was administered concurrently with the first 3 doses of a fixed-combination vaccine containing DTaP (DTaP-HepB-IPV; Pediarix®) at 2, 4, and 6 months of age.[181,]

Haemophilus b Vaccines

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar®), or PPSV23 (Pneumovax® 23) may be administered concurrently with haemophilus b (Hib) conjugate vaccine at a different site using a separate syringe.[105,181,207,208,]

In clinical studies evaluating PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), and PCV20 (Prevnar®) in infants, the pneumococcal vaccine was administered concurrently with the first 3 doses of Hib at 2, 4, and 6 months of age.[181,207,208,]

Hepatitis A Vaccine

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar®), or PPSV23 (Pneumovax® 23) may be administered concomitantly with hepatitis A virus vaccine inactivated using different syringes and different injection sites.[105,181,207,208,215,]

In clinical studies, hepatitis A virus vaccine inactivated was administered concurrently with the fourth dose of PCV13 (Prevnar 13®) in infants 12–15 months of age.[181,]

Hepatitis B Vaccine

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar®), or PPSV23 (Pneumovax® 23) may be administered concurrently with hepatitis B virus vaccine inactivated using different syringes and different injection sites.[105,181,207,208,215,]

In clinical studies evaluating PCV13 (Prevnar 13®) in infants, the pneumococcal vaccine was administered concurrently with the first 3 doses of a fixed-combination vaccine containing hepatitis B virus vaccine (DTaP-HepB-IPV; Pediarix®) at 2, 4, and 6 months of age.[181,]

Influenza Virus Vaccine

Influenza Virus Vaccine Inactivated.

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), PCV21 (Capvaxive®) or PPSV23 (Pneumovax® 23) may be administered concurrently with parenteral influenza virus vaccine inactivated using different syringes and different injection sites.[105,207,215,218,]

Concomitant administration of PCV13 (Prevnar 13®) and parenteral influenza virus vaccine inactivated (using different syringes and different injection sites) in adults 50 years of age or older resulted in similar frequencies of local reactions at the injection site compared with administration of PCV13 (Prevnar 13®) alone.[181] However, there was an increase in some solicited systemic reactions when PCV13 (Prevnar 13®) and parenteral influenza virus vaccine inactivated were administered concomitantly compared with administration of the influenza vaccine alone (headache, chills, rash, decreased appetite, muscle and joint pain) or the pneumococcal vaccine alone (fatigue, headache, chills, decreased appetite, joint pain).[215]

In a study in adults 50 years of age and older with or without a history of prior pneumococcal vaccination, patients were randomized to receive either PCV21 (Capvaxive®) and quadrivalent influenza vaccine (Fluzone® Quadrivalent, [QIV]) concomitantly followed by placebo 30 days later (concomitant group), or QIV and placebo concomitantly followed by PCV21 (Capvaxive®) 30 days later (sequential group).[218] The responses to concomitant administration compared with sequential administration was noninferior for 20 of the 21 serotypes (not met for 23B) and responses for QIV was non inferior for 3 of the 4 influenza strains (not met for A/H3N2).[218] The rates and severity of systemic and local adverse reactions were similar in both groups.[218]

There have been some reports of an increased incidence of adverse local and systemic effects when PPSV23 (Pneumovax® 23) was administered concomitantly with influenza virus vaccine inactivated (at a different injection site) compared with administration of influenza virus vaccine inactivated alone, but these reactions generally were mild and well tolerated and do not preclude simultaneous administration of the vaccines at different sites.[145,146] ACIP states that concomitant administration of PPSV23 (Pneumovax® 23) and parenteral influenza virus vaccine inactivated results in satisfactory antibody responses without increasing the incidence or severity of adverse reactions.[215]

Influenza Vaccine Live Intranasal.

ACIP states that, in the absence of specific data indicating interference, inactivated vaccines can be administered simultaneously with or at any interval before or after influenza vaccine live intranasal.[178,215]

Measles, Mumps, Rubella, and Varicella Vaccines

In clinical studies evaluating PCV13 (Prevnar 13®) in infants, MMR and varicella virus vaccine live or, alternatively, the fixed-combination vaccine containing MMR and varicella virus vaccine live (MMRV; ProQuad®) was administered concurrently with the fourth dose of PCV13.[181] In clinical studies evaluating PCV15 (Vaxneuvance®) in infants, MMR and varicella virus vaccine live were administered concurrently with PCV15 at 12–15 months of age.[207] PCV20 (Prevnar 20®) has been administered concurrently with varicella vaccine (Varivax®) in infants 12-15 months of age.[208]

Meningococcal Vaccines

The manufacturer of PCV13 (Prevnar 13®) states that data are insufficient to assess concomitant administration with meningococcal (groups A, C, Y and W-135) polysaccharide diphtheria toxoid conjugate vaccine (MCV4-D, MenACWY-D; Menactra®) in children and adolescents.[181,215] Coadministration of PCV20 with meningococcal vaccines has not been studied.[220] The same precautions used for coadministration of PCV13 and meningococcal groups A, C, W, and Y polysaccharide diphtheria toxoid conjugate vaccine (Menactra®) should be applied when PCV20 is used.[220]

ACIP and AAP state that MCV4-D (Menactra®) should not be administered concurrently with or within 4 weeks after PCV13 (Prevnar 13®).[105,177,215] To avoid possible interference with the immune response to PCV13 in infants and children with anatomic or functional asplenia, the PCV13 immunization series should be completed first and MCV4-D (Menactra®) administered at least 4 weeks later.[177,215]

PPSV23 (Pneumovax® 23) can be administered concurrently with MCV4 (Menactra®, Menveo®) or MPSV4 (Menomune®) at a different site using a different syringe.[105]

ACIP states that the fixed-combination vaccine containing meningococcal polysaccharide groups C and Y vaccine and Hib conjugate vaccine (Hib-MenCY; MenHibrix®) may be administered concurrently with PCV13 (Prevnar 13®) in infants 2 through 18 months of age at a different site using a different syringe.[177]

Poliovirus Vaccine Inactivated

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), or PPSV23 (Pneumovax® 23) may be given concurrently with poliovirus vaccine inactivated (IPV) using different syringes and different injection sites.[105,207,215]

In clinical studies evaluating PCV13 (Prevnar 13®) in infants, the pneumococcal vaccine was administered concurrently with the first 3 doses of a fixed-combination vaccine containing IPV (DTaP-HepB-IPV; Pediarix®) at 2, 4, and 6 months of age.[181]

Rotavirus Vaccines

PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), or PCV20 (Prevnar 20®) may be given concurrently with rotavirus vaccine live oral (Rotarix®, RotaTeq®).[105,207,215]

Zoster Vaccine

The manufacturer of zoster vaccine live and PPSV23 (Pneumovax® 23) states that consideration should be given to administering these 2 vaccines at least 4 weeks apart.[129]

Data from a randomized, double-blind, controlled study in adults 60 years of age and older indicate that concurrent administration of zoster vaccine live and PPSV23 (Pneumovax® 23) resulted in reduced antibody response to zoster vaccine live compared with that reported when the vaccines were administered 4 weeks apart.[129,180] When assessed using representative pneumococcal serotypes (3, 14, 19A, 22F), the antibody response to PPSV23 (Pneumovax® 23) following concomitant administration was similar to that reported when the vaccines were administered 4 weeks apart.[180,186] Concurrent administration of zoster vaccine live and PPSV23 (Pneumovax® 23) did not result in a clinically important increase in adverse effects compared with administration during separate visits (4 weeks apart).[180,186]

Description

Pneumococcal 13-valent conjugate vaccine (PCV13; Prevnar 13®), pneumococcal 15-valent conjugate vaccine (PCV15; Vaxneuvance®),[207] pneumococcal 20-valent conjugate vaccine (PCV20; Prevnar 20®),[208] pneumococcal 21-valent conjugate vaccine (PCV21; Capvaxive®)[218] and pneumococcal vaccine, polyvalent (pneumococcal 23-valent vaccine; PPSV23; Pneumovax® 23) are used to stimulate active immunity to infection caused by the serotypes of *Streptococcus pneumoniae* (*S. pneumoniae*) contained in the vaccines. [129,181,207,208,218]

The capsular saccharides present in PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), PCV20 (Prevnar 20®), and PCV21 (Capvaxive®) promote production of antibody specific for each pneumococcal capsular type in the vaccine.[181,207,208,218] PCV13 (Prevnar 13®) elicits a T-cell dependent immune response.[181] Protein carrier-specific T-cells provide the signals needed for maturation of the B-cell response.[181] Antibodies produced in response to pneumococcal conjugate vaccines enhance opsonization, phagocytosis, and killing of *S. pneumoniae* by leukocytes and other phagocytic cells.[181,207,208]

Nonclinical and clinical data support opsonophagocytic activity (OPA), as measured by OPA antibody assay, as a contributor to protection against pneumococcal disease.[181,207,208,218] The OPA antibody assay provides an in vitro measurement of the ability of serum antibodies to eliminate pneumococci by promoting complement-mediated phagocytosis and is believed to reflect relevant in vivo mechanisms of protection against pneumococcal disease.[181,207,208,218] In infants who receive PCV13 (Prevnar 13®), OPA correlates well with serotype specific anticapsular polysaccharide immunoglobulin G (IgG) levels as measured by enzyme-linked immunosorbent assay (ELISA).[181] A serum anticapsular polysaccharide antibody concentration of at least 0.35 mcg/mL as measured by ELISA 1 month after the third dose of a single antibody reference concentration has been used to estimate the effectiveness of PCV13 (Prevnar 13®) against invasive pneumococcal disease in infants and children.[181] An antipolysaccharide binding antibody IgG level to predict protection against invasive pneumococcal disease or nonbacteremic pneumonia has not been defined in adults.[181,207]

The extent and duration of immunologic response may vary depending on age and immunocompetence of the vaccinee.[215] Antigens in PCV13 (Prevnar 13®), PCV15 (Vaxneuvance®), and PCV20 (Prevnar®) are conjugated to a carrier protein and are more immunogenic in infants and young children than the unconjugated antigens in PPSV23 (Pneumovax® 23).[207,208,220]

The capsular polysaccharides present in PPSV23 (Pneumovax® 23) promote production of antibody specific for each pneumococcal capsular type in the vaccine.[129] These antibodies enhance opsonization, phagocytosis, and killing of *S. pneumoniae* by leukocytes and other phagocytic cells.[129] Although the immune response to PPSV23 (Pneumovax® 23) generally has been evaluated using quantitative measurements of antibodies, antibody levels that correlate with protections against pneumococcal disease have not been clearly defined.[129]

Following administration of a single dose of PPSV23 (Pneumovax® 23) in healthy adults, more than 80% develop antibodies specific for the pneumococcal capsular types present in the vaccine, usually within 2–3 weeks.[166] The antibody response to the pneumococcal capsular polysaccharides contained in PPSV23 (Pneumovax® 23) generally is poor or inconsistent in infants younger than 2 years of age.[129,166]

A retrospective cohort analysis study based on US Centers for Disease Control and Prevention (CDC) pneumococcal surveillance data indicated that the overall protective effectiveness of PPSV23 (Pneumovax® 23) against invasive pneumococcal infection caused by serotypes included in the vaccine was 57% in individuals 6 years of age or older, 65–84% among specific patient groups (e.g., those with diabetes mellitus, coronary vascular disease, congestive heart failure, chronic pulmonary disease, and anatomic asplenia), and 75% in immunocompetent adults 65 years of age or older.[129]

Individuals with immunodeficiency diseases (e.g., hypogammaglobulinemia, leukemia, lymphoma, multiple myeloma), individuals receiving immunosuppressive therapy, and individuals with Hodgkin's disease who have received extensive chemotherapy, radiation therapy, and splenectomy may have diminished or suboptimal antibody responses to PPSV23 (Pneumovax® 23).[129,166]

Following administration of PPSV23 (Pneumovax® 23) in healthy adults, antibodies formed in response to the vaccine remain elevated for at least 5 years,[126,166] but antibody levels decline after 5–10 years.[166] Antibody levels decline more rapidly in individuals with certain underlying illnesses,[166] including those who have undergone splenectomy following trauma and those with sickle cell disease or nephrotic syndrome.[124,125]

Antigens contained in PPSV23 (Pneumovax® 23) cannot induce long-lasting immunity, since they do not induce T-cell-dependent responses associated with immunologic memory.[166]

Pneumococcal vaccine is commercially available in the US as 2 different vaccine types: pneumococcal conjugate vaccines: pneumococcal conjugate vaccine (pneumococcal 13-valent conjugate vaccine,[181] pneumococcal 15-valent conjugate vaccine,[207] pneumococcal 20-valent conjugate vaccine[208] and pneumococcal 21-valent conjugate vaccine),[218] and pneumococcal vaccine polyvalent (pneumococcal 23-valent vaccine; PPSV23; Pneumovax® 23).[129,181] Although both vaccine types contain capsular antigens extracted from *S. pneumoniae*, the vaccines contain different numbers and forms of these antigens.[129,181,207,208]

PCV13 (Prevnar 13®) is a sterile suspension containing purified capsular saccharide antigens extracted from 13 serotypes of *S. pneumoniae* and individually conjugated to diphtheria CRM_{197}.[181] PCV13 (Prevnar 13®) contains the following 13 capsular saccharide serotypes: 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F, and 23F.[181] Each serotype of *S. pneumoniae* is cultured in soy peptone broth and the individual polysaccharides are purified using centrifugation, precipitation, ultrafiltration, and column chromatography.[181] The polysaccharides are chemically inactivated to make saccharides and these are directly conjugated by reductive amination to the protein carrier (diphtheria CRM_{197}) to form the glycoconjugate.[181] Potency of the vaccine is determined by quantification of each of the saccharide antigens and by the saccharide to protein ratios in the individual glycoconjugates.[181] After shaking, PCV13 (Prevnar 13®) occurs as a homogeneous white suspension.[181]

PCV15 (Vaxneuvance®) is a sterile suspension of purified capsular polysaccharides extracted from 15 serotypes of *S. pneumoniae* and individually conjugated to diphtheria CRM_{197}.[207] PCV15 (Vaxneuvance®) contains the following 15 capsular saccharide serotypes: 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F, 22F, 23F, and 33F.[207] Each S. pneumoniae serotype is grown in media containing yeast extract, dextrose, salts and soy peptone and purified by a series of chemical and physical methods.[207] Then each polysaccharide is chemically activated and conjugated to the carrier protein CRM_{197} to form each glycoconjugate.[207] The final vaccine is prepared by blending the fifteen glycoconjugates with aluminum phosphate adjuvant in a final buffer containing histidine, polysorbate 20, and sodium chloride.[207] After shaking, PCV15 (Vaxneuvance®) occurs as an opalescent suspension.[207]

PCV20 (Prevnar 20®) is a sterile suspension of purified capsular polysaccharides extracted from 20 serotypes of *S. pneumoniae* and individually conjugated to diphtheria CRM_{197}.[208,] PCV20 (Prevnar 20®) contains the following 20 capsular saccharide serotypes: 1, 3, 4, 5, 6A, 6B, 7F, 8, 9V, 10A, 11A, 12F, 14, 15B, 18C, 19A, 19F, 22F, 23F, and 33F.[208,] Each serotype of *S. pneumoniae* is grown in soy peptone broth and the individual polysaccharides are purified by a series of chemical and physical methods.[208,] The polysaccharides are chemically activated and then directly conjugated to the carrier protein CRM_{197}, to form the glycoconjugate.[208,] Potency of the formulated vaccine is determined by quantification of each of the saccharide antigens and by the saccharide to protein ratios in the individual glycoconjugates.[208,] After shaking, PCV20 (Prevnar 20®) occurs as a homogeneous white suspension.[208,] Each 0.5 mL dose of the vaccine is formulated to contain approximately 2.2 µg of each of *S. pneumoniae* serotypes.[208,]

PCV21 (Capvaxive®) is a sterile solution of purified capsular polysaccharides extracted from 21 serotypes of *S. pneumoniae* and individually conjugated to diphtheria $CRM_{197}$to form the conjugate.[218,] PCV21 (Capvaxive®) contains the following 21 capsular saccharide serotypes: 3, 6A, 7F, 8, 9N, 10A, 11A, 12F, 15A, 15B (de-O-acetylated prior to conjugation), 16F, 17F, 19A, 20A, 22F, 23A, 23B, 24F, 31, 33F, and 35B.[218,] Each serotype of *S. pneumoniae* is grown separately in media containing yeast extract, dextrose, salts, and soy peptone and the bacteria are inactivated after growth by addition of phenol to the culture media.[218,] The polysaccharides are chemically activated and then directly conjugated to the carrier protein CRM197, to form the glycoconjugate.[218,] Subsequently, each polysaccharide is purified to produce a powder using a series of chemical and physical methods.[218,] Serotype 15B polysaccharide is de-O-acetylated (deOAc 15B).[218,218,] Each 0.5 mL dose of the vaccine is formulated to contain 4 mcg of each *S. pneumoniae* for a total of 84 mcg of pneumococcal polysaccharide antigen.[218,]

PPSV23 (Pneumovax® 23) is a sterile solution containing purified capsular polysaccharide antigens extracted from 23 different serotypes of *S. pneumoniae*.[129,] PPSV23 (Pneumovax® 23) contains the following 23 capsular polysaccharide serotypes: 1, 2, 3, 4, 5, 6B, 7F, 8, 9N, 9V, 10A, 11A, 12F, 14, 15B, 17F, 18C, 19F, 19A, 20, 22F, 23F, and 33F.[129,] PPSV23 (Pneumovax® 23) occurs as a clear, colorless solution.[129,]

Each 0.5-mL dose of PPSV23 (Pneumovax® 23) contains 25 mcg of each type of capsular polysaccharide antigen[129,] in 0.9% sodium chloride injection.[129,] The vaccine does not contain thimerosal, but does contain phenol as a preservative.[105,129,]

Advice to Patients

The following information contains important points for the clinician to discuss with patients during counseling. For more comprehensive monographs suitable for distribution to the patient, please refer to the *AHFS Patient Medication Information* monographs available from MedlinePlus (https://vsearch.nlm.nih.gov/vivisimo/cgi-bin/query-meta?v:project=medlineplus) (in English and Spanish; written at a 6th- to 8th-grade reading level).

- Advise patient and/or patient's parent or guardian of the risks and benefits of vaccination with pneumococcal vaccine.[129,181,207,208,218,]
- Advise patient and/or patient's parent or guardian of the importance of receiving pneumococcal vaccination if they are at increased risk of pneumococcal disease and inform them that specific vaccine products are given based on the patient's age.[181,199,205,207,208,213,218,220,]
- Advise patient and/or patient's parent or guardian that pneumococcal vaccines may not provide protection in all vaccinees.[129,181,207,208,218,]
- Importance of informing clinicians of any history of allergic reactions to pneumococcal vaccines (i.e., PCV13, PCV15, PCV20, PCV21) or any vaccine containing diphtheria toxoid.[129,181,207,208,218,]
- Importance of informing clinicians if any severe or unusual adverse reactions (including allergic reactions) occur with pneumococcal vaccine.[129,] Clinicians or individuals can report any adverse reactions that occur following vaccination to the Vaccine Adverse Event Reporting System (VAERS) at 800-822-7967 or https://www.vaers.hhs.gov/ (https://www.vaers.hhs.gov/) .[129,181,207,208,218,]
- Importance of informing clinicians of existing or contemplated concomitant therapy, including prescription and OTC drugs, and any concomitant illnesses.[129,181,207,208,218,]
- Importance of females of child bearing potential informing clinicians if they are or plan to become pregnant or plan to breast-feed.[129,181,207,208,218,]
- Inform patients of other important precautionary information.[129,181,207,208,218,]

Additional Information

The American Society of Health-System Pharmacists, Inc. represents that the information provided in the accompanying monograph was formulated with a reasonable standard of care, and in conformity with professional standards in the field. Readers are advised that decisions regarding use of drugs are complex medical decisions requiring the independent, informed decision of an appropriate health care professional, and that the information contained in the monograph is provided for informational purposes only. The manufacturer's labeling should be consulted for more detailed information. The American Society of Health-System Pharmacists, Inc. does not endorse or recommend the use of any drug. The information contained in the monograph is not a substitute for medical care.

Preparations

Excipients in commercially available drug preparations may have clinically important effects in some individuals; consult specific product labeling for details.

Pneumococcal 13-valent Conjugate Vaccine (Diphtheria CRM197 Protein) (PCV13) (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Pneumococcal+13-valent+Conjugate+Vaccine+%28Diphtheria+CRM197+Protein%29+%28PCV13%29&collapse=1)

Parenteral

Injectable suspension, for IM use

Each 0.5 mL dose contains approximately 2.2 mcg of each of Streptococcus pneumoniae serotypes 1, 3, 4, 5, 6A, 7F, 9V, 14, 18C, 19A, and 19F

Prevnar 13® *(available as single-dose prefilled syringes)*, Wyeth (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=LabelerName&ApptName=Wyeth&collapse=1)

Pneumococcal 15-valent Conjugate Vaccine (Diphtheria CRM197 Protein) (PCV15) (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Pneumococcal+15-valent+Conjugate+Vaccine+%28Diphtheria+CRM197+Protein%29+%28PCV15%29&collapse=1)

Parenteral

Injectable suspension, for IM use

Each 0.5 mL dose contains 2 mcg each of S. pneumoniae polysaccharide serotypes 1, 3, 4, 5, 6A, 7F, 9V, 14, 18C, 19A, 19F, 22F, 23F, and 33F

Vaxneuvance® *(available as single-dose prefilled syringes)*, Merck (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=LabelerName&ApptName=Merck&collapse=1)

Pneumococcal 20-valent Conjugate Vaccine (Diphtheria CRM197 Protein) (PCV20) (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Pneumococcal+20-valent+Conjugate+Vaccine+%28Diphtheria+CRM197+Protein%29+%28PCV20%29&collapse=1)

Parenteral

Injectable suspension, for IM use

Each 0.5 mL dose contains approximately 2.2 mcg of each of S. pneumoniae serotypes 1, 3, 4, 5, 6A, 7F, 8, 9V, 10A, 11A, 12F, 14, 15B, 18C, 19A, 19F, 22F, and 23F

Prevnar 20® *(available as single-dose prefilled syringes)*, Wyeth (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=LabelerName&ApptName=Wyeth&collapse=1)

Pneumococcal 21-valent Conjugate Vaccine (Diphtheria CRM197 Protein) (PCV21) (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Pneumococcal+21-valent+Conjugate+Vaccine+%28Diphtheria+CRM197+Protein%29+%28PCV21%29&collapse=1)

Parenteral

Injectable solution, for IM use

Each 0.5 mL dose contains approximately 4 mcg of each of S. pneumoniae serotypes 3, 6A, 7F, 8, 9N, 10A, 11A, 12F, 15A, 15B (deOAc 15B), 16F, 17F, 19A, 20A, 22F, 23A, 23B, 24F, 31, 33F, and 35B

Capvaxive® *(available as single-dose prefilled syringes)*, Merck (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=LabelerName&ApptName=Merck&collapse=1)

Pneumococcal Vaccine, Polyvalent (PPSV23) (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Pneumococcal+Vaccine%2C+Polyvalent+%28PPSV23%29&collapse=1)

Parenteral

Injection

Consists of a mixture of purified capsular polysaccharides from Streptococcus pneumoniae types (1, 2, 3, 4, 5, 6B, 7F, 8, 9N, 9V, 10A, 11A, 12F, 14, 15B, 17F, 18C, 19F, 19A, 20, 22F, 23F, and 33F); each 0.5-mL dose contains 25 mcg of each polysaccharide type

Pneumovax® 23 *(available as single-dose vials and single-dose prefilled syringes)*, Merck (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=LabelerName&ApptName=Merck&collapse=1)

Related Resources

AHFS Patient Medication Information (https://vsearch.nlm.nih.gov/vivisimo/cgi-bin/query-meta?v:project=medlineplus&query=Pneumococcal%20Vaccine) and other related patient health topics (MedlinePlus)
ASHP Drug Shortages Resource Center (https://www.ashp.org/Drug-Shortages)
CCRIS (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+ccris:%%22Pneumococcal%20Vaccine%%22) (Chemical Carcinogenesis Research Information System)
ChemID*plus* (https://chem.nlm.nih.gov/chemidplus/name/Pneumococcal%20Vaccine)
Biochemical Data Summary (http://www.drugbank.ca/unearth/q?utf8=%%E2%%9C%%93&query=Pneumococcal%20Vaccine&searcher=drugs&approved=1&vet_approved=1&nutraceutical=1&illicit=1&withdrawn=1&investiga (US and Canada)
Clinical Trials (https://www.clinicaltrials.gov/ct/search?submit=Search&term=Pneumococcal%20Vaccine)
DailyMed (https://dailymed.nlm.nih.gov/dailymed/search.cfm?query=Pneumococcal%20Vaccine) (drug labels)
DART (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+dart:%%22Pneumococcal%20Vaccine%%22) (Developmental and Reproductive Toxicology Database)
Drugs@FDA (https://www.accessdata.fda.gov/scripts/cder/drugsatfda/index.cfm?fuseaction=Search.SearchAction&SearchType=BasicSearch&SearchTerm=Pneumococcal%20Vaccine) (approval information)
European Medicines Agency (https://www.ema.europa.eu/en/search/search?search_api_views_fulltext=Pneumococcal%20Vaccine)
FDA National Drug Code Directory (https://www.accessdata.fda.gov/scripts/cder/ndc/default.cfm?sugg=NonProprietaryName&ApptName=Pneumococcal%20Vaccine&collapse=1)

FDA Recalls, Market Withdrawals, and Safety Alerts (https://www.fda.gov/Safety/Recalls/default.htm)
HSDB (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+hsdb:%%22Pneumococcal%20Vaccine%%22) (Hazardous Substances Data Bank)
Inxight Drugs (https://drugs.ncats.io/substances?q=%%22Pneumococcal%20Vaccine%%22) (National Center for Advancing Translational Sciences)
LactMed (drug effects on breastfeeding) (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+lactmed:@or+%%28@na+%%22Pneumococcal%20Vaccine%%22+%%29)
New Drug Approvals (https://ahfs.ashp.org/drug-assignments.aspx)
Orange Book (https://www.accessdata.fda.gov/scripts/cder/ob/default.cfm?panel=0&drugname=Pneumococcal%20Vaccine) (therapeutic equivalence)
PharmGKB (https://www.pharmgkb.org/search?connections&gaSearch=Pneumococcal%20Vaccine&query=Pneumococcal%20Vaccine&type=chemical) (Pharmacogenomic data from PharmGKB)
Pillbox (*beta*) (https://pillbox.nlm.nih.gov/pillimage/search_results.php?submit=Search&splid=&getingredient=Pneumococcal%20Vaccine) (drug identification and images)
PubMed (https://www.ncbi.nlm.nih.gov/pubmed?DB=pubmed&term=Pneumococcal%20Vaccine%%5BAll+Fields%%5D) (scientific journals)
Safety-related Labeling Changes (https://www.accessdata.fda.gov/scripts/cder/safetylabelingchanges) (FDA/CDER)
ToxLine (https://toxnet.nlm.nih.gov/cgi-bin/sis/search2/r?dbs+toxline:%%22Pneumococcal%20Vaccine%%22) (Toxicology Literature Online)

† Use is not currently included in the labeling approved by the US Food and Drug Administration.

Original Publication Date: October 01, 1978.
Selected Revisions: February 10, 2026.
Database Extraction: 02/06/2026 18:09:41 +0000+

References

105. American Academy of Pediatrics. Red Book: 2024-2027 Report of the Committee on Infectious Diseases. 33th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2024.

124. Giebink GS, Le CT, Schiffman G et al. Decline of serum antibody in splenectomized children after vaccination with pneumococcal capsular polysaccharides. *J Pediatr*. 1984; 105:576-82 [Web] (https://www.ncbi.nlm.nih.gov/pubmed/6481533?dopt=AbstractPlus)

125. Weintrub PS, Schiffman G, Addiego JE Jr et al. Long-term follow-up and booster immunization with polyvalent pneumococcal polysaccharide in patients with sickle cell anemia. *J Pediatr*. 1984; 105:261-3 [Web] (https://www.ncbi.nlm.nih.gov/pubmed/6747758?dopt=AbstractPlus)

126. Mufson MA, Krause HE, Schiffman G. Long-term persistence of antibody following immunization with pneumococcal polysaccharide vaccine (41643). *Proc Soc Exp Biol Med*. 1983; 173:270-5 [Web] (https://www.ncbi.nlm.nih.gov/pubmed/6867005?dopt=AbstractPlus)

129. Merck & Co. Pneumovax® 23 (pneumococcal vaccine polyvalent) prescribing information. Whitehouse Station, NJ; 2023 Apr.

145. Reviewers' comments (personal observations) on influenza vaccine 80:12.

146. Honkanen PO, Keistinen T, Kivelä SL. Reactions following administration of influenza vaccine alone or with pneumococcal vaccine to the elderly. *Arch Intern Med*. 1996;156:205-8.

166. Centers for Disease Control and Prevention. Epidemiology and prevention of vaccine-preventable diseases: Chapter 17 Pneumococcal disease. 14th ed. Washington DC: Public Health Foundation; May 1, 2024:255-74. Available at CDC website.[Web] (https://www.cdc.gov/pinkbook/hcp/table-of-contents/chapter-17-pneumococcal-disease.html)

177. Division of Bacterial Diseases, National Center for Immunization and Respiratory Diseases, CDC. Prevention and control of meningococcal disease. *MMWR Recomm Rep*. 2013; 62:1-22

178. Influenza Division, National Center for Immunization and Respiratory Diseases, CDC. Prevention and control of seasonal influenza with vaccines. *MMWR Recomm Rep*. 2013; 62:1-43

180. Macintyre CR, Egerton T, McCaughey M et al. Concomitant administration of zoster and pneumococcal vaccines in adults ≥60 years old. *Hum Vaccin*. 2010; 6:894-902 [Web] (https://www.ncbi.nlm.nih.gov/pubmed/20980796?dopt=AbstractPlus)

181. Wyeth Pharmaceuticals. Prevnar 13® (pneumococcal 13-valent conjugate vaccine [diphtheria CRM_{197} protein]) prescribing information. Philadelphia, PA; 2019 Jul.

185. Alexa PL. Dear health care professional letter regarding important update on the transition to Prevnar 13® (pneumococcal 13-valent conjugate vaccine [diphtheria CRM_{197} protein]). New York, NY: Pfizer Inc; 2010 Jul.

186. Merck & Co. Zostavax® (zoster vaccine live suspension for subcutaneous injection) prescribing information. Whitehouse Station, NJ; 2014 Feb.

199. Centers for Disease Control and Prevention. Advisory Committee on Immunization Practices (ACIP) child and adolescent immunizaion schedule by age, recommendations for ages 18 years or younger, United States 2025. Updates may be available at CDC website.[Web] (https://www.cdc.gov/vaccines/hcp/imz-schedules/child-adolescent-age.html)

205. Committee On Infectious Diseases. Immunization for Streptococcus pneumoniae infections in high-risk children. *Pediatrics*. 2014; 134:1230-3 [Web] (https://www.ncbi.nlm.nih.gov/pubmed/25422018?dopt=AbstractPlus)

207. Merck & Co. Vaxneuvance® (pneumococcal 15-valent conjugate vaccine) prescribing information. Whitehouse Station, NJ; 2024 May.

208. Wyeth Pharmaceuticals. Prevnar 20® (pneumococcal 20-valent conjugate vaccine [diphtheria CRM_{197} protein]) prescribing information. Philadelphia, PA; 2023 Apr

211. Centers for Disease Control and Prevention (CDC). Use of 15-valent pneumococcal conjugate vaccine among U.S. children: Updated Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Morb Mortal Wkly Rep*. 2022; 71:1174-81 [Web] (https://www.ncbi.nlm.nih.gov/pubmed/36107786?dopt=AbstractPlus)

212. Centers for Disease Control and Prevention (CDC). Pneumococcal vaccine timing for adults. 2024 Oct. From CDC website[Web] (https://www.cdc.gov/pneumococcal/downloads/vaccine-timing-adults-jobaid.pdf?CDC_AAref_Val=https://www.cdc.gov/vaccines/vpd/pneumo/downloads/pneumo-vaccine-timing.pdf)

213. Kobayashi M, Pilishvili T, Farrar JL et al. Pneumococcal Vaccine for Adults Aged ≥19 Years: Recommendations of the Advisory Committee on Immunization Practices United States, 2023. MMWR Recomm Rep. 2023 Sep 8;72(3):1-39. doi: 10.15585/mmwr.rr7203a1. PMID: 37669242; PMCID: PMC10495181.

215. Kroger A, Bahta L, Hunter P. General Best Practice Guidelines for Immunization. Best Practices Guidance of the Advisory Committee on Immunization Practices (ACIP). Accessed on 2022 Oct 17[Web] (https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/downloads/general-recs.pdf)

216. Centers for Disease Control and Prevention (CDC). Guidelines for vaccinating pregnant persons. 2024 Jul. Accessed 2024 Oct 17[Web] (https://www.cdc.gov/vaccines-pregnancy/hcp/vaccination-guidelines/?CDC_AAref_Val=https://www.cdc.gov/vaccines/pregnancy/hcp-toolkit/guidelines.html)

217. Centers for Disease Control and Prevention (CDC). Vaccines for People with Cochlear Implants. 2024 Jul.[Web] (https://www.cdc.gov/vaccines/vpd/mening/hcp/dis-cochlear-gen.html)

218. Merck Sharp & Dohme LLC. Capvaxive (pneumococcal 21-valent conjugate vaccine) prescribing information. Rahway, NJ; 2024 Jun.

219. Centers for Disease Control and Prevention (CDC). Use of 21-Valent Pneumococcal Conjugate Vaccine Among U.S. Adults: Recommendations of the Advisory Committee on Immunization Practices — United States, 2024. MMWR; 2024; 73:793-8.

220. Centers for Disease Control and Prevention (CDC). Use of 20-Valent Pneumococcal Conjugate Vaccine Among U.S. Children: Updated Recommendations of the Advisory Committee on Immunization Practices — United States, 2023. MMWR; 2023; 72:1072.

221. Senders S, Klein NP, Tamini N, et al. A Phase Three Study of the Safety and Immunogenicity of a Four-dose Series of 20-Valent Pneumococcal Conjugate Vaccine in Healthy Infants. PIDJ. 2024; 43:596-603.

222. Centers for Disease Control and Prevention (CDC). Pneumococcal Vaccine Recommendations. October 26, 2024. From CDC website.[Web] (https://www.cdc.gov/pneumococcal/hcp/vaccine-recommendations/index.html)

About ASHP
ASHP represents pharmacists who serve as patient care providers in acute and ambulatory settings. The organization's nearly 55,000 members include pharmacists, student pharmacists, and pharmacy technicians. For more than 75 years, ASHP has been at the forefront of efforts to improve medication use and enhance patient safety. For more information about the wide array of ASHP activities and the many ways in which pharmacists advance healthcare, visit ASHP's website (https://www.ashp.org), or its consumer website (https://www.safemedication.com).

Contact Us
ASHP
4500 East-West Highway, Suite 900
Bethesda, Maryland 20814

Customer Service
1-866-279-0681
custserv@ashp.org (mailto:custserv@ashp.org)
softwaresupport@ashp.org (mailto:softwaresupport@ashp.org)