

Adolescent Vaccination



Bridging from a Strong Childhood Foundation to a Healthy Adulthood

A report on strategies to increase
adolescent immunization rates

Editorial Board

William Schaffner, MD, Chairman
Dennis A. Brooks, MD, MPH, MBA
Hal B. Jenson, MD
Linda Juszczak, DNSc, MPH, CPNP
Bonnie M. Word, MD



This publication made possible by an unrestricted educational grant to the
National Foundation for Infectious Diseases by sanofi pasteur.

Copyright © 2005 by the National Foundation for Infectious Diseases.

National Foundation for Infectious Diseases
4733 Bethesda Avenue, Suite 750
Bethesda, Maryland 20814

All Rights Reserved.

Adolescent Vaccination



Table of Contents

The National Foundation for Infectious Diseases 4

Editorial Review Board..... 4

Roundtable Participants..... 5

Introduction 6

Adolescent Immunizations: Current Recommendations, Future Vaccines 8

Barriers to Adolescent Immunization 12

Strategies to Increase Adolescent Immunization Rates 14

Conclusion 20

References 22

Appendix: Recommended Childhood and Adolescent
Immunization Schedule: United States–2005 24

Bridging from a Strong Childhood Foundation to a Healthy Adulthood
A report on strategies to increase adolescent immunization rates

The National Foundation for Infectious Diseases

The National Foundation for Infectious Diseases (NFID) is a non-profit tax-exempt 501(c)(3) organization founded in 1973 and dedicated to encouraging and sponsoring public and professional education about infectious diseases; supporting research and training in infectious diseases; and aiding in the prevention and treatment of infectious diseases.

NFID carries out its mission by educating the public; educating health care providers; supporting research and training in infectious diseases; building coalitions; and honoring scientific and public health achievement, legislative contributions, and philanthropy in infectious diseases.

Editorial Review Board

This publication was developed based on proceedings of a roundtable convened on April 28, 2004 by the National Foundation for Infectious Diseases in Washington, D.C., on the issue of improving adolescent immunization rates.

The editorial review board is composed of roundtable faculty who presented data and led discussions throughout the roundtable. This group has reviewed and approved this report.

William Schaffner, MD, Chairman

Professor and Chair, Department of Preventive Medicine
Professor of Medicine (Infectious Diseases)
Vanderbilt University School of Medicine
Nashville, Tennessee

Dennis A. Brooks, MD, MPH, MBA

Assistant Professor of Pediatrics
The Johns Hopkins University School of Medicine
Baltimore, Maryland

Hal B. Jenson, MD

Chair, Department of Pediatrics
Director, Center for Pediatric Research
Eastern Virginia Medical School
Children's Hospital of the King's Daughters
Norfolk, Virginia

Linda Juszczak, DNSc, MPH, CPNP

Assistant Clinical Professor
Albert Einstein School of Medicine
New York, New York
Director, Center for Evaluation and Quality
National Assembly on School-based Health Care
Society for Adolescent Medicine

Bonnie M. Word, MD

Assistant Professor of Pediatrics
Baylor College of Medicine
Director, Infectious Diseases and Travel Medicine Clinics
Texas Children's Hospital
Houston, Texas

Roundtable Participants

Representatives from the following organizations attended the roundtable, providing case studies and invaluable input that has been incorporated into this report.

Aetna, Inc.

Marjorie Schulman, MD
Senior Medical Director

American Academy of Pediatrics

Denia A. Varrasso, MD
Chair, Immunization Subcommittee
Committee on Community Health Services

American Medical Association

Litjen (LJ) Tan, PhD
Director, Infectious Diseases

America's Health Insurance Plans

Wanda Sullivan, MPH
Senior Program Manager, Immunization Initiatives

Association of State and Territorial Health Officials

Anna DeBlois
Policy Analyst, Immunization

U.S. Centers for Disease Control and Prevention

Lance Rodewald, MD
Director, Immunization Services Division
National Immunization Program

National Alliance for Hispanic Health

Magdalena Castro-Lewis
Director

National Association of County and City Health Officials (NACCHO)

James Ransom, MPH
Senior Analyst, Community Health Team

National Association of School Nurses

Nicole Bobo, RN, MSN
Education Director

National Partnership for Immunization

David A. Neumann, PhD
Executive Director

Vermont Children's Health Improvement Program

Judith S. Shaw, RN, MPH
Director

Wellpoint Inc.

Wendy Richards, MD, MBA
Medical Director
Health Improvement Resources
Program Development Unit

Introduction

Thirty-five million American adolescents fail to receive at least one recommended vaccine.¹ This gap exists despite specific adolescent immunization recommendations from the U.S. Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP), the American Academy of Pediatrics (AAP) and the American Academy of Family Physicians (AAFP). Low immunization rates in adolescents have a wide array of implications—outbreaks of vaccine-preventable diseases, negative effects on quality of life and increased disease-associated costs. Importantly, low immunization rates establish reservoirs of disease in adolescents that can affect others, including high-risk infants, elderly persons and persons with underlying medical conditions.

Vaccination has been recognized as one of the top 10 medical achievements of the 20th century (Table 1).² The U.S. immunization program, with its strong focus on infant and early childhood immunizations, has been a remarkable success. Building on this success by focusing on immunization during adolescence—the time of transition from a healthy childhood to a healthy adulthood—is the focus of this report.

Recognizing the need to improve adolescent immunization rates, *Healthy People 2010* has set a goal of 90 percent coverage of adolescents aged 13 to 15 years for all universally recommended vaccines (Figure 1).³ Data used to gauge immunization status versus these goals are based solely on parent recall; therefore, they likely overestimate actual immunization rates. Still, these numbers show that improvements will be needed if *Healthy People 2010* goals are to be met for hepatitis B (reported immunization rate of

78 percent) and varicella (69 percent). Reported compliance rates are much higher for the other two vaccines universally recommended for adolescents, at 91 percent for tetanus and diphtheria toxoid (Td) and 92 percent for measles, mumps and rubella (MMR).

Table 1

Ten Great Public Health Achievements of the 20th Century

- Vaccination
- Motor-vehicle safety
- Safer workplaces
- Control of infectious diseases
- Decrease in deaths from coronary heart disease and stroke
- Safer and healthier foods
- Healthier mothers and babies
- Family planning
- Fluoridation of drinking water
- Recognition of tobacco use as a health hazard

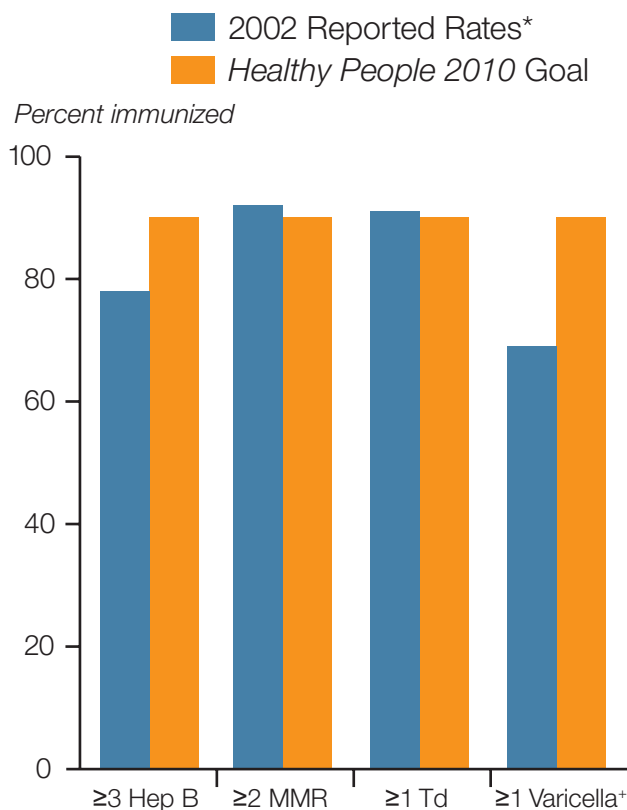
Source: CDC. *MMWR*. 1999;48(12):241-243.²

Confounding the process of vaccinating adolescents is the population itself. Adolescence is a complex time. It is a period of extreme growth and change during which adolescents strive for independence. It is also a period when risky health behaviors are not uncommon. Adolescents are likely to bristle at the idea of visiting their pediatrician (i.e., “baby doctor”), and their sense of invincibility makes diseases prevented by vaccines seem remote to their lives. Finally, adolescence is also a likely period of parental conflict. Since parents generally address family health care issues, diminished communication between parents and adolescents can easily become a barrier to optimal health care.

It is clear that we must continue to work diligently to raise and then sustain high immunization rates across all populations and ages. Many groups recognize the importance of this goal and the need to focus specifically on underserved populations where immunization gaps exist. In addition to essential focus on ethnic and racial minorities and those at lower socioeconomic levels, we must also recognize the need to focus on all adolescents, an unmistakably underserved population, in an effort to help them transition into a healthy adulthood.

Figure 1

Healthy People 2010 Adolescent Immunization Goals



*Data are based primarily on parental recall; provider verification has not occurred.

⁺Excluding adolescents who have had varicella infection.

Source: U.S. Department of Health and Human Services, *Healthy People 2010*.³

The Impact of High—and Low—Immunization Rates

Immunizations have had an enormous impact on public health: worldwide smallpox eradication; polio eradication in the Western Hemisphere; and more than 99 percent reduction in the U.S. incidence of congenital rubella, diphtheria and other diseases. Without continued focus on the need to vaccinate, however, the U.S. immunization program may fall victim to its own success.⁴ Once a vaccine has been used for an extended period, the community begins to lose sight of the social costs of the disease it prevents and instead focuses on the vaccine's side effects. This results in decreased vaccine compliance and increased risk of disease outbreaks because, despite the public health benefit of disease control afforded by vaccination, causative organisms often remain in the community or can easily be imported from abroad. Examples of this cycle are plentiful.

- Amid concerns about safety of whole-cell pertussis vaccine, pertussis immunization rates fell in Japan from nearly 80 percent in 1974 to just 10 percent by 1976.⁵ A subsequent pertussis epidemic occurred in 1979; 13,000 cases and 41 disease-related deaths were reported. By 1981, routine vaccination resumed and disease rates again fell sharply.
- In 1992, 54 polio cases were reported in a religious sect in The Netherlands that routinely refuses vaccination.⁶ All cases were among unvaccinated (53) or inadequately vaccinated (1) persons. Forty-one (76 percent) cases were paralytic. One neonate died.
- Outbreaks due to vaccine complacency are not limited to other countries. In Colorado, a state that allows religious and philosophical exemptions to childhood immunization, the rate of vaccine exemptors is more than twice the national average.⁷ More than 15,000 children were not vaccinated against pertussis and measles in 1998. Exemptors were 22 times more likely to contract measles and six times more likely to get pertussis than vaccinated cohorts. In 1997 and 1998, there were 505 confirmed measles cases in Colorado; from 1996 to 1998, there were more than 1,100 confirmed or probable pertussis cases.

Adolescent Immunizations: Current Recommendations, Future Vaccines

The CDC childhood and adolescent immunization schedule urges providers to make a special effort to administer universally recommended vaccines to adolescents if not previously given (Appendix, page 24).⁸ These vaccines for adolescents include hepatitis B, the second dose of measles, mumps and rubella (MMR2), and varicella. In addition, Td and quadrivalent meningococcal conjugate (See box, this page) vaccines are universally recommended for all adolescents at 11 to 12 years of age. Finally, three vaccines—influenza, pneumococcal polysaccharide (PPV) and hepatitis A—are recommended for adolescents in certain high-risk groups.

In the next few years, additional vaccines are anticipated to expand protection against serious infectious diseases, including pertussis (adolescent booster), human papillomavirus, respiratory syncytial virus, herpes simplex virus, cytomegalovirus, chlamydia and group B streptococcus (Table 2, page 10). Many of these vaccines may be targeted specifically to adolescents.

Vaccines for all adolescents

Hepatitis B: CDC estimates that about 78,000 new hepatitis B cases occur annually, with the highest rate of disease in persons aged 20 to 49 years.¹⁰ Because the

New Vaccine Added to the Adolescent Immunization Schedule

ACIP voted in February 2005 for routine meningococcal vaccination at the pre-adolescent (11-12 year) health care visit, at high school entry (15 year old) and for college freshmen living in dormitories.⁹ The quadrivalent meningococcal conjugate vaccine licensed by the U.S. Food and Drug Administration in January 2005 is approved for use in persons aged 11 to 55 years. These new recommendations will go into effect upon publication, expected in the CDC's *Morbidity and Mortality Weekly Reports* in spring 2005. The quadrivalent polysaccharide meningococcal vaccine, licensed for use in the U.S. in 1978, remains available for vaccination of children aged 2 to 10 years and adults older than 55 years.

majority of new hepatitis B infections are asymptomatic, however, incidence estimates vary widely. Widespread vaccination during childhood has contributed to a decreased hepatitis B incidence. Catch-up vaccination during adolescence would build on this and provide a uniform springboard for all adolescents as they enter adulthood. Adolescents in whom infection becomes chronic have a 15 percent chance of dying of liver disease.¹¹ Hepatitis B virus causes up to 80 percent of hepatocellular carcinomas. The vaccine, the first to prevent cancer, elicits protective antibody responses after three doses in more than 95 percent of adolescents.¹²

Measles: During a major outbreak in 1996, one third of the 575 reported measles cases were among patients aged 10 to 19 years.¹³ Measles in adolescents has implications not only for the patients, but also for those at increased risk of measles complications (persons under

5 or over 20 years of age) with whom they may come in contact.¹⁴ While the annual measles incidence currently is low in the U.S. due to widespread vaccination, there is a constant risk of measles outbreaks through importation and travel to endemic areas. The measles vaccine confers immunity in more than 99 percent of persons after two doses.¹⁵

Rubella: The main objective of the U.S. rubella vaccination program is prevention of congenital rubella syndrome (CRS). While the overall rubella incidence trend is downward, increases in two groups are notable. Disease rates in Hispanics increased dramatically during the 1990s, from 0.06 to 0.97/100,000. Rates in persons aged 15 to 44 years have also been on the rise since the mid-1990s.¹⁶ The increased rubella incidence in Hispanics is of particular concern because of an associated increase in population-specific rates of CRS. From 1997 to 1999, 83 percent of CRS infants (20 of 24) were born to Hispanic mothers. The rubella vaccine confers immunity for at least 15 years in 90 percent of vaccinated persons.¹⁵

Varicella: By 2003, CDC reported that 80 percent of toddlers were vaccinated against varicella by the age of two years.¹⁷ However, the vaccination rate in toddlers was considerably lower before 2000 (less than 60 percent). Thus, many children can be expected to lack immunity as they reach adolescence in the coming years. This is of particular concern because the risk of complications from varicella is highest in those under 1 and over 15 years, and the case fatality rate increases with age. In those aged 15 to 19 years, the fatality rate is 2.7/100,000 compared with 1/100,000 in those aged 1 to 14 years.¹⁵ Catch-up vaccination during adolescence will continue to be important to provide uniform protection against varicella during adulthood. Varicella vaccine confers permanent immunity in most vaccinees.¹⁵

Tetanus and diphtheria: CDC surveillance data report a tetanus case fatality rate of 18 percent, with 75 percent of the deaths in persons aged 65 and older.¹⁸ Diphtheria remains fatal in 5 to 10 percent of cases, with a higher case fatality rate (up to 20 percent) in persons under 5 or over 40 years of age.¹⁵ While 95 percent of children



receive three doses of diphtheria, tetanus and acellular pertussis (DTaP) vaccine by 35 months of age, just 85 percent receive the four doses recommended,¹⁹ and booster vaccination rates during adolescence are even lower.²⁰ Immunity levels wane over time as vaccination rates decrease. Around 80 percent of adolescents aged 12 to 19 years have protective antibody levels against both tetanus and diphtheria.²¹ This proportion continues to drop throughout adulthood, which is of great concern because tetanus is ubiquitous in the environment and pockets of endemic diphtheria still circulate in the U.S.,²² leaving unvaccinated persons at risk of contracting these deadly diseases. Virtually all properly vaccinated individuals develop protective immunity against tetanus and more than 95 percent against diphtheria.¹⁵

Meningococcal disease: This disease is marked by cyclical incidence patterns and affects adolescents dis-

proportionately. During the mid- to late 1990s, up to 30 percent of cases were in adolescents and young adults.²³ During this same period, 22 percent of cases in those aged 15 to 24 years were fatal, compared with 10 percent in the overall population.^{23,24} The quadrivalent meningococcal conjugate vaccine is highly effective and is expected to provide a longer duration of immunity than the polysaccharide vaccine. Widespread use of the conjugate vaccine may also provide herd immunity by decreasing nasopharyngeal carriage of *Neisseria meningitidis* serogroups included in the vaccine (A, C, Y, W-135).²⁵



Vaccines for high-risk adolescent populations

Influenza: Influenza causes an average of 36,000 deaths and 200,000 hospitalizations annually in the U.S.^{26, 27}

Among the primary target groups recommended for annual influenza vaccination are adolescents at increased risk of complications due to underlying medical conditions, including asthma and diabetes. An estimated 3.6 million persons aged 12 to 17 years suffer from the most prevalent risk factor, asthma;²⁸ however, just 10 to 31 percent of

them receive influenza vaccine in any given year.²⁹⁻³¹ The vaccine is up to 90 percent effective based on immunogenic match of vaccine and circulating strains and on age and immune status of vaccinees.²⁷

Pneumococcal polysaccharide vaccine (PPV): More than 40,000 cases of invasive pneumococcal disease and 5,700 deaths were reported in the U.S. in 2002, with nearly 250 cases and eight deaths reported in those aged 5 to 17 years.³² Conjugate pneumococcal vaccines have greatly reduced the incidence of invasive *Streptococcus pneumoniae* infections among young children and adults. The incidence among adolescents is the lowest for any age group, but adolescents infected with *S. pneumoniae* can transmit it to those at highest risk of infection and death (including infants and the elderly). The polysaccharide vaccine, which contains antigens from 23 pneumococcal serotypes that cause 88 percent of invasive disease, is indicated for all persons at least 2 years of age who are immunocompromised or have certain chronic illnesses (e.g., cardiovascular or pulmonary disease, diabetes).³³ Over 80 percent of vaccine recipients develop antibodies against pneumococcal serotypes contained in the vaccine.¹⁵

Hepatitis A: Hepatitis A is a very commonly reported vaccine-preventable disease in the U.S. One third of Americans have evidence of past infection.³⁴ Hepatitis A vaccine is recommended for children and adolescents in selected states and regions where infection rates were more than twice the national average (≥ 20 cases/100,000 persons) during the baseline period of 1987 to 1997 (map available at: <http://www.cdc.gov/ncidod/diseases/hepatitis/a/faq.htm>). "The vaccine is also recommended for anyone who has chronic liver disease or clotting factor disorders, men who engage in homosexual sex, women

who have sex with bisexual men or anyone who uses either injection or non-injection illegal drugs.” In addition, vaccination should be considered for children and adolescents living in any area where the infection rate exceeds the national average. Optimum protection is achieved when the two-dose series is completed. More than 97 percent of adolescents are protected within one month of the first dose of hepatitis A vaccine.¹⁵

Table 2

Potential Future Vaccines

- Acellular pertussis (booster)*
- Human papillomavirus
- Herpes simplex virus
- Cytomegalovirus
- Respiratory syncytial virus
- Chlamydia
- Group B streptococcus

**Candidate vaccines currently under review by the U.S. FDA.*

Future vaccines

Although it is difficult to predict the focus of future vaccination strategies, it is possible to foresee that certain vaccines, when available, will have an impact on the health of adolescents.

Pertussis has been on the rise in the U.S. There was a 62 percent increase in incidence among adolescents aged 10 to 19 years from 1994-1996 to 1997-2000.³⁵ More than 11,500 cases, the most in 37 years, were reported in 2003; 34 percent were in people aged 10 to 19 years.³⁶

Pertussis is highly communicable, with a secondary attack rate of up to 90 percent among susceptible household contacts.³⁷ Currently, pertussis-containing vaccines are not approved for use after the age of 7. However, license applications have been filed for acellular pertussis vaccine to be used in adolescents and adults.



Human papillomavirus (HPV) infection of the cervix in adolescents has been linked to later development of cervical cancer. A recent study examined prevalence and risk factors for HPV infection in 312 adolescent girls (mean age, 16).³⁸ HPV was detected in 200 (64 percent) of the teens. One hundred (50 percent) of those infected had two or more types of HPV and 154 (77 percent) had one or more of the high-risk types associated with subsequent development of cancer. The vaccine in current clinical trials is expected to provide protection from HPV types 6 and 11, the types most likely to cause genital warts, and also HPV types 16 and 18, the types with the highest relative risk for cervical cancer. These four high-risk strains are responsible for 70 percent of all cervical cancer.

Barriers to Adolescent Immunization

Until recently, immunization programs and recommendations did not place much emphasis on adolescent immunization. ACIP, along with AAP, AAFP and the American Medical Association (AMA), first recommended a routine medical evaluation for all children aged 11 to 12 years in 1996. In 2003, ACIP published its annual immunization recommendations under a new title, Recommended Childhood and Adolescent Immunization Schedule (Appendix, page 24). Although these changes reflect an increased emphasis on the importance of adolescent immunization, by themselves they will not sufficiently increase awareness or immunization rates; other barriers must also be identified and overcome. Barriers to increased adolescent immunization rates can be grouped into four general categories: governmental, health care provider, parent/adolescent and economic.

Governmental barriers

Governmental barriers include parent/guardian consent requirements, lack of uniformity in state and school immunization mandates and failure to adequately enforce current requirements, especially after initial school entry. Penalties for failure to comply with early childhood vaccination requirements (e.g., school and daycare entry mandates) are relatively easy to enforce. Few parallel mandates exist

for adolescent vaccination. Lack of uniformity in state laws is a large issue in our increasingly mobile society; children who are apparently up-to-date with their vaccines may move from one state to another and find this is no longer the case.

The federal government has constructively addressed some of these barriers. In 1994, the Vaccines for Children (VFC) program was established. VFC provides immunizations at doctors' offices for children up to age 19 years who are uninsured, Medicaid recipients, Native Americans or Alaska Natives. VFC also provides for vaccination at participating federally qualified health centers and rural health clinics for children whose insurance does not provide reimbursement for immunizations.

While providing vaccines for many children who otherwise might not receive them, VFC did not completely close the gap. In 1997, the State Children's Health Insurance Program (SCHIP) was created. This program allows states to offer health insurance for children, up to age 19 years, whose families earn too much to qualify for Medicaid (and VFC) and who are not covered by private insurance. The program is state administered; each state sets its own guidelines regarding eligibility and services, although some services, including immunizations, must be covered.

Health care provider barriers

The success of the childhood immunization program highlights the importance of regular health care visits. Infant and toddler immunizations are closely linked to well-child visits. In contrast, adolescence is generally perceived to be the "healthy years," and is marked by a sharp decline in physician-patient contact. Therefore, it is even more important for health care providers treating adolescents to take advantage of every contact and office visit. No matter the

reason for the office visit (e.g., sick, injury, camp physical, working papers), each should become an opportunity to review an adolescent's vaccine status and provide needed immunizations.



Parent and adolescent barriers

Parents often assume that routine immunizations are completed by the time of elementary school entry. But even parents who may understand that immunization is not completed by age 5 will likely overlook the need for further vaccination in the absence of notification from their child's physician or school informing them otherwise.

Parents are ultimately responsible for the health of their children, which includes taking them to a health care provider for annual visits. Parents and adolescents must be educated about disease risks and the importance of immunization. The fact that they are not is in part due to limited medical adolescent visits and in part to a failure of providers to educate them during office visits. This education is particularly important during the adolescent visit because immunization recommendations, which are updated often, likely are different than they were during the adolescent's infancy and early childhood years. Adolescents and their parents also assume they have received primary care when this is not the case, such as when having a sick visit, a gynecologic visit or a sports physical. Parents should ensure their child has more than sporadic visits; each child should have a primary care provider.

Emancipated minors present a unique challenge to delivery of immunization and other health care services because they often are completely outside of parental control and influence. Criteria for emancipation vary by state, as do the rights afforded the emancipated minor. In general, an emancipated minor is 16 or 17 years old. Emancipation may be a result of marriage, military service, pregnancy, having given birth or being self-supporting.

Economic barriers

Although programs such as VFC and SCHIP strive to close cost barriers to immunization, lack of adequate health insurance remains an issue. Unfortunately, families without private insurance coverage often are reluctant to see a health care provider so they remain unaware of government programs. Providers, too, may either be unaware that these programs exist, have minimal knowledge about how they work or be slow to discuss them with patients due to lack of time and resources.

Private health insurance plans provide a wide range of benefit coverage for immunizations and other preventive services for adolescents. Health maintenance organizations (HMO) offer broad coverage (>90%) of immunizations.³⁹ At-risk preferred provider organizations (PPO) often provide coverage similar to their HMO plans. Employer self-funded plans may offer coverage of immunizations, depending on company priorities. Hybrid PPOs (e.g., consumer-directed plans) and Health Savings Accounts (HSA) may offer first-dollar coverage for immunizations, but may also leave the choice of coverage to the consumer. As with coverage, reimbursement rates to providers vary. In many cases, providers state that reimbursement rates for vaccines and administration are too low, resulting in less time for effective provider-patient/parent communication.

Strategies to Increase Adolescent Immunization Rates

Strategies need to be implemented in a thoughtful manner to raise adolescent immunization rates. Recognizing this need, CDC's Task Force on Community Preventive Services reviewed 17 interventions designed to improve vaccination rates in children, adolescents and adults.⁴⁰ Interventions used as part of observational studies and clinical trials were included and sorted into three categories: strategies that increase demand, enhance access and address provider barriers (Table 3). The strategies that result in the largest gains in vaccination rates generally include interventions focused on all three areas.

The Task Force made recommendations based on the number of available studies, the suitability of study designs for evaluating effectiveness, quality of study execution, consistency of results and effect size. Although some interventions might be effective, the Task Force could not recommend them because sufficient data were not available. Interventions recommended by the Task Force are summarized at the beginning of each section below, followed by discussion of specific strategies recommended by the roundtable participants.

Increasing Demand

To increase demand for vaccines, the Task Force strongly recommends use of reminder/recall systems and multi-component interventions that include education. It also recommends vaccination requirements for child care, school and college attendance, but notes that differences in effectiveness of state laws (because of interstate differences in requirements established by the laws) could not be determined.

Establish a platform for adolescent immunization

Age-based vaccination recommendations are highly effective and serve to institutionalize the immunization process for adolescents, parents and providers. For instance, the childhood immunization schedule has institutionalized the rhythm of infant immunizations at birth, 2, 4 and 6 months. Likewise, adult age-based vaccination recommendations for influenza and pneumococcal vaccine have proven more successful than risk-based recommendations.

Establishing a specific age for delivery of adolescent vaccines will help institutionalize the process. ACIP, AAP, AAFP and AMA identify 11 to 12 years of age as the optimal time for delivery of adolescent immunizations.⁴¹ Two vaccines are recommended for every adolescent at this age—Td booster and primary vaccination with the quadrivalent meningococcal conjugate vaccine. A review of immunization status is also recommended, as is vaccination if needed with hepatitis B, MMR and varicella.

Vaccination recommendations based on other factors, such as the presence of risk factors, historically have not met with the same success. For example, even though the ACIP, AAP, AAFP, AMA and other groups

strongly recommend that children with asthma receive an influenza vaccine each year, only a third of such children do. Although the concept of an adolescent visit timed to a specific age is established in the minds of many providers, using these visits as an opportunity to immunize is not.

Provider and professional recommendations

ACIP, AAP, AAFP, AMA and other major medical groups recommend and endorse adolescent immunizations. Policy statements from other groups that influence consumer decisions, clearly endorsing the recommendations outlined in the childhood and adolescent immunization schedule published annually by CDC, would likely also help increase consumer awareness and vaccine uptake.

The recommendations of individual physicians, nurses and other health care providers also are crucial to increasing vaccination rates. A provider's specific recommendation for immunization significantly increases vaccine uptake. In one survey,⁴² 85 percent of patients received the pneumococcal vaccine when their provider recommended it, even if they personally had negative feelings about being vaccinated. Without a provider recommendation, just 16 percent of those with negative inclinations were vaccinated.

School-based immunization requirements

School-based immunization requirements can be a fundamental stimulus to improve adolescent immunization rates. Initial school entry has long been a critical period

Table 3

Interventions Assessed by the Task Force on Community Prevention Services

Increasing community demand for vaccines

- Client reminder/recall systems⁺⁺
- Multicomponent interventions that include education⁺⁺
- Vaccination requirements for child care, school and college attendance⁺
- Communitywide education only^{*}
- Clinic-based education only^{*}
- Client or family incentives^{*}
- Client-held medical records^{*}

Enhancing access to vaccination services

- Reducing out-of-pocket costs⁺⁺
- Expanding access in medical or public health clinical settings⁺⁺,¹

- Vaccination programs in Women, Infants and Children (WIC) settings^{+,2}
- Home visits⁺
- Vaccination programs in schools^{*}
- Vaccination programs in child care centers^{*}

Provider-based interventions

- Provider reminder/recall⁺⁺
- Assessment and feedback for vaccination providers⁺⁺
- Standing orders⁺⁺,³
- Provider education only^{*}

⁺⁺Strongly recommended; ⁺Recommended; ^{*}Insufficient evidence to determine effectiveness

¹As part of a multicomponent intervention.

²WIC covers children up to age 5; no utility for adolescents.

³Strongly recommended for adults; insufficient evidence for children.

Source: CDC. *MMWR* 1999;48(RR-8):1-15.⁴⁰

Adolescent Vaccination

for assessing childhood immunization status and providing catch-up vaccination. Re-evaluation of immunization rates at school-related milestones in older children (e.g., the move from elementary to middle school, and from middle to high school) has not had the same impact. There may be many reasons for this. Schools and educators are overburdened, leaving little time for immunization status checks. School nurses, the professionals



most often responsible for spearheading such efforts in the past, are declining in number, often leaving this task to administrative personnel. Finally, there is no consistency across school districts; parents who become aware of conflicting requirements are left questioning what is right for their child.

School-based requirements alone may not increase adolescent immunization rates adequately, but at least they will bring the issue to the attention of parents and open a

dialogue. School districts should strive to increase immunization rates using the ACIP annual Recommended Childhood and Adolescent Immunization Schedule as a guide. Establishing immunization mandates may be a positive first step toward this goal.

State-based immunization laws

Laws and requirements that unify constituencies otherwise subject to local, often school district-based requirements that can vary widely will likely have a positive effect on immunization rates. To further a unified recommendation for adolescent immunization, it would be beneficial if states employed the ACIP recommendation that adolescent vaccination be timed to entry into the sixth or seventh grade. Currently, states with regulations list age ranges including 11 to 12 years, 11 to 16 years, 11 to 18 years and the somewhat ambiguous “college age.”

The 11-to-12-year age range recommended by ACIP is advantageous for several strategic reasons. First, an overriding concept of vaccination is to provide immunity at as young an age as possible for maximum protection. Second, 98 percent of children remain in school through this age; dropout rates begin to climb at age 13. Third, adolescents eventually tend to stop doctor visits completely before beginning to see new and disparate types of primary health care providers later in adolescence (e.g., family physicians, internists, obstetricians, gynecologists, other specialists). Finally, younger adolescents are more likely to follow recommendations from health care providers and their parents.

Education and awareness programs

Parent education is essential, as they are the drivers of health care decisions. Parents have a very low awareness that the benefits of vaccination extend beyond the first

few years of life. Health care providers are the single best source of information for parents. While parents receive information from myriad sources, studies prove health care provider recommendations have significant impact on patient attitudes and actions.⁴¹ Providers must strive to inform all parents and patients in their practices about the importance of immunization and that its benefits extend into adolescence and adulthood.

Schools can also serve to educate and should consider adding vaccine-preventable diseases to the health and science curricula. This is already done in some districts. As an example, one local school district's health curriculum includes student self-assessment of immune status based on immunization records, and the science curriculum includes an assignment to study any vaccine.

VFC and SCHIP Contact Information

More information about the Vaccines for Children (VFC) program can be accessed online at <http://www.cdc.gov/nip/vfc/Default.htm>, by calling toll-free 1-800-232-2522 (in Spanish at 1-800-232-0233) or by e-mailing the National Immunization Program at nipinfo@cdc.com.

More information about the State Children's Health Insurance Program (SCHIP), including links to state-specific information, can be accessed at <http://www.cms.hhs.gov/schip/> or by calling toll-free 1-877-267-2323 (TTY 1-866-226-1819).

Enhancing Access to Vaccination Services

To enhance access, interventions are recommended that will reduce out-of-pocket costs and expand access in medical or public health clinic settings. One way to reduce out-of-pocket costs is to be sure all VFC-eligible children up to age 19 receive all recommended vaccines. Another way is enrollment in SCHIP, which is also available to eligible children up to age 19.

Health care coverage

Out-of-pocket cost to families adversely affects vaccination compliance. Lack of health care coverage remains an important issue, even though government-funded programs are in place to provide recommended vaccines to all children. Uninsured and under-insured adolescents often see a health care provider only for acute illness, at which time providers focus only on the presenting problem. If possible, providers must take these opportunities to vaccinate and, if appropriate, inform families about the availability of coverage for recommended vaccines.

The majority of private health plans provide coverage for recommended vaccines and their administration to children and adolescents. Private health plans generally look to the policy and recommendation statements of ACIP and annual immunization schedules to design health insurance plan benefit policies. Self-insured companies may approach immunization coverage differently and might benefit from a business case for immunization that reveals the short and long-term benefits—reduced absenteeism (parents not needing to miss work due to sick children), avoidance of costly medical claims, decreased illness in workers themselves (due to reduced transmission of infectious diseases from their children) and increased productivity that accrues from covering recommended immunizations for their employees and family members.

Partner with local communities and institutions

Having a medical home (the AAP defines a medical home as primary care that is accessible, continuous, comprehensive, family centered, coordinated, compassionate and culturally effective) should be a priority, but this goal is not always achieved. While health care providers should strive to assure every adolescent has a medical home, they must also recognize that immunizations may, at times, be delivered outside the medical home. Institutions and community organizations that can become immunization partners will vary by location. Schools are a major partner, as discussed throughout this report. Others may include community-based youth centers (e.g., YMCA, YWCA, Boys & Girls Clubs), religious groups, camps and shelters.

Addressing Provider Barriers

The Task Force strongly recommended providers use provider reminder/recall systems, perform regular audit and feedback of their systems and put standing orders in place, whenever possible. There were not enough qualifying studies to assess the impact of provider education on immunization rates, although the best described and most intensive interventions produced improvements in provider knowledge and attitudes.

Minimize missed opportunities to vaccinate

“Minimize missed opportunities” is a phrase often seen in childhood vaccination literature. To minimize missed opportunities, providers are called upon to assess immune status and provide vaccines at every visit, unless an absolute contraindication to vaccine administration exists during that visit. This concept is even more important for adolescent immunization since adolescents are seen much less frequently and an adolescent “well visit”

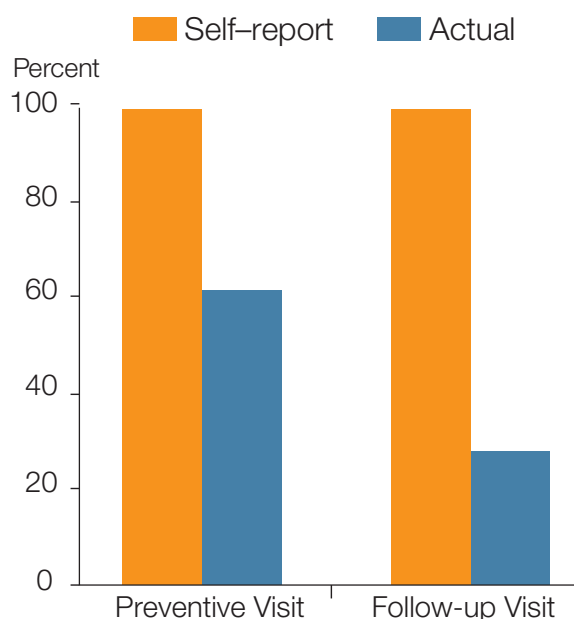
in which vaccines are routinely administered is not the norm. Until such a visit is institutionalized, it is essential that providers assess immunization status at every adolescent visit and administer vaccinations as appropriate. This includes all types of visits: well, sick, camp physical, pre-college, working papers, etc.

Audit and feedback

Immunization providers report that they do not miss opportunities to vaccinate, but these reports are rarely accurate. Perception versus performance was reported in a 2002 pediatric immunization study.⁴³ One hundred percent of providers said they took advantage of every opportunity to vaccinate during well-child or follow-up visits. Chart reviews, however, revealed only 60 percent used every well-child visit and just over 20 percent used every follow-up visit (Figure 2).

Figure 2

Providers Using Every Opportunity To Vaccinate



Source: Prislun R. *Am J Prev Med* 2002; 22:165-9.⁴³

As Prislín and colleagues demonstrated, without some measure of effectiveness, many practitioners do not realize the need to improve immunization rates. Bordley and colleagues conducted a systematic review of 15 audit and feedback studies, five of which were in children.⁴⁴ In general, the literature is consistent in suggesting that audit and feedback, either alone or in combination, may improve immunization rates.

Fully utilize vaccine registries across all ages

Having a repository of vaccination information for adolescents is especially important because this age group is often without a medical home. By consolidating vaccination records, registries can provide a key source of data for health care providers in a wide variety of treatment settings. Providers cannot simply look to registries to access information. They must fully participate by feeding vaccination information into the registry for all patients, including adolescents.

Public health registry goals currently focus on younger children; the *Healthy People 2010* goal is that 95 percent of children less than 6 years of age participate in a fully operational vaccine registry by 2010.⁴⁵ Data indicate approximately 43 percent of children in this age group now participate. While the focus on younger children is a start, providers should take advantage of the registry process to begin amassing vaccination data for children of all ages.

Use standing orders

Standing orders have been shown to have a strong impact on adult vaccination rates.⁴⁶ Although a physician must be involved in developing standing order policies and protocols, once in place these orders empower nurses and others to vaccinate. Standing orders routinely exist for many interventions. For example, in emergency

departments, nurses often debride wounds and provide tetanus vaccine before a physician sees a patient. Studies have also shown improved influenza and pneumococcal vaccination rates through use of standing orders in long-term care facilities and hospitals.^{47,48} Similar protocols for recommended adolescent vaccines would likely decrease missed vaccination opportunities.

Review and update office immunization practices

It is incumbent upon health care providers to remain up to date as immunization recommendations and practices change. The harmonized ACIP, AAP and AAFP childhood and adolescent immunization schedule is updated and published at least annually. It is published in *Morbidity and Mortality Weekly Report* and *Pediatrics*, is available online at the CDC Web site (www.cdc.gov/nip) and often is distributed or available from state health departments. The entire office staff should be aware of changes so they can take full advantage of any encounter with an adolescent, using it as an opportunity to assess immunization status, educate, inform and vaccinate.

Conclusion



Raising and then sustaining high vaccination rates in adolescents is an important public health goal. Guidelines from ACIP, AAP, AAFP and AMA provide clear and specific recommendations about vaccines that should be administered to adolescents at 11 to 12 years of age as a primary immunization (i.e., meningococcal conjugate), if not previously given (i.e., hepatitis B, MMR, varicella) as a booster dose to all adolescents (i.e., Td), or to adolescents with specific risk factors (i.e., influenza, PPV, hepatitis A).

Accessing and vaccinating adolescents is not a simple task. Many adolescents stop seeing pediatricians (the most effective vaccinators) as their primary care physicians, moving on to other types of providers or perhaps seeing none at all. Parental conflict is not uncommon during adolescence and often leads to diminished parental control of health care decisions, including whether to immunize. Further compromising vaccine uptake is the sense of invincibility common in adolescents, limiting their appreciation of the long-term protection vaccination affords.

To improve vaccination rates, health care providers need to overcome these adolescent-specific vaccination barriers while also addressing issues of demand, access and affordability that are common across all age groups.

One way to minimize financial barriers that may limit vaccine uptake is to ensure qualified adolescents participate in VFC and SCHIP programs. Both programs provide coverage for recommended immunizations for eligible participants up to 19 years of age. Providers should be informed about basic eligibility requirements and enrollment procedures (or assign this responsibility to someone in their office) and provide families with necessary guidance (see page 17).

Health care provider recommendations have a significant impact on vaccination rates. Therefore, providers should make clear recommendations endorsing vaccination. This dovetails with the general goal of educating and encouraging patients (and parents) to take an active role in preventive health care practices.

Providers should be aware of their role in low immunization rates. While most providers say they vaccinate at every opportunity, studies have shown this is not the case. Providers should examine their immunization practices critically and implement necessary changes to ensure no opportunity to vaccinate is missed. For example, standing orders can

be implemented to allow qualified non-physicians to vaccinate adolescents based on pre-defined parameters, when appropriate.

Those in a position to do so should lobby for school-based requirements and strong enforcement of them. School-based mandates have had substantial impact on early childhood vaccination efforts but have been used less, and to less effect, in older children. Unified state-based laws would also be a positive step.

The effect of many vaccine-preventable diseases would be diminished by widespread adolescent vaccination at 11 to 12 years old, as recommended. Integrating routine vaccination of adolescents into normal adolescent health care now will also provide a framework for integration of future vaccines. Future vaccines promise to build on current protection by providing immunity from such serious and potentially deadly illnesses and infections as pertussis and human papillomavirus, a leading cause of cervical cancer.

References

1. Little J. 35 million teens missing recommended vaccines. *AAP News* 2000;17(3):81.
2. CDC. Ten great public health achievements—United States, 1900-1999. *MMWR* 1999;48(12):241-243.
3. U.S. Department of Health and Human Services. *Healthy People 2010. With Understanding and Improving Health and Objectives for Improving Health*. 2nd ed. 2 vols. Washington, DC: U.S. Government Printing Office, November 2000.
4. Infectious Diseases in Children. Maintaining public trust in vaccines: Are we victims of our own success? Available at: <http://idinchildren.com/199907/frameset.asp?article=vaccine.asp>. Accessed June 17, 2004.
5. Gangarosa EJ, Galazka AM, Wolfe CR, et al. Impact of anti-vaccine movements on pertussis control: the untold story. *Lancet* 1998;351:356-361.
6. CDC. Update: Poliomyelitis outbreak—Netherlands, 1992. *MMWR* 1992;41(49):917.
7. Feikin DR, Lezotte DC, Hamman RF, Salmon DA, Chen RT, Hoffman RE. Individual and community risks of measles and pertussis associated with personal exemptions to immunization. *JAMA* 2000;284(24):3145-3150.
8. CDC. Recommended childhood and adolescent immunization schedule—United States, 2005. Available at: <http://www.cdc.gov/nip>. Accessed January 11, 2005.
9. Centers for Disease Control and Prevention. Meningococcal (groups A, C, Y and W-135) conjugate vaccine (MCV-4): ACIP recommends meningococcal vaccine for adolescents and college freshmen. Available at: http://www.cdc.gov/nip/vaccine/meningitis/mcv4/mcv4_acip.htm. Accessed February 17, 2005.
10. CDC. Hepatitis B fact sheet. Available at: <http://www.cdc.gov/ncidod/diseases/hepatitis/b/bfact.pdf>. Accessed July 27, 2004.
11. CDC. Importance of hepatitis B vaccination in the prevention of acute and chronic liver disease and liver cancer caused by hepatitis B and the safety of hepatitis B vaccine. Available at: <http://www.cdc.gov/nip/vacsafe/concerns/hepB/testimony.htm>. Accessed June 17, 2004.
12. Engerix-B [hepatitis B vaccine (recombinant)] Vaccine [prescribing information]. Research Triangle Park, NC: GlaxoSmithKline; August 2004.
13. National Foundation for Infectious Diseases. Facts about adolescent immunization. Available at: <http://www.nfid.org/factsheets/adolncai.html>. Accessed November 11, 2004.
14. CDC. Measles—what you need to know. Available at: <http://www.cdc.gov/nip/diseases/measles/vac-chart.htm>. Accessed November 8, 2004.
15. CDC. *Epidemiology and Prevention of Vaccine-Preventable Diseases*. 8th ed. January 2004.
16. Reef SE, Frey TK, Theall K, et al. The changing epidemiology of rubella in the 1990s: On the verge of elimination and new challenges for control and prevention. *JAMA* 2002;287(4):464-472.
17. CDC. Immunization coverage in the U.S.: National Immunization Survey. Available at: <http://www.cdc.gov/nip/coverage/default.htm#chart>. Accessed June 17, 2004.
18. CDC. Tetanus surveillance—United States, 1998-2000. *MMWR* 2003;52(SS-3):1-12.
19. CDC. National, state, and urban area vaccination coverage levels among children aged 19-35 months—United States, 2003. *MMWR* 2004;53(29):658-661.
20. Singleton JA, Greby SM, Wooten KG, Walker FJ, Strikas R. Influenza, pneumococcal, and tetanus toxoid vaccination of adults—United States, 1993-7. *MMWR CDC Surveill Summ* 2000;49:39-62.
21. McQuillan GM, Kruszon-Moran D, Deforest A, Chu SY, Wharton M. Serologic immunity to diphtheria and tetanus in the United States. *Ann Intern Med* 2002;136(9):660-666.
22. Marston CK, Jamieson F, Cahoon F, et al. Persistence of a distinct corynebacterium diphtheria clonal group within two communities in the United States and Canada where diphtheria is endemic. *J Clin Microbiol* 2001;39(4):1586-1590.
23. Harrison LH, Pass MA, Mendelsohn AB, et al. Invasive meningococcal disease in adolescents and young adults. *JAMA* 2001;286:694-699.
24. Rosenstein NE, Perkins BA, Stephens DS, Popovic T, Hughes JM. Meningococcal diseases. *N Engl J Med* 2001;344:1378-1388.
25. CDC. Prevention and control of meningococcal disease: Recommendations of the Advisory Committee on Infectious Diseases (ACIP). *MMWR* 2000;49(RR-7):1-22.

26. Thompson WW, Shay DK, Weintraub E, et al. Influenza-associated hospitalizations in the United States. *JAMA* 2004;292(11):1333-1340.
27. CDC. Prevention and control of influenza: Recommendations of the Advisory Committee on Immunization Practices. *MMWR* 2004;53(RR-6):1-40.
28. CDC. National Health Interview Survey, 2002. Available at: http://www.cdc.gov/nchs/data/series/sr_10/sr10_221.pdf. Accessed June 22, 2004.
29. Kramarz P, DeStefano F, Gargiullo PM, et al. Influenza vaccination in children with asthma in health maintenance organizations. *Vaccine* 2000;18:2288-2294.
30. Hall CB. Influenza: A shot or not? *Pediatrics* 1987;79:564-566.
31. Poehling KA, Speroff T, Dittus RS, Griffin MR, Hickson GB, Edwards KM. Predictors of influenza virus vaccination status in hospitalized children. *Pediatrics* 2001;108(6). Available at: <http://pediatrics.aappublications.org/cgi/content/full/108/6/e99>. Accessed June 17, 2004.
32. Active Bacterial Core Surveillance (ABCs) 2002 streptococcus pneumoniae surveillance report. Available at: <http://www.cdc.gov/ncidod/dbmd/abcs/survreports/spneu02.pdf>. Accessed November 11, 2004.
33. CDC. Preventing pneumococcal disease among infants and young children: Recommendations of the Advisory Committee on Infectious Disease (ACIP). *MMWR* 2000;49(RR-9):1-38.
34. CDC. Prevention of hepatitis A through active or passive immunization: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR* 1999;48(RR-12):1-39.
35. CDC. Pertussis—United States, 1997-2000. *MMWR* 2002;51(4):73-76.
36. Bacterial Vaccine Preventable Diseases Branch, National Immunization Program, Centers for Disease Control and Prevention. 2004. Unpublished data.
37. CDC. Diphtheria, tetanus, and pertussis: Recommendations for vaccine use and other preventive measures. Recommendations of the Immunization Practices Advisory Committee (ACIP). *MMWR* 1991;40(RR10):1-28.
38. Tarkowski TA, Koumans EH, Sawyer M, et al. Epidemiology of human papillomavirus infection and abnormal cytologic test results in an urban adolescent population. *J Infect Dis* 2004;189(1):46-50.
39. America's Health Insurance Plans (AHIP). Health and medicine surveys, 2002. Available at: <http://www.ahip.org/content/default.aspx?bc+38182>. Accessed December 9, 2004.
40. CDC. Vaccine-preventable diseases: Improving vaccination coverage in children, adolescents, and adults. A report on recommendations from the Task Force on Community Preventive Services. *MMWR* 1999;48(RR-8):1-15.
41. CDC. Immunization of adolescents. Recommendations of the Advisory Committee on Immunization Practices, the American Academy of Pediatrics, the American Academy of Family Physicians, and the American Medical Association. *MMWR* 1996;45(RR-13):1-17.
42. Nichol KL, MacDonald R, Hauge M. Factors associated with influenza and pneumococcal vaccination behavior among high-risk adults. *J Gen Intern Med* 1996;11(11):673-677.
43. Prislun R, Sawyer MH, De Guire M, Brennan J, Holcomb K, Nader PR. Missed opportunities to immunize: Psychosocial and practice correlates. *Am J Prev Med* 2002;22(3):165-169.
44. Bordley WC, Chelminski A, Margolis PA, Kraus R, Szilagyi PG, Vann JJ. The effect of audit and feedback on immunization delivery: A systematic review. *Am J Prev Med* 2000;18(4):343-350.
45. CDC. Immunization registry progress—United States, January-December 2002. *MMWR* 2004;53(20):431-433.
46. CDC. Use of standing orders programs to increase adult vaccination rates. Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR* 2000;49(RR-1):15-26.
47. Crouse BJ, Nichol K, Peterson DC, Grimm MB. Hospital-based strategies for improving influenza vaccination rates. *J Fam Pract* 1994;38: 258-261.
48. Stevenson KB, McMahon JW, Harris J, Hilman JR, Helgerson SD. Increasing pneumococcal vaccination rates among residents of long-term-care facilities: Provider-based improvement strategies implemented by peer-review organizations in four western states. *Infect Control Hosp Epidemiol* 2000;21:705-710.

Recommended Childhood and Adolescent Immunization Schedule UNITED STATES • 2005

Vaccine ▼	Age ▶	Birth	1 month	2 months	4 months	6 months	12 months	15 months	18 months	24 months	4–6 years	11–12 years	13–18 years
Hepatitis B ¹		HepB #1											
Diphtheria, Tetanus, Pertussis ²				DTaP	DTaP	DTaP		DTaP			DTaP	Td	Td
<i>Haemophilus influenzae</i> type b ³				Hib	Hib	Hib							
Inactivated Poliovirus				IPV	IPV						IPV		
Measles, Mumps, Rubella ⁴							MMR #1				MMR #2	MMR #2	
Varicella ⁵							Varicella				Varicella		
Pneumococcal ⁶				PCV	PCV	PCV	PCV			PCV	PPV		
Influenza ⁷							Influenza (Yearly)				Influenza (Yearly)		
Hepatitis A ⁸													

This schedule indicates the recommended ages for routine administration of currently licensed childhood vaccines, as of December 1, 2004, for children through age 18 years. Any dose not administered at the recommended age should be administered at any subsequent visit when indicated and feasible.

Indicates age groups that warrant special effort to administer those vaccines not previously administered. Additional vaccines may be licensed and recommended during the year. Licensed combination vaccines may be used whenever any components of the combination are indicated and other components of the vaccine

are not contraindicated. Providers should consult the manufacturers' package inserts for detailed recommendations. Clinically significant adverse events that follow immunization should be reported to the Vaccine Adverse Event Reporting System (VAERS). Guidance about how to obtain and complete a VAERS form are available at www.vaers.org or by telephone, 800-822-7967.

Range of recommended ages
Preadolescent assessment
Only if mother HBsAg(–)
Catch-up immunization

1. Hepatitis B (HepB) vaccine. All infants should receive the first dose of HepB vaccine soon after birth and before hospital discharge; the first dose may also be administered by age 2 months if the mother is hepatitis B surface antigen (HBsAg) negative. Only monovalent HepB may be used for the birth dose. Monovalent or combination vaccine containing HepB may be used to complete the series. Four doses of vaccine may be administered when a birth dose is given. The second dose should be administered at least 4 weeks after the first dose, except for combination vaccines which cannot be administered before age 6 weeks. The third dose should be given at least 16 weeks after the first dose and at least 8 weeks after the second dose. The last dose in the vaccination series (third or fourth dose) should not be administered before age 24 weeks.

Infants born to HBsAg-positive mothers should receive HepB and 0.5 mL of hepatitis B immune globulin (HBIG) at separate sites within 12 hours of birth. The second dose is recommended at age 1–2 months. The final dose in the immunization series should not be administered before age 24 weeks. These infants should be tested for HBsAg and antibody to HBsAg (anti-HBs) at age 9–15 months.

Infants born to mothers whose HBsAg status is unknown should receive the first dose of the HepB series within 12 hours of birth. Maternal blood should be drawn as soon as possible to determine the mother's HBsAg status; if the HBsAg test is positive, the infant should receive HBIG as soon as possible (no later than age 1 week). The second dose is recommended at age 1–2 months. The last dose in the immunization series should not be administered before age 24 weeks.

2. Diphtheria and tetanus toxoids and acellular pertussis (DTaP) vaccine. The fourth dose of DTaP may be administered as early as age 12 months, provided 6 months have elapsed since the third dose and the child is unlikely to return at age 15–18 months. The final dose in the series should be given at age ≥ 4 years. **Tetanus and diphtheria toxoids (Td)** is recommended at age 11–12 years if at least 5 years have elapsed since the last dose of tetanus and diphtheria toxoid-containing vaccine. Subsequent routine Td boosters are recommended every 10 years.

3. *Haemophilus influenzae* type b (Hib) conjugate vaccine. Three Hib conjugate vaccines are licensed for infant use. If PRP-OMP (PedvaxHIB® or ComVax® [Merck]) is administered at ages 2 and 4 months, a dose at age 6 months is not required. DTaP/Hib combination products should not be used for primary immunization in infants at ages 2, 4 or 6 months but can be used as boosters after any Hib vaccine. The final dose in the series should be administered at age ≥ 12 months.

4. Measles, mumps, and rubella vaccine (MMR). The second dose of MMR is recommended routinely at age 4–6 years but may be administered during any visit, provided at least 4 weeks have elapsed since the first dose and both doses are administered beginning at or after age 12 months. Those who have not previously received the second dose should complete the schedule by age 11–12 years.

5. Varicella vaccine. Varicella vaccine is recommended at any visit at or after age 12 months for susceptible children (i.e., those who lack a reliable history of chickenpox). Susceptible persons aged ≥ 13 years should receive 2 doses administered at least 4 weeks apart.

6. Pneumococcal vaccine. The heptavalent pneumococcal conjugate vaccine (PCV) is recommended for all children aged 2–23 months and for certain children aged 24–59 months. The final dose in the series should be given at age ≥ 12 months. **Pneumococcal polysaccharide vaccine (PPV)** is recommended in addition to PCV for certain high-risk groups. See *MMWR* 2000;49(RR-9):1-35.

7. Influenza vaccine. Influenza vaccine is recommended annually for children aged ≥ 6 months with certain risk factors (including, but not limited to, asthma, cardiac disease, sickle cell disease, human immunodeficiency virus [HIV], and diabetes), healthcare workers, and other persons (including household members) in close contact with persons in groups at high risk (see *MMWR* 2004;53(RR-6):1-40). In addition, healthy children aged 6–23 months and close contacts of healthy children aged 0–23 months are recommended to receive influenza vaccine because children in this age group are at substantially increased risk for influenza-related hospitalizations. For healthy persons aged 5–49 years, the intranasally administered, live, attenuated influenza vaccine (LAIV) is an acceptable alternative to the intramuscular trivalent inactivated influenza vaccine (TIV). See *MMWR* 2004;53(RR-6):1-40. Children receiving TIV should be administered a dosage appropriate for their age (0.25 mL if aged 6–35 months or 0.5 mL if aged ≥ 3 years). Children aged ≤ 8 years who are receiving influenza vaccine for the first time should receive 2 doses (separated by at least 4 weeks for TIV and at least 6 weeks for LAIV).

8. Hepatitis A vaccine. Hepatitis A vaccine is recommended for children and adolescents in selected states and regions and for certain high-risk groups; consult your local public health authority. Children and adolescents in these states, regions, and high-risk groups who have not been immunized against hepatitis A can begin the hepatitis A immunization series during any visit. The 2 doses in the series should be administered at least 6 months apart. See *MMWR* 1999;48(RR-12):1-37.



Department of Health and Human Services
Centers for Disease Control and Prevention



The Childhood and Adolescent Immunization Schedule is approved by:
Advisory Committee on Immunization Practices www.cdc.gov/nip/acip
American Academy of Pediatrics www.aap.org
American Academy of Family Physicians www.aafp.org



Adolescent Vaccination

Bridging From a Strong Childhood Foundation to a Healthy Adulthood

*A report on strategies to increase
adolescent immunization rates*



**National
Foundation for
Infectious
Diseases**

RESEARCH PREVENTION EDUCATION

4733 Bethesda Avenue, Suite 750
Bethesda, Maryland 20814

