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# Immunizations for Adults and Children

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# Immunizations for Adults and Children

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## Introduction

Vaccines represent the most important medical advance of the twentieth century. The time has passed when large numbers of children and adults suffered serious, life threatening illness from viruses including poliovirus, measles virus, influenza viruses, hepatitis B virus and varicella zoster virus or faced lifelong disability or death from bacterial infections including *Hemophilus influenzae*, meningococcus and pneumococcus, all infections that can be prevented now by effective vaccines.

In this review, we discuss various aspects of vaccines for children and adults, including a description and recommendation of new vaccines, the importance of and improvements in established vaccines, and overcoming obstacles such as ethical dilemmas and office dynamics to improve uptake. We include two summary tables, Table 1 and Table 2, which highlight vaccine immunization schedules for children and adults, respectively.<sup>1</sup>

## Herpes zoster vaccine (Zostavax)

**Key points:** Zostavax is now approved for patients aged 50-59 years. This age range has a better

response with a 70% reduction in risk of getting shingles. It is not necessary to check varicella titers before giving the vaccine.

Approximately 1 in 3 people in the United States become ill with herpes zoster or shingles and 10-18% develop post-herpetic neuralgia, a devastating chronic pain syndrome. Zostavax became available in 2006.<sup>2</sup> It reduces the risk by one-half of shingles and by two-thirds the risk of post-herpetic neuralgia in immunized patients over age 60. Zostavax is not helpful in treating shingles or post-herpetic neuralgia. It can be administered to patients who previously had shingles as they experience a 3% recurrence rate. Persons with compromised immune systems and persons allergic to neomycin and gelatin should not take this vaccine.

## Hepatitis A vaccine

**Key points:** Everyone over age 1 can get this vaccine.

Hepatitis A virus (HAV) causes foodborne illness that usually lasts 2 months; however, 10-15% last up to 6 months. In rare cases, acute liver failure and death ensue. From 1998 to 2008, 227 cases of HAV were reported in West Virginia.<sup>3</sup> In 2007, outbreaks of HAV occurred in Pendleton and Wirt Counties and, in 2010, an outbreak occurred among 11 people in Cabell County, WV, and nearby Boyd County, KY.

Although HAV is not required for children in schools or daycare centers, it is a good idea to vaccinate everyone over age 1 year. It is especially recommended for persons over age 18 that provide a home or day care for an international adopted child, men who have sex with men, illicit drug users, people with chronic liver disease from other causes, travelers to countries with high prevalence of HAV and researchers working with HAV.<sup>4</sup>

## Hepatitis B vaccine

**Key points:** Anyone not in a monogamous sexual relationship should get this vaccine. Those born after 1991 have probably had it as part of routine childhood vaccination.

**What's New:** The ACIP now recommends Hepatitis B vaccine for diabetics especially those aged 19-59 with their increased risk being due to contaminated glucose monitoring equipment.

Hepatitis B virus (HBV) causes an acute illness with anorexia, diarrhea and vomiting and a chronic illness that can lead to cirrhosis, liver cancer, and death. Since 1991, newborns in the United States routinely receive their first dose of hepatitis B vaccine within 12 hours of birth, a program that decreased by over 95% the incidence of acute HBV illness among children.<sup>4</sup> Because HBV is transmitted by blood and body fluids, anyone who is sexually active is at risk and

## Objectives

1. Be able to describe recent changes in adult and pediatric vaccines.
2. Be able to apply knowledge about vaccines to clinical practice.
3. Be aware of recent outbreaks of certain vaccine preventable diseases in West Virginia.
4. Be able to improve office mechanics to improve vaccine uptake.

persons at highest risk include sex partners and household contacts of those infected with HBV, men who have sex with men, intravenous drug abusers, healthcare workers, dialysis patients and travelers to countries with a high prevalence of HBV. Patients with HIV infection, chronic liver disease and diabetes should be vaccinated. A recombinant vaccine, hepatitis B vaccine involves insertion of the HBsAg gene using plasmids into yeast or mammalian cells; anyone with a life-threatening allergy to Baker's yeast should not receive the vaccine.

### Tetanus & Diphtheria Toxoids & Acellular Pertussis Vaccine (DTP/TT/Td/Dtap/Tdap)

**What's new:** All healthcare personnel should receive a single dose of Tdap regardless of the time since last Td dose. Tdap should be administered during the second or third trimester to pregnant women or immediately postpartum.

— Adults who have close contact with an infant less than 1 year old should have a Tdap.

— All adolescents and adults can have one Tdap in place of their usual tetanus booster.

Although only 3 cases of tetanus have been reported in WV from 1999-2008 and no cases of diphtheria, there have been 288 cases of pertussis or whooping cough (Figure 1).<sup>3</sup> Adults either vaccinated against pertussis or having the disease in childhood show waning immunity, become susceptible to the disease and can transmit the disease to infants under 1 year who have not yet developed full immunity. During 2001-2003, 28,998 cases of pertussis were reported in the United States.<sup>5</sup> In the older DPT vaccine, the pertussis component was derived from killed bacteria and it caused many serious adverse reactions in children. Recently, an acellular pertussis component was incorporated into

the vaccine (DTaP for children less than 7 years old and Tdap for people over 11 years old) that elicits few adverse reactions. Td should be administered to adults every 10 years provided they previously received one Tdap as an adult. TT is given to adults who are allergic to the diphtheria portion of the vaccine.

### Pneumococcal Vaccine PPV23 for Adults and PCV13 for Children

**Key Points:** The maximum number of doses of Pneumovax (PPV23) an adult should receive is two.

**What's New:** Asthma and smoking are now considered in the chronic medical condition category and adults with either of these risk factors get two doses, one before age 65 and one after age 65 years of age.

PCV13, a conjugated vaccine, is the new standard of care vaccine for children.

PCV13 is now FDA approved for people over age 50 but ACIP has not yet made recommendations.

*Streptococcus pneumoniae* causes serious disease among children and adults, with younger children and older adults most at risk.<sup>6</sup> In WV from 1999 to 2008, 1,932 cases of invasive pneumococcal disease (IPD) were reported (Figure 1).<sup>3</sup> The current vaccine, comprised of 23 polysaccharides or PPV23, was licensed in 1983.<sup>7</sup> Adults of average risk should receive only one dose of PPV23 after the age of 65 years. Adults with chronic medical conditions including heart disease, chronic lung disease, diabetes mellitus, alcoholism, cerebrospinal fluid leaks and cochlear implants should receive one dose before age 65 and one after age 65, provided at least 5 years have elapsed between the two doses. Immunocompromised adults should receive two doses five years apart; both doses can be given before the age of 65 years. Immunocompromised children who

receive PPV23 before age 10 can receive a second dose three years later and those who receive their first dose after 10 years of age can receive a second dose five years later. Elderly patients should receive only one dose of PPV23 after 65 years of age, as the modest antibody responses to second doses do not warrant them.

Protein-conjugated pneumococcal polysaccharide vaccine (PCV7) for infants and children was introduced in 2000 as one of the regularly scheduled immunizations for infants starting at age 2 months for the prevention of otitis media and invasive pneumococcal disease (IPD). The vaccine comprised of seven polysaccharides, each conjugated to minute amounts of diphtheria protein, induced higher antibody responses. It led to a significant decline in all IPD cases, especially in childhood IPD, due to the seven serotypes in PCV7, and a significant decline of IPD in adults due to the same serotypes, probably through decreased spread of these serotypes from grandchild to grandparent.<sup>8</sup> As five of the seven serotypes in PCV7 (6B,9V,14,19F,23) can develop penicillin resistance, the number of cases of penicillin resistant IPD also decreased. In 2010, PCV13 supplanted PCV7 as the routinely used pneumococcal vaccine for infants and children. PCV13 contains 13 pneumococcal serotypes and offers wider protection against IPD.<sup>7</sup>

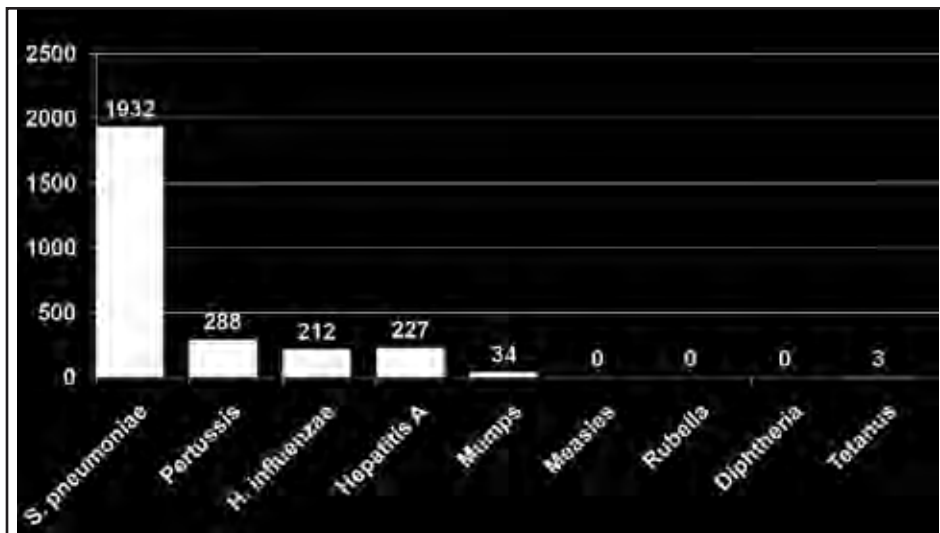
### Influenza Vaccine

**What's New:** Since 2010, all people over age 6 months should receive the influenza vaccine. New preparations include the high dose influenza vaccine for those over age 65, intradermal vaccine, and a quadrivalent live attenuated vaccine. The H1N1 strain is included in the 2011 vaccine.

The two seasonal influenza vaccines are a trivalent inactivated vaccine and a live attenuated influenza virus vaccine (LAIV) that

**Figure 1.**

*Cumulative cases of selected vaccine preventable diseases in West Virginia, 1999-2008.*



typically contain two type A strains and one type B strain; the included vaccine strains change annually.<sup>9</sup> The inactivated virus vaccine comes in three CDC approved formulations: an intramuscular injection approved for ages 6 months and older, a high-dose injection approved for ages 65 years and older and an intradermal injection approved for ages 18-64 years. The high-dose vaccine contains four-fold as much antigen as the traditional flu shot and produces a stronger immune response in older persons. The intradermal injection employs a needle that is 90% smaller than the needle used for the intramuscular injection and contains 40% less antigen. LAIV, a nasal spray, is approved for healthy individuals 2-49 years of age. Immunocompromised persons should not receive LAIV. The first quadrivalent seasonal influenza vaccine was approved in February 2012. It contains two Type A and two Type B strains. The quadrivalent vaccine is an LAIV which is also administered intranasally and is approved for the same patient population as the trivalent LAIV.

In 2010, the Advisory Committee on Immunization Practices recommended for the first time that all persons aged 6 months and older

should receive influenza vaccine, unless contraindicated.<sup>9</sup> Infants and children aged 6 months to 8 years who are receiving flu vaccine for the first time or who did not or may not have received a flu vaccine last year require two doses this season, at least 28 days apart. Infants and children aged 6 months to 8 years who received only one dose of flu vaccine during the 2010-11 season would normally be recommended to receive two doses this season; however, since the formulation of the vaccine is the same for the 2011-12 season as for the 2010-11 season, a child in the 6 months to 8 years age group who received at least one dose last year, only requires one dose this year.

People who should not receive influenza vaccine include those with a severe egg allergy, a severe reaction to influenza vaccine, a history of Guillain-Barre syndrome associated with administration of influenza vaccine and infants younger than 6 months of age. People with a moderate to severe illness with fever should delay immunization until they have recovered.

#### **Poliovirus vaccine**

**Key point:** There is only one poliovirus vaccine given at this time and it is the inactivated vaccine (IPV).

The immunization of infants, children and adults with poliovirus vaccine started in the late 1950's, initially with the Salk inactivated poliovirus vaccine (IPV) and then the Sabin oral poliovirus vaccine (OPV), virtually eliminating poliomyelitis in the United States during the ensuing decades. However, after a few cases of paralytic polio occurred among adults who had received OPV, the CDC discontinued routine use of OPV in 2000 and now all infants, children and adults receive IPV.<sup>4</sup>

#### **Measles, Mumps, and Rubella Vaccine (MMR)**

**Key Points:** MMR is a live vaccine and should not be given to severely immunocompromised people.

MMR vaccine is a trivalent vaccine containing three live attenuated viruses for protection against measles, mumps and rubella infections. During the ten years from 1999-2008 in WV, no cases of measles or rubella were detected and only 34 cases of mumps were reported (Figure 1). In 2011, sixteen outbreaks of measles were reported in the United States, the largest occurred in Minneapolis and among the 21 patients who contracted measles, 16 patients were unvaccinated.<sup>10</sup>

#### **Varicella vaccine**

**What's new:** Since 2006, two doses are recommended, one at 12-15 months and another at 4-6 years. It is now recommended for HIV positive children and adults with certain CD4 counts, namely lymphocyte percentages of 15-24% in children and CD4 counts greater than 200cells/microliter in adolescents and adults.

Routine varicella vaccine usage has decreased hospitalizations and deaths from this disease. Deaths occur mainly among immunocompromised patients. After identifying a shift in the peak incidence in age of varicella cases among those who

received the vaccine once as an infant, the CDC recommendation changed to include a second dose of vaccine at age 4-6 years.<sup>4</sup>

**Human Papillomavirus vaccine (HPV2 and HPV4)**

**What's new:** HPV4 (quadrivalent) is now recommended for boys aged 9-26 years to prevent genital warts.

Human papillomavirus vaccine (HPV, either bivalent or quadrivalent) is recommended for all girls starting at 11-12 years of age (range 9-26 years).<sup>11</sup> The quadrivalent HPV vaccine prevents infection with four serotypes included in the vaccine, two of which cause most cervical cancers and genital warts.

HPV4 is suggested for males 9-26 years of age to prevent genital warts and possibly head and neck cancer. It reduces the risk of anal intraepithelial neoplasia in men who

have sex with men. The recombinant vaccine is made in Baker's yeast, so anyone with a severe yeast allergy should avoid the vaccine. Syncope has been reported after vaccination so each vaccinee should be observed for 15 minutes.

**Meningococcal Vaccine (MCV4-conjugate quadrivalent and MPSV4-polysaccharide quadrivalent)**

**What's new:** Since 2010, the MCV4 vaccine is given as a two dose series, the first at age 11-12 years and a booster at age 16 years. Persons with asplenia and complement deficiency should receive a booster every 5 years. MPSV4 is for people over age 56 years.

The meningococcal vaccine, which contains four of the most common meningococcal antigens, protects against about 80% of meningococcal disease. College students in their first and second years, especially those

who live in campus dormitories, are at high risk of contracting the disease and many colleges now require proof of vaccination before attendance. The new requirements suggest a dose of vaccine within 5 years of starting college so those who received their first dose at age 11-12 should receive a booster after age 16 years.<sup>12</sup>

**Hemophilus influenzae type B vaccine (Hib)**

**What's new:** Widespread use of Hib conjugate vaccine nearly completely eradicated invasive disease and eliminated nasopharyngeal carriage.

Hib causes invasive disease and meningitis, with serious complications including mental retardation. Hib vaccine is available alone or in combination with other vaccines and need only be administered at 2, 4, and 6 months of age.<sup>4</sup> A booster dose is administered at 12-15 months.

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**Table 1. Recommendations for Routine Immunization of Children 0-8 Years of Age**

Vaccine	Code	Number of Doses	First Dose at Age	Additional Doses at Ages	Notes
<b>VIRUS VACCINES</b>					
Hepatitis B	HepB	3	Birth	1-2m, 6-18m	Give HBIG within 12h of birth if Mother HbsAg positive
Hepatitis A	HepA	2	12-23 m	12-23m	Two doses at least 6m apart
Influenza, seasonal	Flu	2	6m-8y	At least 4w after first dose	First year receiving vaccine
		1	Over 8y	Annually	Administer one dose each Fall
Measles, mumps, rubella	MMR	2	12-15m	4-6y	Can give second dose before 4y if at least 4 weeks between two doses
Poliovirus, inactivated	IPV	4	2 m	4m, 6-18m, 4-6y	Final dose on or after 4y of age
Rotavirus	RV	3	2 m	4m, 6m	No dose at 6m if Rotarix given at 2 and 4m
Varicella	Var	2	12-15m	4-6y	Age 12m-12y need at least 3m between doses
<b>BACTERIAL VACCINES</b>					
Diphtheria, tetanus, pertussis	DTap	5	2m	4m, 6m, 12-18m, 4-6y	Need at least 6m between 2 <sup>nd</sup> and 3 <sup>rd</sup> doses
Haemophilus influenza type b	Hib	4	2m	4m, 6m, 12-15m	No dose at 6m if PedVaxHIB or Comvax given at 2 and 4m
Meningococcal	MCV4	1	2-6y	2-6y	High risk only
Pneumococcal	PCV13	4	2m	4m, 6m, 12-15m	Complete PCV7 series with PCV13

**Rotavirus**

**What's new:** There are now two approved vaccines, RV5 and RV1, both live oral vaccines and about 74-87% effective at preventing the disease. Intussusception is not increased in recipients.

Before vaccine, four of five children experienced rotavirus infection by age 5 and this illness accounted for 30-50% of hospitalizations among this age group.<sup>4</sup> RV5, a live oral vaccine, shows 98% effectiveness in

preventing severe disease. RV1 appears to have similar rates of efficacy. RV1 has latex in the applicator and should not be administered to persons with latex allergy. RV5 is latex-free.

**Ethical issues about vaccines**

Parents who deny vaccines for their children, except for specific medical conditions confirmed by a physician, fail to act in the best interests of their children, religious beliefs notwithstanding. Physicians have an ethical responsibility to address their reasons for refusal and

explain the risk and benefit. School districts in every state require routine immunizations of children before they start kindergarten, an important ethical prevention program.

Some parents who refuse vaccines for their children, especially MMR, may worry that the vaccines cause autism. Unfortunately, that relationship was fostered by one group of researchers from the UK who published falsified data for personal gain.<sup>13</sup> Subsequently, several studies provided evidence that refuted autism as an adverse event of immunization with MMR vaccine.<sup>14</sup>

**Table 2. Recommendations for Routine Immunization of Adults**

Vaccine	Code	Number of Doses	Age Range for Immunization	Notes
<b>VIRUS VACCINES</b>				
Hepatitis B	HepB	3	All adults at high risk 19 years and older, especially health care persons	Administer 2 <sup>nd</sup> dose 1 month later; 3 <sup>rd</sup> dose at least 2 months after 2 <sup>nd</sup>
Hepatitis A	HepA	2	All adults at high risk 19 years and older including travelers to countries with high endemicity	Two doses at least 6m apart
Influenza, seasonal	Flu	1	All adults 19 years and older	Annual immunization
Measles, mumps, rubella	MMR	1 or 2	19-49 years if unvaccinated	Persons who lack immunity
		1	50 years and older if unvaccinated	Persons who lack immunity
Human papillomavirus	HPV	3	Women 13-26 years, Men 9-26 years HPV4	Administer 2 <sup>nd</sup> dose 1-2 months later and 3 <sup>rd</sup> dose 6 months after 2 <sup>nd</sup> dose
Zoster	HZ	1	50 years and older	Administer to persons who have or have not had shingles
Varicella	VZV	2	19 years and older if unvaccinated or otherwise lack immunity	Persons who lack immunity
<b>BACTERIAL VACCINES</b>				
Diphtheria, tetanus, pertussis	Td, Tdap	1	19 to 64 years	1-time dose of Tdap, Td vaccine every 10 y
		1	65 years and older	1-time dose of Tdap Td vaccine every 10 y
Meningococcal	MCV4	1 or 2	55 years and younger	1 or 2 doses for pre-college students and booster every 5 years for high risk adults
	MPSV4	1	56 years and older	Single dose
Pneumococcal	PPV23	1 or 2	1 dose before age 65 years for high risk adults; 1 dose for all adults over 65 years	Second dose should be at least 5 years after first dose and after age 65 years

Recently, the US Court of Federal Claims ruled that the “theory of vaccine-related causation [of autism] is scientifically unsupported,” that thimerosal-containing vaccines do not cause autism.

### How can we increase vaccine uptake?

Physicians should initiate office procedures that are proven to increase immunization rates. First, employ standing orders for influenza and pneumococcal vaccines for adults. We reported a retrospective study of standing orders for elderly patients that showed higher rates of immunizations than when individual orders were relied on at each visit.<sup>15</sup> Second, communicate using reminders for un-immunized at-risk patients. Third, since Medicare data for the US and West Virginia show that only about two-thirds of elderly adults have been immunized with PPV23 we should take advantage of opportunities to promote this vaccine such as in the annual Medicare wellness visit and when patients present for their influenza vaccine. Even though PPV23 can be administered any time of the year, data collected in our practice showed that influenza vaccine season provided the trigger to remind physicians to offer PPV23.<sup>16</sup> Finally, physicians should be advocates for vaccines and provide education

about their need as uncertainty about the need for H1N1 vaccine among elderly in 2009 prevented many of them from getting the vaccine.<sup>17</sup>

The admonition that “an ounce of prevention is worth a pound of cure” applies to vaccines more than any other medical advance. During the past six decades established and new vaccines pushed many viral and bacterial diseases into the background by preventing a myriad of serious illnesses and saving untold numbers of lives. The systematic, appropriate and conscientious use of vaccines among children and adults in West Virginia will promote their health and reduce serious disease among them.

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## CME POST-TEST

4. A 65 year old man with a history of hypertension only should receive the pneumococcal vaccine
  - a. every 5 years
  - b. 2 doses, 5 years apart
  - c. once
  - d. as PCV7 which is indicated for adults
5. Which is true about influenza vaccine?
  - a. It comes in a new high dose formulation for people over age 65 years
  - b. Live attenuated vaccine is given by injection
  - c. Live attenuated vaccine is for people over age 50
6. People with fever and moderate illness should still get the vaccine that visit
6. A 70 year old female has a new grandchild and asks about Tdap vaccine. Which is true?
  - a. She doesn't need it if she had whooping cough as a child
  - b. She needs to wait until 10 years after her last tetanus shot
  - c. She should not get it because it is not indicated over age 65
  - d. She should get it as soon as possible