Immunization Programs for Infants, Children, Adolescents, and Adults: Clinical Practice Guidelines by the Infectious Diseases Society of America

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Evidence-based guidelines for immunization of infants, children, adolescents, and adults have been prepared by an Expert Panel of the Infectious Diseases Society of America (IDSA). These updated guidelines replace the previous immunization guidelines published in 2002. These guidelines are prepared for health care professionals who care for either immunocompetent or immunocompromised people of all ages. Since 2002, the capacity to prevent more infectious diseases has increased markedly for several reasons: new vaccines have been licensed (human papillomavirus vaccine; live, attenuated influenza vaccine; meningococcal conjugate vaccine; rotavirus vaccine; tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis [Tdap] vaccine; and zoster vaccine), new combination vaccines have become available (measles, mumps, rubella and varicella vaccine; tetanus, diphtheria, and pertussis and inactivated polio vaccine; and tetanus, diphtheria, and pertussis and inactivated polio/*Haemophilus influenzae* type b vaccine), hepatitis A vaccines are now recommended universally for young children, influenza vaccines are recommended annually for all children aged 6 months through 18 years and for adults aged ⩾50 years, and a second dose of varicella vaccine has been added to the routine childhood and adolescent immunization schedule. Many of these changes have resulted in expansion of the adolescent and adult immunization schedules. In addition, increased emphasis has been placed on removing barriers to immunization, eliminating racial/ethnic disparities, addressing vaccine safety issues, financing recommended vaccines, and immunizing specific groups, including health care providers, immunocompromised people, pregnant women, international travelers, and internationally adopted children. This document includes 46 standards that, if followed, should lead to optimal disease prevention through vaccination in multiple population groups while maintaining high levels of safety.

EXECUTIVE SUMMARY

Immunization is one of the most beneficial and cost-effective disease prevention measures [1]. Successes of immunization include worldwide eradication of smallpox, control of poliomyelitis with hopes of eradication, and elimination of indigenous measles and rubella in the United States [2, 3], although the 2008 upsurge in measles cases serves as a reminder that measles is still imported into the United States [4]. The incidence of most other vaccine-preventable diseases, excluding pertussis and tetanus, has shown a reduction of ⩾99%, compared with the annual morbidity prior to devel-

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These guidelines were developed and issued on behalf of the Infectious Diseases Society of America (IDSA). It is important to realize that guidelines cannot always account for individual variation among patients. They are not intended to supplant physician judgment with respect to particular patients or special clinical situations. The IDSA considers adherence to these guidelines to be voluntary, with the ultimate determination regarding their application to be made by the physician in the light of each patient's individual circumstances.

opment of the corresponding vaccine (Table 1) [7]. An analysis of clinical preventive measures widely recommended by the US Preventive Services Task Force reported that childhood immunization was 1 of only 3 services that received a perfect score of 10 (ie, top tier for both the clinical burden that the vaccines could prevent and cost-effectiveness to society) based on clinically preventable disease burden and cost-effectiveness. Immunization of adults aged ⩾50 years with influenza vaccine and adults aged ⩾65 years with pneumococcal vaccine both received a score of 8 out of 10 (ie, highly cost-effective and can prevent a significant health burden) [1].

Systematic weighting of the quality of evidence and the grade of recommendation are explained in Table 2.

I. Vaccine Recommendations for Infants, Children, Adolescents, and Adults

1. Infants, children, adolescents, and adults should receive all age-appropriate vaccines recommended by the Advisory Committee on Immunization Practices, the American Academy of Family Physicians, and the American Academy of Pediatrics (A-I).
2. Any vaccine dose not administered at the recommended age should be administered at any subsequent medical encounter when indicated and feasible without reinitiating the series (A-III).
3. Recommendations for the minimum interval between doses for people who have delayed immunizations or who want to accelerate their schedule should be followed (B-III).
4. When appropriate, all indicated vaccines should be administered simultaneously (B-III).
5. Licensed combination vaccines can be administered whenever any components of the combination are indicated, other components are not contraindicated, and if the vaccine is licensed by the US Food and Drug Administration (FDA) for that dose of the series (A-I).
6. Immunization requirements for childcare, school and college attendance, and nursing homes should be followed (A-II).
7. Vaccine delivery should be coordinated with other preventive health care services for children, adolescents, and adults (B-III).
8. All vaccines should be stored and administered as recommended by the manufacturer and as licensed by the FDA (B-II).

II. Immunization Standards, Overcoming Barriers to Immunization, Vaccine Safety, Misconceptions, Finances, Access, and Strategies to Improve Coverage

9. Health care providers should determine and follow valid vaccine contraindications and precautions before administration of any vaccine (B-III).
10. Health care providers should be aware of the National Vaccine Injury Compensation Program (NVICP) and its requirements (B-III).
11. All patients or parents should receive Vaccine Information Statements (VISs) for each vaccine administered as required by law for vaccines covered by the NVICP (C-III).
12. Providers should educate their patients and parents about the benefits, safety, and risks of vaccines in a culturally appropriate and easy-to-understand language prior to each immunization (C-III).
13. Clinically significant adverse events following immuni-

Table 1. Baseline 20th Century Annual Morbidity, 2007 Morbidity, and Morbidity Decrease for 10 Infectious Diseases with Vaccines Recommended before 1990 for Universal Use in Children in the United States, as Well as Health People 2010 Vaccine Coverage Goals and 2007 Vaccine Coverage

Disease	Annual morbidity, no. of cases		Morbidity decrease, %	Healthy People 2010 Coverage Goal[a]	Vaccine coverage in 2007, %
	20th century	2007			
Diphtheria	21,053	0	100	4 doses, ⩾90%	85
Measles	530,217	43	99.9	1 dose, ⩾90%	93
Mumps	162,344	800	99.5	1 dose, ⩾90%	93
Pertussis	200,752	10,454	94.8	4 doses, ⩾90%	85
Polio (paralytic)	16,316	0	100	3 doses, ⩾90%	92
Rubella	47,745	12	99.9	1 dose, ⩾90%	93
Congenital rubella syndrome	152	0	99.3	1 dose, ⩾90%	…
Smallpox	29,005	0	100	…	…
Tetanus	580	28	95.2	4 doses, ⩾90%	85
Haemophilus. influenzae (type b and unknown; <5 years)	20,000	202	99	⩾3 doses, ⩾90%	94

NOTE. Adapted from [5, 6].

[a] For 19–35-month-old children.

Table 2. Definition of Quality of Evidence and Strength of Recommendation

Assessment	Type of evidence
Strength of recommendation	
Grade A	Good evidence to support a recommendation for use
Grade B	Moderate evidence to support a recommendation for use
Grade C	Poor evidence to support a recommendation
Quality of evidence	
Level I	Evidence from at least 1 properly designed randomized, controlled trial
Level II	Evidence from at least 1 well-designed clinical trial, without randomization; from cohort or case-controlled analytic studies (preferably from >1 center); from multiple time series; or from dramatic results of uncontrolled experiments
Level III	Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees

NOTE. Adapted from the Canadian Task Force on the Periodic Health Examination [8].

zation should be reported to the Vaccine Adverse Events Reporting System (VAERS) (B-III).

Finance

14. Patient out-of-pocket immunization expenses should be minimized (A-I).

15. Vaccine-financing programs, including the Vaccines for Children (VFC) program, Section 317 of the Public Health Service Act federal grant program, state programs, and private insurance, should be optimized for each patient, as appropriate (B-II).

16. Providers who serve infants, children, and adolescents aged <19 years should be enrolled in the VFC program (B-II).

17. Providers should be aware of other government supported and other funded programs that cover the cost of vaccines and their administration for people who do not have adequate resources (C-III).

Access to Immunizations

18. Barriers to immunizations should be identified and eliminated or as minimized as possible (B-II).

19. Immunization services should be easy to access, including express immunization services (eg, influenza immunization clinics) and expanded hours of immunization services (A-II).

20. Immunization should be integrated into routine health care services offered in offices and clinics (C-III).

21. Private providers should consider participating in programs that provide financially vulnerable adults with access to immunizations at no cost (C-III).

Strategies to Improve Immunization Coverage

22. Reminder/recall systems should be used to enhance immunization rates (A-I).

23. Information regarding administration of vaccines should be entered into immunization information systems (ie, immunization registries) (B-III).

24. Standing orders for immunizations should be established in clinics, hospitals, and nursing homes (A-I).

25. The immunization status of patients should be reviewed at each patient visit (B-II), and patients and parents should be provided with accurate immunization records at office or clinic visits (B-III).

26. All health care providers who administer vaccines should be properly educated and should receive ongoing education (A-III).

27. Regular assessments of immunization coverage rates should be conducted in provider practices (A-I).

28. Demand for adolescent and adult immunization should be increased by improving public and provider awareness of immunizations recommended for adolescents and adults (B-III).

III. Complementary (Nontraditional) Immunization Settings

29. Providers should support use of community-based settings to immunize target populations that have difficulty accessing usual immunization providers (B-III).

30. Providers should support establishment of school-based, childcare-based, and hospital-based immunization programs to deliver influenza immunization to school-aged children, adolescents, and adults (B-III).

31. Immunization providers in complementary settings should adhere to quality standards, including ability to appropriately manage vaccine-related adverse events, proper storage and handling of vaccines, appropriate record keeping, regulatory issues, and provision of education regarding both risks

and benefits of immunizations, as well as other preventive care measures, including adherence to hand hygiene (B-III).

32. Providers of immunizations in nontraditional settings should ensure that records of immunizations administered in these settings are sent to primary care providers and to immunization information systems (registries) and should encourage vaccinees in such settings to see their primary care providers for other preventive and therapeutic services (B-III).

IV. Immunization of Specific Groups

Health Care Professionals

33. All health care professionals should be immunized appropriately (B-II). Specifically, annual immunization with influenza vaccine and receipt of a booster dose of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) should be ensured, as well as adequate immunization against measles, mumps, rubella, and varicella. People whose work anticipates they may be exposed to blood or body fluids should be immunized against hepatitis B.

34. Hospitals, clinics, and offices should implement programs to ensure that health care professionals are immunized appropriately and that annual immunization coverage assessments are performed (B-II).

Immunocompromised Persons

35. All immunocompromised infants, children, adolescents, and adults should be appropriately immunized (B-II).

36. Providers should be aware of contraindications and precautions for vaccines in people with primary and secondary immunodeficiencies (B-III).

37. Providers should educate immunocompromised patients that, depending on the vaccine and their degree of immune dysfunction, the vaccines that are administered may not be fully effective (C-III).

38. Providers who care for immunocompromised patients should ensure that household contacts are immunized appropriately to reduce the risk of exposure of immunocompromised patients to vaccine-preventable diseases (B-III).

Pregnancy

39. Providers should be aware of immunizations routinely recommended for women during pregnancy, including inactivated trivalent influenza vaccine (A-II).

40. Providers should administer appropriate vaccines to pregnant women with medical or exposure indications that put them at risk of certain vaccine-preventable diseases (A-I).

41. Following delivery, women should receive all recommended vaccines that could not be or were not administered during pregnancy (A-II).

42. Providers should be aware of and follow valid contraindications and precautions for immunizing pregnant women (A-III).

International Travel

43. Providers who care for people who travel should ensure that all country-specific vaccines are administered in a time frame that ensures optimal development of protection (A-I).

44. Health care professionals should be aware of key sources of information regarding immunization of travelers at every age (B-III).

Internationally Adopted Children

45. Providers should accept only written documentation as evidence of previous immunization (B-III).

46. Providers should be aware of the various approaches that can be followed if there is concern about whether vaccines administered to an international adoptee were immunogenic (B-III).

INTRODUCTION

In 2002, the Infectious Diseases Society of America (IDSA) published a clinical practice guideline for quality standards for immunization [9]. The IDSA updates its guidelines when new data or publications change prior recommendations or when the Expert Panel decides that clarification or additional guidance is warranted. For the 2009 guidelines, vaccine licensure, approval, recommendations, safety, financing, barriers, and implementation issues were reviewed. This report does not include issues involving vaccines and autism and other potential adverse events. The Centers for Disease Control and Prevention (CDC) and the National Institutes of Health commissioned the National Academy of Sciences' Institute of Medicine to convene an Immunization Safety Review Committee in 2000. This committee, comprising 15 members with diverse expertise, was charged with providing independent advice to vaccine policy makers and to health care professionals, the public, and the media. The committee reviewed the scientific plausibility of possible causal associations between vaccines and various adverse events. The committee reviewed the following 8 specific topics about existing and emerging vaccine safety concerns: measles-mumps-rubella vaccine and autism (April 2001); thimerosal-containing vaccines and neurodevelopmental disorders (October 2001); multiple immunizations and immune dysfunction (February 2002); hepatitis B vaccine and demyelinating neurologic disorders (May 2002): SV40 contamination of polio vaccine and cancer (October 2002); vaccinations and sudden unexpected death in infancy (March 2003); influenza vaccines and neurologic complications (October 2003); and vaccines and autism (May 2004).

For each topic, the committee found the evidence to be inconclusive or in favor of rejection of causal associations be-

tween vaccines and the adverse events reviewed. The committee did not recommend a policy review of the childhood and adolescent immunization schedule or of recommendations for administration of routine childhood vaccines. Executive summaries of each of the committee's 8 reports are available online at http://www.iom.edu/imsafety.

Except where indicated in the text, these guidelines are provided by the IDSA for health care professionals to ensure appropriate and timely administration of recommended immunizations to infants, children, adolescents, and adults. The Expert Panel addressed the following clinical questions (objectives) in this update.

1. What are the current immunization recommendations for infants, children, adolescents, and adults?
2. What are the current immunization standards, and how do they contribute to overcoming barriers to immunization and address vaccine safety, misconceptions, finance, access, and strategies to improve coverage?
3. How is immunization implemented in complementary (nontraditional) settings?
4. What are the current immunization recommendations for special groups, including health care professionals, immunocompromised people, pregnant women, international travelers, and internationally adopted children?

PRACTICE GUIDELINES

Practice guidelines are systematically developed statements to assist health care professionals, patients, and payers in making decisions about appropriate health care for specific clinical circumstances. Attributes of high-quality guidelines include validity, reliability, reproducibility, clinical applicability, clinical flexibility, clarity, multidisciplinary process, review of evidence, and documentation [10].

METHODS

Expert Panel composition. The IDSA Standards and Practice Guidelines Committee (SPGC) convened experts in the field of vaccinology from the United States. Panel members had experience in pediatric and adult clinical and laboratory medicine, nursing, public health, and infectious diseases and included representatives from the following collaborating organizations: American Academy of Pediatrics (AAP), American College of Obstetricians and Gynecologists (ACOG), American College of Physicians (ACP), American Medical Association (AMA), American Osteopathic Association, CDC, National Association of Pediatric Nurse Practitioners, National Vaccine Advisory Committee of the Department of Health and Human Services, and the Pediatric Infectious Diseases Society. Panel members and their affiliations are listed at the end of the text.

Literature review and analysis. For the 2009 update, the Expert Panel reviewed data published since 2000 and literature referenced in the 2002 guidelines. Computerized literature searches of the PubMed database were performed using the terms immunization, vaccination, and vaccines. Only English-language literature was reviewed. The review focused on human studies.

Process overview. In evaluating evidence regarding management of immunizations, the Expert Panel followed a process used in development of other IDSA guidelines. The process included a systematic weighting of the quality of evidence and the grade of recommendation (Table 2).

Consensus development based on evidence. The entire Expert Panel met on 4 occasions via teleconference to initiate and complete the guidelines. The purposes of the teleconferences were to discuss and formalize the questions (objectives) to be addressed, designate writing assignments, review draft guidelines, and obtain input about external review. All members of the Expert Panel participated in preparation of the draft guidelines, which were then disseminated for review by the entire Expert Panel. Feedback from external reviewers also was solicited (see the Acknowledgements). All collaborating organizations were asked to provide feedback and endorse the guidelines. These guidelines were reviewed and cleared by the CDC, are supported by the AMA, and have been endorsed by the following organizations: the AAP, the National Association of Pediatric Nurse Practitioners, and the Pediatric Infectious Diseases Society. The content of the guidelines and the manuscript were reviewed and approved by the IDSA SPGC and by the Board of Directors before dissemination.

Guidelines and conflict of interest. All members of the Expert Panel complied with the IDSA policy on conflicts of interest, which requires disclosure of any financial or other interest that might be construed as constituting an actual, potential, or apparent conflict. Members of the Expert Panel were provided the IDSA conflict of interest disclosure statement and were asked to identify links to companies developing products that might be affected by promulgation of the guidelines. Information was requested regarding employment, consultancies, stock ownership, honoraria, research funding, expert testimony, and membership on company advisory committees. The Expert Panel made decisions on a case-by-case basis as to whether an individual's role should be limited as a result of a conflict. No limiting conflicts were identified.

Revision dates. At annual intervals, the Expert Panel Chairs, the SPGC liaison advisor, and the Chair of the SPGC will determine the need for revisions to the guidelines on the basis of an examination of current literature. If necessary, the Expert Panel will be reconvened to discuss potential changes. When appropriate, the Expert Panel will recommend revision of the guideline to the SPGC and the IDSA Board of Directors for review and approval.

RESULTS OF THE LITERATURE SEARCH

Types of studies evaluated included randomized, clinical trials; cohort and case-control analytic studies; and the results of uncontrolled studies. Evidence from opinions of respected authorities, based on clinical experience, descriptive studies, and reports of expert advisory committees also were considered. Specifically, we considered the recommendations of the AAFP; the AAP; the ACOG; the Advisory Committee on Immunization Practices (ACIP); the ACP; the National Vaccine Advisory Committee, including the Standards for Child and Adolescent Immunization Practices and the Standards for Adult Immunization; the Task Force on Community Preventive Services; and the National Vaccine Injury Compensation Program. Expert Panel members were assigned sections of the guidelines to prepare with the final document reviewed and approved by all members.

GUIDELINE RECOMMENDATIONS FOR IMMUNIZATION OF INFANTS, CHILDREN, ADOLESCENTS, AND ADULTS

I. WHAT ARE THE CURRENT IMMUNIZATION RECOMMENDATIONS FOR INFANTS, CHILDREN, ADOLESCENTS, AND ADULTS?

Recommendations

1. Infants, children, adolescents, and adults should receive all age-appropriate vaccines recommended by the Advisory Committee on Immunization Practices, the American Academy of Family Physicians, and the American Academy of Pediatrics (A-I).
2. Any vaccine dose not administered at the recommended age should be administered at any subsequent medical encounter when indicated and feasible without reinitiating the series (A-III).
3. Recommendations for the minimum interval between doses for people who have delayed immunizations or who want to accelerate their schedule should be followed (B-III).
4. When appropriate, all indicated vaccines should be administered simultaneously (B-III).
5. Licensed combination vaccines can be administered whenever any components of the combination are indicated, other components are not contraindicated, and if the vaccine is licensed by the US Food and Drug Administration (FDA) for that dose of the series (A-I).
6. Immunization requirements for childcare, school and college attendance, and nursing homes should be followed (A-II).
7. Vaccine delivery should be coordinated with other preventive health care services for children, adolescents, and adults (B-III).
8. All vaccines should be stored and administered as recommended by the manufacturer and as licensed by the FDA (B-II).

Evidence summary. Evidence-based recommendations for use of each vaccine licensed by the FDA for the civilian population in the United States are made by the ACIP with input from professional partner organizations (http://www.cdc.gov/vaccines/recs/acip/default.htm). In addition, the Committee on Infectious Diseases of the AAP makes policy recommendations for vaccines licensed by the FDA for use in infants, children, and adolescents. Recommendations of the ACIP are considered to be official following approval by the Director of the CDC, and recommendations of the AAFP, AAP, and ACP are considered to be official after approval by the AAFP and AAP boards of directors and ACP Board of Regents. In addition to the 15 appointed members of the ACIP, input on immunization recommendations are provided by 26 liaison and 8 ex officio organizations, which include representation from major medical societies, managed care organizations, government agencies, and others.

Once per year, the AAFP, AAP, and ACIP issue a harmonized childhood and adolescent immunization schedule, which is available online (http://www.cdc.gov/vaccines/recs/schedules/default.htm#child) and is published in *The Morbidity and Mortality Weekly Report, Pediatrics,* and *American Family Physician.* In addition, the AAFP, ACIP, ACOG, and ACP annually issue a harmonized adult immunization schedule, which can be found online (http://www.cdc.gov/vaccines/recs/schedules/default.htm) and is published in *American Family Physician, Annals of Internal Medicine,* and *The Morbidity and Mortality Weekly Report.* In the time between annual publications of the immunization schedules, additions and changes to schedules are published as Notices to Readers in *The Morbidity and Mortality Weekly Report* and subsequently incorporated into the next annual published schedules. Health care professionals should ensure that the most current schedules are followed and should adhere as closely as possible to the most current recommended immunization schedule.

For a variety of reasons, infants, children, adolescents, and adults often fall behind on receipt of recommended immunizations [11]. Because the goal of administering vaccines is to prevent disease, children and adults who are not current with recommended immunizations should be immunized as soon as possible, before exposure to a potentially infectious organism. Licensure of vaccines by the FDA and recommendations for the age(s) at which vaccines are administered are influenced by age-specific risks for disease acquisition, age-specific risks for complications, ability to respond to a vaccine, and in infants, potential interference with the immune response by passively transferred maternal antibody as well as immunologic immaturity. Several vaccines, including those that are inactivated, toxoids, polysaccharide conjugates, and recombinant subunits,

require administration of ⩾2 doses for development of an appropriate and persisting immune response [12–17]. With the exception of zoster and yellow fever vaccines, protection using attenuated, live viral vaccines requires >1 dose [18–20], and protection against influenza requires annual immunization [21].

For people aged 4 months through 18 years, a printed catch-up schedule is available for infants, children, and adolescents who begin late or who are >1 month behind on receipt of immunizations. For children from birth through 5 years of age, an interactive computer-based program is available to assist with catch-up (http://www.cdc.gov/vaccines/scheduler/catchup.htm). For adults who are behind on their immunizations, recommendations for individual vaccines on the adult immunization schedule should be consulted. A vaccine series does not need to be restarted, regardless of the time that has elapsed between doses and regardless of vaccine type [22].

In some circumstances, a vaccine that requires multiple doses may need to be administered at shorter intervals than those customarily used. This may occur if a person is behind schedule and needs to become current with recommended vaccines quickly or if international travel is imminent. In these situations, an accelerated schedule can be used. The catch-up immunization table for people aged 4 months through 18 years and the computer program for children from birth through 5 years of age not only provide a catch-up schedule but also minimum intervals between doses for children whose immunizations have been delayed or for patients or parents who want to accelerate a schedule. There are no data to support administration of vaccines at intervals less than these minimum intervals or earlier than the minimum age. An exception is during a measles outbreak when measles cases are occurring among infants aged <12 months. In this instance, measles immunization of infants as young as 6 months of age can be performed as part of outbreak control. Doses of measles-containing vaccine administered to infants aged <12 months should not be counted as part of the recommended immunization series [22]. The ACIP recommends that vaccine doses administered ⩽4 days before the minimum interval or age be counted as valid [22]. Doses administered ⩾5 days before the minimum age should be repeated on or after the child reaches the minimum age and ⩾4 weeks after the invalid dose.

If >1 vaccine is recommended to be administered at a specific age, vaccines should be administered at the same visit at separate injection sites. Simultaneously administering all vaccines to a person who is eligible is important, because simultaneous administration increases the probability that a child or adult will be appropriately immunized [23]. Simultaneous administration is often critical when preparing for foreign travel and if uncertainty exists as to whether a person will return for additionally recommended vaccine doses. Simultaneously administering different combinations of live and inactivated vaccines has resulted in seroconversion rates similar to rates observed when the vaccines are administered separately [22].

Use of combination vaccines can reduce the number of injections required. Licensed combination vaccines can be used whenever any components contained in the vaccine are indicated, if its other components are not contraindicated, and if the vaccine is licensed by the FDA for that dose in the series [24, 25].

Laws requiring immunization for school or child care attendance are a safety net for the immunization program in the United States [26]. All 50 states and the District of Columbia have school and child care immunization laws in effect that vary by state (http://www.immunize.org/laws or http://www.cdc.gov/other.htm#states/). These laws have resulted in decreased incidence of measles, mumps, and pertussis in states with laws, compared with states without laws [26–28]. Regulations also have proven effective in protecting college students from vaccine-preventable diseases [29]. These laws improve compliance with recommendations and enable achievement of herd protection for people who cannot be immunized because of medical indications or who do not respond to vaccine. Children who are not appropriately immunized are not permitted to attend school or child care, although most states allow exemptions for medical and religious objections to immunization [30]; a number of states allow personal belief exemptions. In situations where parents refuse vaccines for their child, and if a medical contraindication for receipt of vaccines does not exist, the child's physician should document that the parents have been informed about risks and benefits of vaccines. A document for this purpose is available from the AAP (http://practice.aap.org/content.aspx?aid=1605&nodeID=3014).

Research has demonstrated that providing quality, evidence-based preventive care is important in helping people live healthy lives. Delivery of many evidence-based preventive services is suboptimal because of limited clinician time, the large number of recommendations, and the difficulty of integrating many preventive service recommendations into health care visits because of many competing demands [31]. Health care providers, health insurance plans, employers, and consumers all need information about preventive services that produce the greatest benefit and return on investment, to be able to target them for enhancing utilization rates.

The National Commission on Prevention Priorities provided a ranking of 25 clinical services meeting the study's inclusion criteria [1]. Services were scored by clinically preventable burden and cost-effectiveness. Only 3 services received the highest score of 10: discussing aspirin use for prevention of cardiovascular events in high-risk adults, tobacco-use screening and intervention, and immunization of children. Ninety percent or more of children in the United States receive most of the im-

munizations recommended annually for preschool children (http://www.cdc.gov/vaccines/stats-surv/imz-coverage.htm). The proportion is even higher for school-aged children receiving immunizations mandated for school attendance. Other services receiving a score of 8 from the Commission were pneumococcal immunization of adults aged ⩾65 years and annual influenza immunization of adults aged ⩾50 years. The AAFP, AAP, ACP, AMA, and CDC all recommend preventive health services at all life stages during regularly scheduled preventive care visits. Professional organizations emphasize the importance of continuity of care in comprehensive health supervision and the need to avoid fragmentation of care. When possible, immunizations, along with other preventive care measures, should be delivered in a medical home environment [32].

When the FDA licenses a vaccine, recommendations are made regarding storage, handling, and administration. Failure to adhere to recommended specifications for storage and handling of immunobiologics can reduce their potency and result in an inadequate immune response. Each vaccine package insert contains recommendations about methods for reconstitution of the vaccine. All vaccines should be inspected upon delivery and monitored during storage to ensure adherence to the cold chain. Information about appropriate storage temperature, temperature monitoring, response to out-of-temperature range storage, and expiration date is contained in package inserts and can be found online (http://www.cdc.gov/vaccines/recs/storage/default.htm). All FDA-licensed vaccines have a preferred route of administration, which is specified in the package insert and in ACIP and professional society recommendations [22].

II. WHAT ARE THE CURRENT IMMUNIZATION STANDARDS, AND HOW DO THEY CONTRIBUTE TO OVERCOMING BARRIERS TO IMMUNIZATION AND ADDRESS VACCINE SAFETY, MISCONCEPTIONS, FINANCE, ACCESS, AND STRATEGIES TO IMPROVE COVERAGE?

Recommendations

9. Health care providers should determine and follow valid vaccine contraindications and precautions before administration of any vaccine (B-III).

10. Health care providers should be aware of the NVICP and its requirements (B-III).

11. All patients or parents should receive VISs for each vaccine administered as required by law for vaccines covered by the NVICP (C-III).

12. Providers should educate their patients and parents about the benefits, safety, and risks of vaccines in a culturally appropriate and easy-to-understand language prior to each immunization (C-III).

13. Clinically significant adverse events following immunization should be reported to the VAERS (B-III).

Evidence summary. Observation of valid contraindications and precautions is critical to assure that vaccines are used as recommended to obtain optimal safety. A contraindication means the vaccine should not be administered under any circumstance. A generic contraindication for all vaccines is prior anaphylactic reaction to a vaccine or a vaccine constituent. A precaution does not preclude vaccine administration, but the events or conditions listed as a precaution should be reviewed carefully before vaccine administration (http://www.cdc.gov/vaccines/recs/vac-admin/contraindications.htm). Anaphylaxis has been demonstrated to occur on rare occasions to certain vaccines, and immunoglobulin E–mediated immune responses to some vaccine components have been demonstrated, including gelatin contained in some vaccines. If a person with a history of anaphylaxis to a vaccine or component of the vaccine is given the vaccine inappropriately, then anaphylaxis may recur. On some occasions, disseminated infection with vaccine virus has occurred, with serious consequences, in persons who are severely immunocompromised and who receive a live viral vaccine. Such outcomes have included vaccine-associated paralytic poliomyelitis following administration of oral polio virus vaccine and measles-associated encephalitis in patients with congenital immunodeficiencies who have received a measles virus–containing vaccine [33]. If invalid contraindications are used, then immunization rates can suffer. Studies have found missed opportunities for immunization in primary care, and surveys have shown that some providers report being overly cautious when interpreting contraindications. Immunization rates and immunization timeliness of a practice are correlated with physician-reported beliefs about vaccine contraindications [34–37].

Prior to enactment of the National Childhood Vaccine Injury Act (NCVIA) in 1986, there had been a large increase in litigation against manufacturers, primarily related to diphtheria, tetanus, and whole-cell pertussis vaccine (DTP) [38]. Major grounds for litigation involving DTP and oral polio vaccines were allegations that the manufacturers had not fulfilled their obligations regarding the duty to warn prospective vaccine recipients and/or their guardians about risks and benefits of the vaccines. The NCVIA accepted the duty to warn as a federal responsibility and required development of VISs for all covered vaccines. The CDC oversees creation and modification of the VISs. Federal law requires that all vaccine providers give the appropriate VIS to prospective vaccine recipients or their guardians prior to each dose of vaccine [39]. Although as of 2009, all vaccines universally recommended for children or adolescents are covered by the NVICP, VISs also are available for a variety of vaccines that are not covered by the NVICP. All VISs can be found at http://www.cdc.gov/vaccines/pubs/

default.htm#vis. The NCVIA has offered substantial protection to providers against litigation related to vaccine administration [39, 40]. Families who feel that their child was injured by a vaccine can request compensation from NVICP. Information on how to file a VICP claim is available at http://www.hrsa.gov/vaccinecompensation or by telephone at 1-800-338-2382.

Providers have a responsibility to educate their patients or parents/guardians prior to a procedure, including immunizations. The VIS is a helpful source of information. The actual effectiveness of the VIS in communicating vaccine risks and benefits is unclear, in part because it is not known how many people actually read them. Each VIS is written in easy to understand language (http://www.cdc.gov/vaccines/pubs/vis/default.htm). There are VISs available for individual vaccines or as a multiple vaccines document that may be used as an optional substitute for any or all of the VISs that cover vaccines recommended routinely for children from birth through 6 months of age (DTaP, inactivated polio vaccine [IPV], *Haemophilus influenzae* type b [Hib], pneumococcal conjugate vaccine [PCV], hepatitis B [HepB], and rotavirus [RV]). The Task Force on Community Preventive Services recommends multicomponent interventions to increase community demand that include education (http://www.thecommunityguide.org/vaccine/vpd-int-demand-multicomponent-ed.pdf) [41].

The NCVIA requires immunization providers to report all adverse events that would contraindicate further doses of a covered immunization as well as all adverse events meeting the criteria for an injury specified in a table maintained by the NVICP. Reports should be made to the VAERS. Reporting forms can be obtained by calling 1-800-822-7967 or by visiting http://www.vaers.hhs.gov. The VAERS system generally is not useful in determining whether temporally related adverse events are related causally to vaccines [42]. However, VAERS is important in identifying potential signals of adverse events that require further investigation. For example, reports of intussusception among infants receiving the rhesus rotavirus tetravalent vaccine, with onsets clustering 3–5 days after receipt of the first dose, suggested the vaccine could cause intussusception [43]. Furthermore, more comprehensive investigations confirmed the causal association, and the use of this vaccine was discontinued [44, 45]. Thus, VAERS reports led to a policy change due to a newly recognized but rare adverse effect that was not established before vaccine licensure. Passive reporting of adverse events suggested meningococcal conjugate (MCV4) vaccine may be related causally to Guillain-Barré syndrome, although extremely rarely [46]. This led to a formal case-control study, the preliminary results of which do not support a causal link [47]. VAERS is the only system that has the potential to collect adverse event data for every vaccine dose administered in the United States.

Finance

Recommendations

14. Patient out-of-pocket immunization expenses should be minimized (A-I).
15. Vaccine-financing programs, including the VFC program, Section 317 of the Public Health Service Act federal grant program, state programs, and private insurance, should be optimized for each patient, as appropriate (B-II).
16. Providers who serve infants, children, and adolescents aged <19 years should be enrolled in the VFC program (B-II).
17. Providers should be aware of other government supported and other funded programs that cover the cost of vaccines and their administration for people who do not have adequate resources (C-III).

Evidence summary. The Task Force on Community Preventive Services reviewed the evidence of effectiveness of reducing out-of-pocket costs at increasing immunization coverage levels among children, adolescents, and adults [41]. Reducing out-of-pocket costs for immunizations can be accomplished by providing free immunizations, reducing administrative costs associated with immunizations, providing insurance coverage, or reducing co-payments for immunizations at the point of service. The Task Force found 19 high-quality studies that demonstrated a median coverage improvement of 10% for interventions that only reduced cost and an improvement of 16% when a cost-reduction intervention was coupled with another active intervention such as reminder/recall [48]. Optimizing the use of government funding sources or private insurance for individual patients is considered a mechanism of providing free or reduced cost vaccine and is within the scope of the Task Force evidence review.

The VFC program has been shown to improve access to childhood and adolescent immunizations by reducing referrals for immunization from the medical home (http://www.cdc.gov/vaccines/programs/vfc/default.htm). Reducing referrals reduces missed opportunities to vaccinate. A survey of 1236 physicians showed that, among physicians who received free immunization supplies from the VFC program or elsewhere, 44% were likely to refer an uninsured child, whereas 90% of those not receiving free immunization were likely to refer an uninsured child ($P < .001$) [49].

The National Vaccine Advisory Committee developed the Standards for Child and Adolescent Immunization Practices and the Standards for Adult Immunization Practices [23, 50]. The standards recommended by this committee of experts included that providers practice community-based approaches to immunization services (Tables 3 and 4). Community-based approaches may involve working with partners in the community, including public health departments, managed care organizations, and other service providers, to determine community

Table 3. Standards for Child and Adolescent Immunization Practices

Availability of vaccines
Immunization services are readily available
Immunizations are coordinated with other health care services and provided in a Medical Home, when possible
Barriers to immunization are identified and minimized
Patient costs are minimized
Assessment of immunization status
Health care professionals review the immunization and health status of patients at every encounter to determine which vaccines are indicated
Health care professionals assess for and follow only medically accepted contraindications
Effective communication about vaccine benefits and risks
Parents or guardians and patients are educated about the benefits and risks of immunization in a culturally appropriate manner and in easy-to-understand language
Proper storage and administration of vaccines and documentation of immunizations
Health care professionals follow appropriate procedures for vaccine storage and handling
Up-to-date, written immunization protocols are accessible at all locations where vaccines are administered
Persons who administer vaccines and staff who manage or support vaccine administration are knowledgeable and receive ongoing education
Health care professionals simultaneously administer as many indicated vaccine doses as possible
Immunization records for patients are accurate, complete, and easily accessible
Health care professionals report adverse events following immunization promptly and accurately to the Vaccine Adverse Event Reporting System and are aware of a separate program, the National Vaccine Injury Compensation Program
All personnel who have contact with patients are appropriately vaccinated
Implementation of strategies to improve immunization coverage
Systems are used to remind parents or guardians, patients, and health care professionals when immunizations are due and to re-call persons who are overdue
Office- or clinic-based patient record reviews and immunization coverage assessments are performed annually
Health care professionals practice community-based approaches

NOTE. Reproduced with permission from [23].

needs and to develop immunization services that address these needs.

Access to Immunizations

Recommendations

18. Barriers to immunizations should be identified and eliminated or as minimized as possible (B-II).

19. Immunization services should be easy to access, including express immunization services (eg, influenza immunization clinics) and expanded hours of immunization services (A-II).

20. Immunization should be integrated into routine health care services offered in offices and clinics (C-III).

21. Private providers should consider participating in programs that provide financially vulnerable adults with access to immunizations at no cost (C-III).

Evidence summary. The Standards for Child and Adolescent Immunization Practices were designed to lower barriers to immunization services for children and adolescents. The Standards include assuring that immunization services are readily available and coupled with other routine clinical services, lowering barriers to immunizations, reducing out-of-pocket costs to patients and parents, and communicating effectively the benefits and risks of immunization (Table 3) [23]. A 1-year nonrandomized trial conducted in 1995 in New Mexico compared 2 health care settings: a control setting and a setting in which the Standards were implemented. Immunization coverage levels at the intervention site increased from 58% to 80%, whereas coverage levels remained static at 42% in the control setting. In addition, completion of a 4-dose immunization series increased substantially in the standards group, compared with the control group [51].

The Task Force on Community Preventive Services identified 16 high-quality studies on expanding access to immunization services. Most of these studies combined expansion of access with another intervention including provider education, reducing costs, and reminder/recall. The types of expanded access tested included drop-in clinics, increasing hours to include nights and weekends, dedicated immunization clinics, and transportation assistance. The median impact of these

Table 4. Standards for Adult Immunization Practices

Make immunizations available
Adult immunization services are readily available
Barriers to receiving vaccines are identified and minimized
Patient "out-of-pocket" immunization costs are minimized
Assess patients' immunization status.
Health care professionals routinely review the immunization status of patients
Health care professionals assess for valid contraindications
Communicate effectively with patients
Patients are educated about risks and benefits of immunization in easy-to-understand language
Administer and document immunizations properly
Written immunization protocols are available at all locations where vaccines are administered
Persons who administer vaccines are properly trained
Health care professionals recommend simultaneous administration of indicated vaccine doses
Immunization records for patients are accurate and easily accessible
All personnel who have contact with patients are appropriately vaccinated
Implement strategies to improve immunization rates.
Systems are developed and used to remind patients and health care professionals when immunizations are due and to re-call patients who are overdue
Standing orders for immunizations are employed
Regular assessments of immunization coverage levels are conducted in a provider's practice
Partner with the community
Patient oriented and community based

NOTE. Reproduced with permission from [50].

expanded access interventions was a 13% improvement in coverage. Updated and detailed information on the Task Force evidence summaries of barrier-reduction interventions can be found at http://www.thecommunityguide.org.

Strategies to Improve Immunization Coverage

Recommendations

22. Reminder/recall systems should be used to enhance immunization rates (A-I).

23. Information regarding administration of vaccines should be entered into immunization information systems (ie, immunization registries) (B-III).

24. Standing orders for immunizations should be established in clinics, hospitals, and nursing homes (A-I).

25. The immunization status of patients should be reviewed at each patient visit (B-II), and patients and parents should be provided with accurate immunization records at office or clinic visits (B-III).

26. All health care providers who administer vaccines should be properly educated and should receive ongoing education (A-III).

27. Regular assessments of immunization coverage rates should be conducted in provider practices (A-I).

28. Demand for adolescent and adult immunization should be increased by improving public and provider awareness of immunizations recommended for adolescents and adults (B-III).

Evidence summary. The Task Force on Community Preventive Services reviewed the evidence of effectiveness of reminder/recall systems, which remind a provider that a specific immunization is due (reminder) or overdue (recall). The content and the methods used to deliver reminders varied among studies in the systematic review. The Task Force reviewed studies containing a total of 17 intervention arms that used reminder/recall alone and 12 intervention arms that used reminder/recall in conjunction with other interventions. The median improvements in immunization coverage were 17% and 14%, respectively [48]. The Task Force and a Cochrane Database review concluded that strong evidence exists that reminder/recall systems improve coverage for routinely recommended immunizations for children, adolescents, and adults [41, 52], but reminder/recall messages are underused by pediatricians and public health clinics [53].

Immunization information systems are confidential, computerized information systems that contain information about immunizations. The National Vaccine Advisory Committee reviewed the nation's progress on implementing immunization information systems and made recommendations to enhance access to immunization information systems. The National Vaccine Advisory Committee recommended that all immunization providers should participate in an immunization infor-

mation system and that all immunization recipients should have their immunizations recorded in an immunization information system [54]. Although immunization information systems continue to expand their capacity to collect information on people of all ages, there is a need for sustained efforts to improve participation and to ensure that data quality measures for timeliness and completeness are met [55]. A CDC program goal for 2010 is to achieve >95% participation in an immunization information system among children aged <6 years [55].

The Task Force on Community Preventive Services reviewed the evidence of effectiveness of standing orders programs to improve immunization coverage levels. Standing orders involve programs in which nonphysician medical personnel prescribe or deliver immunizations to clients without direct physician involvement at the time of the visit [56]. The Task Force found that standing orders, when used alone, were effective in increasing adult coverage with universally recommended immunizations by a median of 51% (range, 30%–81%). More information on this systematic review can be found at http://www.thecommunityguide.org.

The National Vaccine Advisory Committee developed the Standards for Child and Adolescent Immunization Practices and the Standards for Adult Immunization Practices [41, 50]. The standards recommended by this committee of experts included that health care professionals should review the immunization and health status of patients at every encounter to determine which immunizations are indicated; that immunization records for patients are accurate, complete, and easily accessible; and that people who administer immunizations and staff who manage or support immunization administration are knowledgeable and receive ongoing education.

The Task Force on Community Preventive Services reviewed the evidence of effectiveness of assessment of immunization coverage levels at provider offices, coupled with feedback to the provider of their immunization performance. The goals of these interventions can include changing the provider's knowledge, attitudes, and behavior and stimulating other changes in the way immunizations are delivered (eg, using provider reminder/recall systems or standing orders). Assessments can be conducted for providers in private or group practices, managed care organizations, teaching hospitals, or other settings and can be conducted by the provider's staff, the staff of the organization that manages the setting, insurance companies, or others interested in improving immunization delivery. The Task Force found 5 intervention arms that evaluated provider assessment and feedback alone and 8 intervention arms that evaluated multicomponent programs that included provider assessment and feedback. The results of these studies showed median improvements in immunization coverage of 16% and 17%, respectively. The Task Force concluded that the results indicate that provider assessment and feedback increase immunization provision across a wide range of providers and contexts. More information on the details of this intervention can be found at http://www.thecommunityguide.org.

The National Vaccine Advisory Committee made a number of recommendations to sustain the success of childhood immunizations in the United States [23]. Among the recommendations of this expert committee are that parents should be supported in their efforts to immunize their children and that public awareness campaigns to improve parents' knowledge about the importance and safety of immunizations should be sustained and/or initiated, particularly in underserved areas.

III. HOW IS IMMUNIZATION IMPLEMENTED IN COMPLEMENTARY (NONTRADITIONAL) IMMUNIZATION SETTINGS?

Recommendations

29. Providers should support use of community-based settings to immunize target populations that have difficulty accessing usual immunization providers (B-III).

30. Providers should support establishment of school-based, childcare-based, and hospital-based immunization programs to deliver influenza immunization to school-aged children, adolescents, and adults (B-III).

31. Immunization providers in complementary settings should adhere to quality standards, including ability to appropriately manage vaccine-related adverse events, proper storage and handling of vaccines, appropriate record keeping, regulatory issues, and provision of education regarding both risks and benefits of immunizations, as well as other preventive care measures, including adherence to hand hygiene (B-III).

32. Providers of immunizations in nontraditional settings should ensure that records of immunizations administered in these settings are sent to primary care providers and to immunization information systems (registries) and should encourage vaccinees in such settings to see their primary care providers for other preventive and therapeutic services (B-III).

Evidence summary. Complementary immunization sites are often called "nontraditional immunization sites," which reflects their existence outside the traditional primary health care setting. Such sites complement primary care, particularly for adult and potentially adolescent immunizations, given that many Americans do not have a personal health care provider [57] and given that a significant percentage of adult immunizations occur outside the primary care setting [58].

In recent years, there has been a substantial increase in immunizations recommended for adolescents including MCV4, Tdap, and 3 doses of human papillomavirus vaccine for females [15–17]. Many adolescents do not make regular health care visits at times when the vaccines are recommended to be ad-

ministered [59], and many do not have a medical home where medical care can be consistently provided. Thus, provision of immunization services in other places, such as schools, may be necessary to reach this vulnerable age group. Thus, complementary settings, such as schools, shopping malls, and pharmacies, and immunization through sports teams should be evaluated [59, 60].

By contrast, an estimated 80% of pediatric immunizations occur within the context of primary care practice. Complementary sites appear less important for vaccinating children than for older aged people. However, even for pediatric immunizations, complementary sites may be needed to reach populations that have poor access to primary care. This may be especially true for annual influenza immunization, which should be delivered to all children and adolescents aged 6 months through 18 years each fall or winter. Immunizations could be offered at places where parents access other health care services, such as Special Supplemental Nutrition Program for Women, Infants, and Children offices and pharmacies, or in community settings, such as housing projects, schools or school-based clinics, and churches, thereby breaking down barriers to immunization. However, the use of such sites will need to be promoted and supported with adequate resources, and their utility will need to be evaluated.

Proper use of complementary sites for immunization services can provide the following benefits: (1) improving access to immunizations for many adolescents and adults who are otherwise unable to reach a primary care provider; (2) having the potential to eliminate barriers associated with seeking care in a primary care setting, such as making an appointment or long waiting times; (3) providing immunizations at lower costs, which may increase access for the uninsured or for people who have insurance that either does not cover immunizations or is associated with large deductibles or co-payments; and (4) increasing opportunities to raise awareness and educate the public about the value of immunizations. In addition, new partnerships and alliances can be formed that can improve immunization outreach; these may be especially important when planning for pandemic influenza.

Challenges exist to the provision of immunization services outside the primary care setting and include the following: (1) Management of adverse events including syncope [61] that may occur after immunization; all immunization providers must be trained to respond appropriately. (2) Assurance that immunization records are available for primary care providers and other vaccinators when patients receive subsequent care; this requires careful record keeping including the use of a registry/information system (for example, to eliminate unnecessary reimmunization). (3) Legal limitations on who can administer vaccines; many states have legislation regulating which health care professionals can administer immunizations. Finally, (4) motivation of the public to seek immunization in complementary settings. These limitations will have to be addressed to optimally utilize complementary settings to assure all people for whom immunizations are recommended can gain ready access to immunization services [62].

Racial and ethnic disparities currently exist in immunization coverage rates, particularly for adults, and adolescent immunization remains a challenge in most primary care settings. These populations may be served by use of complementary immunization settings. For racial and ethnic minorities, community leaders and respected community organizations can play influential roles in promoting immunization. Thus, it is important to consider using settings such as churches, community health and social centers, YWCA/YMCA facilities, and places of employment to reach the racial and ethnic minorities not well served by traditional immunization services.

Hospital-based programs can implement influenza immunization protocols to ensure no one is discharged from the hospital before or during influenza season without receiving immunization. The hospital emergency department is another setting in which to reach children, adolescents, and adults with chronic illness who may need influenza vaccine prior to discharge and to use Tdap in place of tetanus and diphtheria vaccine when a tetanus immunization is indicated [63]. The use of standing orders or protocols expedites delivery of immunization in this setting [56].

The AMA has issued quality standards for store-based clinics (http://www.ama-assn.org/go/policy). The AAP's policy on retail-based clinics can be found at http://aappolicy.aapublications.org/cgi/reprint/pediatrics;118/6/2561.pdf. The AAP is committed to the medical home model for medical care for infants, children, and adolescents.

Pertinent to immunization services delivered in complementary settings are the following: (1) standardized medical protocols derived from evidence-based practice guidelines should be used to ensure patient safety and quality of care; (2) immunization providers should have direct access to and/or protocol oversight by physicians, as consistent with state laws; (3) protocols should be established to ensure continuity of care with practicing physicians within the local community; (4) referral systems should be established for cases beyond the scope of practice of the setting; (5) patients should be informed about the qualifications and limitations of providers giving care; (6) appropriate sanitation and hygienic guidelines should be followed by the facility; (7) electronic health records should be used, when available, as a means of communicating patient information and facilitating continuity of care; and (8) patients should be advised to establish care with a primary care provider to ensure continuity of care and to receive other disease or condition preventive measures.

The National Vaccine Advisory Committee has issued quality

standards and guidance specific to adult immunization programs in complementary settings [60]. The 7 standards are (1) information and education, such as culturally appropriate materials on the benefits and safety of the vaccine and the provision of vaccine information statements, should be provided to vaccinees; (2) adherence to vaccine handling and storage recommendations included in vaccine package inserts is critical; (3) preimmunization screening interviews should be conducted that include obtaining history of prior immunizations obtained before administering vaccines; (4) immunization providers must assess the presence of contraindications; (5) documentation of the immunization should be kept and recorded in the vaccinee's medical file, sent to the primary care provider, and given to the vaccinee; documentation includes the date of administration, name of the vaccine, manufacturer and lot number, the administration site, and the provider who gave the immunization and should note that the VIS was provided and discussed with the immunization recipient or parent; (6) providers in complementary settings who administer vaccines must have the legal authority to do so and must be appropriately educated and licensed in all aspects of immunization administration; and (7) providers must be educated to recognize and treat adverse events, and the equipment needed to do so must be available on site.

Immunization providers in complementary settings also should be mindful of all of the quality standards required for safe immunization. This includes following standard precautions to prevent transmission of infection during immunization, such as proper hand hygiene prior to vaccinating. Safety devices for vaccine administration also are recommended for complementary settings. It is vital to safely dispose of needles in a hazardous waste container that is puncture proof without manually recapping or detaching the needle from the syringe. The use of gloves is not necessary for immunization in any setting, unless the person giving the immunization has open lesions or determines that a potential for exposure to blood or body fluids exists.

Privacy practices will be challenging in complementary settings. Concerns about physical privacy must be met, such as by providing screens for mass influenza immunization clinics in public settings. In addition, privacy of health care information must be respected (ie, abiding by all Health Insurance Portability and Accountability Act regulations). As an example, clinic workers should not call out a patient's first and last name in retail, school, or other public settings.

Whatever the setting, developmental considerations and age must be considered when vaccinating infants, children, adolescents, and adults. All patients must be screened appropriately prior to immunization, and providers in all settings must discuss immunization risks and benefits with patients in an age-appropriate manner. Anxiety produced by needles can be problematic at all ages and must be acknowledged by the provider in complementary settings [61].

For many adolescents and adults, receipt of an immunization may be that person's only encounter with the health care system. Thus, every effort should be made by a complementary immunization provider to make that experience as positive as possible and to refer the patient to a traditional primary care provider where she/he can receive further evaluation for additional preventive and therapeutic medical interventions.

IV. WHAT ARE THE CURRENT IMMUNIZATION RECOMMENDATIONS FOR SPECIAL GROUPS, INCLUDING HEALTH CARE PROVIDERS, IMMUNOCOMPROMISED PEOPLE, PREGNANT WOMEN, INTERNATIONAL TRAVELERS, AND INTERNATIONALLY ADOPTED CHILDREN?

Health Care Professionals

Recommendations

33. All health care professionals should be immunized appropriately (B-II). Specifically, annual immunization with influenza vaccine and receipt of a booster dose of Tdap should be ensured, as well as adequate immunization against measles, mumps, rubella, and varicella. People whose work anticipates they may be exposed to blood or body fluids should be immunized against hepatitis B.

34. Hospitals, clinics, and offices should implement programs to ensure that health care professionals are immunized appropriately and that annual immunization coverage assessments are performed (B-II).

Evidence summary. Occupational activities place health care professionals at increased risk of exposure to communicable diseases through their close contact with patients and with patients' specimens, body fluids, and excretions. These same close contacts make it possible for health care providers to transmit their own communicable diseases to their vulnerable patients. Recognizing this, infection control procedures have been established to minimize the risk of infection transmission during provision of medical care. Immunization of personnel working in the entire spectrum of health care settings is a fundamental feature of infection control, patient safety programs, and personnel safety. Immunization should be a component of the occupational health program of all medical care facilities, including hospitals; physicians' offices; extended care and nursing facilities; free-standing surgical, radiological, and other units; and clinics of all types. All health care professionals and people who work in any health care setting should be included. These settings encompass personnel who provide direct patient care (eg, physicians, nurses, dentists, respiratory and physical therapists, phlebotomists, radiology technicians, receptionists, social workers, and chap-

lains) as well as personnel who work in the health care environment who may not care for patients directly (eg, dietary workers, environmental services, security, and administrative personnel). Included also are emergency medical technicians, contract personnel, volunteers, and students of all disciplines in the health care environment. Although many physicians and other providers work as independent contractors and are not employed by the hospitals and other health care facilities in which they practice, this does not exempt them from their obligation to be immunized.

The ACIP issues recommendations for immunization of health care personnel. Health care personnel should be immune to measles, mumps, rubella, varicella, pertussis, and influenza. Specific recommendations for immunization of health care professionals can be found at http://www.cdc.gov/vaccines/recs/schedules/adult-schedule.htm. The Healthcare Infection Control Practices Advisory Committee/ACIP document dealing with health care professional immunizations is being updated and can be found at http://www.cdc.gov/vaccines and http://www.cdc.gov/ncidod/dhqp/hicpac.html when it is published. Health care professionals who may be exposed to blood or body fluids should be protected against hepatitis B [13], all health care personnel should be immunized annually against influenza [21], and laboratory personnel who handle specimens or cultures containing *Neisseria meningitidis* should be immunized with MCV4 if they are aged <56 years and with meningococcal polysaccharide vaccine if they are aged ⩾56 years.

Nosocomial outbreaks of measles and rubella were once common. The transmission of measles has involved many health care settings, including physicians' offices and emergency departments and has occurred from patients to health care personnel as well as the reverse [4, 19, 64–78]. The sources of nosocomial rubella have been both patients (including infants with congenital rubella) and medical personnel [70–73]. Some exposures have occurred in obstetrical clinics, infecting pregnant patients; infection of pregnant health care providers also has occurred. Although less frequent, nosocomial transmission of mumps has been reported [74, 75].

The endemic transmission of these 3 viral infections in the United States has been interrupted through a concerted effort that includes routine immunization of all infants and children and vigorous public health investigation of remaining cases, including cases imported into this country from abroad [4]. Nevertheless, the assurance of immunity of the health care workforce will need to continue. There is a group of parents who are refusing to have their children immunized or who are delaying immunizations. This produces a population of susceptible persons who can sustain an outbreak if the virus is introduced into that population. Furthermore, citizens of other countries may develop these diseases shortly after their arrival in the United States. In 2006, imported measles spread to an insufficiently immunized hospital employee [76].

The substantial mumps outbreak of 2006 in the midwestern United States demonstrated that not all involved health care professionals had been optimally immunized. The CDC now recommends that health care personnel should receive 2 doses of mumps vaccine [19].

Varicella also has been transmitted in health care settings and often is introduced into hospitals by children or by medical personnel who were asymptomatic at the end of the incubation period, just before skin lesions erupt [77–80]. Patients with herpes zoster also can be the source of transmissible varicella virus, requiring an immune population of health care personnel to prevent nosocomial acquisition.

Pertussis is resurgent, with the number of reported cases having increased steadily since the 1980s. This is thought to be the consequence of immunity waning after childhood vaccination, leaving adolescents and adults only partially protected. In this setting, pertussis introductions into health care settings serving both children and adults have become quite common and now often rank among the most frequent infectious disease exposures that require evaluation by occupational health services of hospitals [81–83]. The licensure, in 2005, of an acellular pertussis vaccine formulated for use in adolescents and adults (in combination with Tdap) stimulated the CDC to recommend that health care personnel receive a single dose of Tdap as soon as feasible [62, 84].

Hepatitis B was once a regular occupational hazard of all health care professionals whose interactions with patients involved exposure to their blood or body fluids, particularly in the context of using a sharp instrument. Serosurveys performed in the prevaccine era indicated that health care professionals had 3–5 times the risk of acquiring hepatitis B, compared with the general population [85, 86]. In 1991, the Occupational Safety and Health Administration issued regulations that required all health care facilities to provide their employees hepatitis B immunization [87]. Consequently, hepatitis B infections among health care professionals have decreased substantially [88].

Introduction of influenza into hospitals, nursing homes, and other health care facilities is a well-recognized event. Infected medical personnel may introduce influenza into the facility from the community and also may acquire influenza from infected patients and then further transmit infection to patients and other medical staff [89, 90]. Influenza also produces substantial absenteeism among personnel, with resultant disruptive impact on the provision of medical care. Influenza immunization of health care professionals has been shown to reduce the risk of acquisition of influenza by patients leading also to reduced mortality and has been shown to be cost-saving [91–94]. Influenza vaccine is not only effective in reducing trans-

mission of this highly contagious virus from health care personnel to patients in their care, many of whom are at high risk of developing serious complications, but also in preventing influenza disease among health care professionals and in reducing days of work absence. Several states now require annual influenza immunization of health care professionals in acute and long-term care settings. A number of professional medical and nursing societies endorse required annual influenza immunization with informed declination for health care professionals, which allows a health care professional to sign a statement acknowledging, despite recommendations, that they are refusing vaccination.

Immunocompromised Persons

Recommendations

35. All immunocompromised infants, children, adolescents, and adults should be appropriately immunized (B-II).

36. Providers should be aware of contraindications and precautions for vaccines in people with primary and secondary immunodeficiencies (B-III).

37. Providers should educate immunocompromised patients that, depending on the vaccine and their degree of immune dysfunction, the vaccines that are administered may not be fully effective (C-III).

38. Providers who care for immunocompromised patients should ensure that household contacts are immunized appropriately to reduce the risk of exposure of immunocompromised patients to vaccine-preventable diseases (B-III).

Evidence summary. People may be immunocompromised due to either primary or secondary (acquired) immunodeficiency conditions. Primary disorders of the immune system generally are inherited, may involve any part of the immune system, and share the common feature of susceptibility to infection with various organisms, some of which may be prevented by immunization, depending on the specific immunodeficiency. Secondary deficiencies of the immune system are acquired and encompass many categories, including human immunodeficiency virus (HIV) infection, solid organ or hematopoietic malignancies, or transplantation; immunosuppression due to administration of chemotherapy or other therapeutics, such as systemic corticosteroids, radiation or monoclonal antibodies; or other chronic conditions, including diabetes mellitus, autoimmune diseases, and splenectomy. People who are immunocompromised require special considerations for immunization, because they may be at increased risk for morbidity and mortality from various infections, at increased risk of serious consequences of immunizations, or at risk for inadequate response to immunization (Table 5). People with primary or secondary immunodeficiencies can be immunized safely with inactivated vaccines, which generally are recommended in the same dose and on the same schedule as for immunocompetent people. Response to both inactivated and live vaccines may be suboptimal, and higher doses (eg, special formulations of hepatitis B vaccine for adult patients undergoing hemodialysis and other immunocompromised adults) or additional doses (eg, for patients who have undergone transplantation) may be needed to ensure protection [33, 95–102].

Live, attenuated vaccines generally are not recommended at any age for many of these groups because of known or theoretical risks of disseminated infection due to the vaccine virus [96–102]. Exceptions exist, including measles-mumps-rubella and varicella vaccines, which are recommended for susceptible people with HIV infection who have a $CD4^+$ T lymphocyte percentage $\geqslant$15% and no or mild symptoms of disease [100, 101]. Vaccines should be administered by primary care providers or subspecialists, if responsibility for primary care has been assumed by them. In addition, primary care providers should ensure that household contacts of patients with immunocompromised conditions are immunized appropriately, including with annual influenza vaccine, to reduce the risk of exposure of immunocompromised patients.

Pregnancy

Recommendations

39. Providers should be aware of immunizations routinely recommended for women during pregnancy, including inactivated trivalent influenza vaccine (A-II).

40. Providers should administer appropriate vaccines to pregnant women with medical or exposure indications that put them at risk of certain vaccine-preventable diseases (A-I).

41. Following delivery, women should receive all recommended vaccines that could not be or were not administered during pregnancy (A-II).

42. Providers should be aware of and follow valid contraindications and precautions for immunizing pregnant women (A-III).

Evidence summary. Summarizing evidence for use of vaccines in pregnant women is hampered by lack of efficacy and safety studies in the United States. Recommendations for vaccine use are largely based on disease burden and severity for mothers and newborn infants, studies reported from other countries, and expert committee opinion. The only vaccines recommended in the United States for routine use during pregnancy are adult type tetanus and reduced diphtheria toxoids (Td), either for primary or booster doses, and inactivated trivalent influenza vaccines [103, 104]. Other recommended vaccines are for women with medical or exposure indications that put them at increased risk of certain vaccine-preventable infectious diseases. Although immunization during pregnancy poses theoretical risks, to date, there has been no evidence indicating

Table 5. Immunization of Children and Adolescents with Primary and Secondary Immune Deficiencies

Category	Examples of specific immunodeficiency	Vaccine contraindication(s)	Effectiveness and comments
Primary[a]			
B lymphocyte (humoral)	Severe antibody deficiencies (eg, X-linked agammaglobulinemia and common variable immunodeficiency)	OPV,[b] smallpox, LAIV, yellow fever and live-bacteria vaccines;[c] consider measles vaccine; no data for varicella or rotavirus vaccines	Effectiveness of any vaccine dependent only on humoral response is doubtful; IGIV therapy interferes with measles and possibly varicella immune response
	Less-severe antibody deficiencies (eg, selective IgA deficiency and IgG subclass deficiencies)	OPV;[b] other live vaccines[d] seem to be safe, but caution is urged	All vaccines probably effective; immune response may be attenuated
T lymphocyte (cell-mediated and humoral)	Complete defects (eg, severe combined immunodeficiency, complete DiGeorge syndrome)	All live vaccines[c,d]	All vaccines ineffective
	Partial defects (eg, most patients with DiGeorge syndrome, Wiskott-Aldrich syndrome, ataxia telangiectasia)	All live vaccines[c,d]	Effectiveness of any vaccine depends on degree of immune suppression; recommend inactivated vaccines
Complement	Deficiency of early components (C1–C4)	None	All routine vaccines probably effective; pneumococcal and meningococcal vaccines are recommended
	Deficiency of late components (C5–C9), properdin, factor B	None	All routine vaccines probably effective; meningococcal and pneumococcal vaccines are recommended
Phagocytic function	Chronic granulomatous disease, leukocyte adhesion defects, myeloperoxidase deficiency	Live-bacteria vaccines[c]	All inactivated vaccines safe and probably effective; live viral vaccines probably safe and effective
Secondary[a]			
	HIV/AIDS	OPV,[b] smallpox, BCG, LAIV;[d] withhold MMR, varicella, and rotavirus in severely immunocompromised children	MMR, varicella, rotavirus, and all inactivated vaccines, including influenza, may be effective[e]
	Malignant neoplasm, transplantation, autoimmune disease, immunosuppressive or radiation therapy	Live-virus and -bacteria, depending on immune status[c,d]	Effectiveness of any vaccine depends on degree of immunosuppression

NOTE. Reproduced with permission from [95]. BCG, bacille Calmette-Guérin; Ig, immunoglobulin; IGIV, immunoglobulin intravenous; HIV, human immunodeficiency virus; LAIV, live, attenuated influenza vaccine; MMR, measles-mumps-rubella; OPV, oral poliovirus.

[a] All children and adolescents should receive an annual age-appropriate inactivated influenza vaccine. LAIV is indicated only for healthy people aged 5 through 49 years.

[b] OPV vaccine no longer is recommended for routine use in the United States.

[c] Live-bacteria vaccines: BCG and Ty21a *Salmonella typhi* vaccine.

[d] Live-virus vaccines: LAIV; MMR; measles, mumps, rubella and varicella vaccine; OPV; varicella; yellow fever; vaccinia (smallpox); rotavirus; and herpes zoster.

[e] HIV-infected children should receive Ig after exposure to measles and may receive varicella vaccine if $CD4^+$ T lymphocyte count is $\geqslant$15% of that expected for age [99].

vaccines used today have detrimental effects on the fetus or on a pregnant woman. In principle, live, attenuated vaccines are of more concern because of adverse fetal effects; thus, live, attenuated vaccines should not be given to pregnant women. ACIP recommendations for pregnant women can be found at http://www.cdc.gov/vaccines/recs/schedules/adult-schedule.htm.

Women who have not received a Td-containing booster during the previous 10 years and women who are unimmunized or incompletely immunized should complete the primary Td series. In 1999, the World Health Organization (WHO) launched the Maternal and Neonatal Tetanus Elimination initiative, giving women 2 doses of tetanus toxoid vaccine during pregnancy and 1 dose during each subsequent pregnancy up to a total of 5 doses. By December 2008, 12 countries and 15 states and Union Territories in India had eliminated maternal and neonatal tetanus, whereas 46 countries had not met the WHO Maternal and Neonatal Tetanus Elimination goal (http://www.who.int). This program of tetanus toxoid administration during pregnancy has been associated with a striking decrease in infant mortality rates attributable to tetanus and has not demonstrated adverse effects in mothers or fetuses [105].

Pertussis is the only vaccine-preventable disease that is increasing in the United States. Waning immunity, which starts ~7 years after the 4 or 5 childhood pertussis immunizations, is a cause [106]. In 2005, a tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis (Tdap) vaccine was licensed and recommended as a one-time replacement of the decennial Td booster for people aged 18 through 64 years. If a pregnant woman has not received a Td vaccination within the past 10 years, administer Td during the second or third trimester of pregnancy. If the woman received her most recent Td vaccination <10 years previously, administer Tdap during the immediate postpartum period. The postpartum Tdap dose should be administered before discharge from the hospital or birthing center or, if that is not possible, as soon as feasible thereafter. A dose of Tdap is not only recommended for those postpartum women but also for close contacts of infants aged <12 months and for all health care personnel with direct patient contact if they have not previously received Tdap. An interval for Tdap administration as short as 2 years from the most recent Td dose is suggested; shorter intervals can be used. Td can be deferred during pregnancy, and Tdap can be substituted in the immediate postpartum period, or Tdap can be administered instead of Td to a pregnant woman after an informed discussion with the woman [107]. In addition, the AAP and the ACOG have issued recommendations that go beyond those of the ACIP. Both the AAP and the ACOG recommend that pregnant women who have not received a Td-containing booster in the previous 2 years should be immunized with Tdap vaccine during pregnancy [108]. This recommendation is based on the desire to provide passive immunity to infants from mothers before active protection in the infant is achieved after completion of the 3-dose primary DTaP immunization series at 6 months of age. Since 2004, ~90% of pertussis-related deaths and severe complications have occurred in infants aged ⩽3 months, and 75% of these infants acquired their infection from a household member—most frequently the mother [109]. Although the ACIP was concerned about protecting young infants from pertussis, the committee was hesitant to recommend vaccination of pregnant women because of limited data in this population.

Studies indicate that healthy women who are pregnant are at increased risk of serious complications including death from influenza. A study of ~2200 women given inactivated trivalent influenza vaccine during pregnancy reported no adverse effects in the infants who were observed for 7 years. An estimated 2 million women were immunized during the period 2000–2003 with inactivated trivalent influenza vaccine; only 9 injection site reactions, 8 systemic reactions, and 3 miscarriages (not elevated above background rate) were reported [21]. Inactivated trivalent influenza vaccine should be administered to all women who will be pregnant during the influenza season, regardless of trimester. Influenza immunization of a woman during pregnancy also appears to protect infants aged <6 months [110]. Infants aged <6 months cannot be immunized or receive antiviral prophylaxis, because no products are licensed for this age group. Live, attenuated influenza vaccine (LAIV) is not licensed for use in pregnant women and should not be administered. However, pregnant women do not need to avoid contact with people who have received LAIV [21].

Pregnant women with endemic or epidemic exposures to certain vaccine-preventable diseases should receive certain vaccines, because the risk of serious disease outweighs the theoretical risk of adverse effects on the mother or fetus. These vaccines include hepatitis B vaccine, quadrivalent meningococcal conjugate vaccine (which is preferred, although quadrivalent meningococcal polysaccharide vaccine is acceptable), and parenteral typhoid vaccine. Rabies vaccine should be administered only if exposure occurs. Hepatitis A vaccine and inactivated polio virus vaccine can be given if travel to an area of endemicity is unavoidable. Japanese encephalitis vaccine and yellow fever vaccine should be administered only if travel to a region of endemicity cannot be avoided and if the risk for exposure is significant. Live, attenuated vaccines (eg, LAIV; measles, mumps, and rubella vaccine; varicella vaccine; and oral typhoid vaccines) should be avoided during pregnancy [103].

Previously unimmunized pregnant women or women who have not been immunized during the previous 5 years should receive pneumococcal polysaccharide vaccine if they are at increased risk of acquiring serious infection due to *Streptococcus pneumoniae* [103]. Women at increased risk include those with underlying medical conditions (eg, women with diabetes mel-

litus, chronic lung disease, liver disease, or HIV infection or immunocompromised women) and women with functional or anatomical asplenia. Pregnant women immunized 5 years previously with meningococcal polysaccharide vaccine should receive meningococcal conjugate vaccine if they have functional or anatomical asplenia, have a terminal complement component deficiency, or are working in a microbiology laboratory where exposure to *N. meningitidis* is routine. These groups of women have an increased risk of developing invasive meningococcal infection [103].

The final consideration for pregnant women is to provide certain vaccines postpartum before hospital discharge. Vaccines recommended in this circumstance are measles-mumps-rubella vaccine for rubella-nonimmune women, measles-mumps-rubella vaccine for women who previously had not received 2 doses of a measles-containing vaccine, Tdap as described above, and varicella for women who are nonimmune or if a second dose of varicella vaccine was not administered previously. Breast-feeding is not a contraindication to maternal postpartum immunization, including use of live, attenuated viral vaccines.

International Travel

Recommendations

43. Providers who care for people who travel should ensure that all country-specific vaccines are administered in a time frame that ensures optimal development of protection (A-I).
44. Health care professionals should be aware of key sources of information regarding immunization of travelers at every age (B-III).

Evidence summary. People travel internationally for many reasons, including tourism, business, education, and visits to relatives and friends. Although clinics that specialize in pretravel advice, including immunizations, are located in many areas, primary care providers should be able to provide basic pretravel services and advice, including providing information about immunizations to people planning international travel or referring people to clinics that specialize in travel medicine. The 2 major immunization issues to consider in immunizing travelers are status of routinely recommended immunizations and need for travel-specific immunizations [111]. To ensure that routinely recommended immunizations are up to date, knowledge of a patient's previous immunization history and medical history is necessary. The use of travel-specific immunizations is based on scientific evidence of benefits, risks, and (if few or no data are available) expert opinion. Immunizations should be individualized depending on the traveler's immunization and medical history, the specific travel itinerary, season, living conditions during the journey, mode and purpose of travel, and the amount of time before departure [112, 113]. Ideally, a traveler should arrange an appointment with a travel medicine health care provider 4–6 weeks before departure [114]. Country-specific immunization information is available for all countries (http://www.cdc.gov/travel and http://www.who.int/ith/en/)
[115, 116].

Immunizations for travel may be categorized into 2 groups: required (ie, those that may be required to cross international borders) and recommended (ie, those recommended according to risk for infection in the area of travel) [111]. Immunization schedules according to accepted standards are available for children, adolescents [94, 117], and adults, as well as pregnant travelers [118]. Special recommendations may be necessary for people who are immunocompromised [119]. Also, accelerated schedules are available for the traveler without adequate time before travel for both routinely recommended as well as travel immunizations.

Internationally Adopted Children

Recommendations

45. Providers should accept only written documentation as evidence of previous immunization (B-III).
46. Providers should be aware of the various approaches that can be followed if there is concern about whether vaccines administered to an international adoptee were immunogenic (B-III).

Evidence summary. In 2007, ~21,000 children were adopted into the United States from countries around the world [120], with 90% of international adoptees coming from countries in Asia, Central and South America, and Eastern Europe. The diverse birth countries of origin of these children, their previous living circumstances (orphanages and/or foster care), potential gaps in their medical histories before adoption, and lack of reliable health care for some of these children, particularly children from developing countries, make the medical evaluation, including immunization history, of internationally adopted children difficult.

Before admission to the United States, all internationally adopted children are required to have a medical examination performed by a physician designated by the US Department of State in their country of origin. This examination is limited to completing legal requirements for screening for certain communicable diseases and examination for serious physical and mental illness that would prevent the issuance of a permanent residency visa. This evaluation is not comprehensive and does not thoroughly assess immunization status. During any preadoption visits, pediatricians and other health care professionals should stress the importance of acquiring immunization and other health care records. Internationally adopted children who are aged <10 years are exempt from Immigration and Nationality Act regulations pertaining to immunization of immigrants

Table 6. Vaccine Resource Web Sites

Organization	Web site(s)
Health professional associations	
American Academy of Family Physicians	http://www.familydoctor.org
American Academy of Pediatrics	http://www.aap.org
American Academy of Pediatrics Childhood Immunization Support Program	http://www.cispimmunize.org
American College of Physicians	http://www.acponline.org/
American Medical Association	http://www.ama-assn.org
American Nurses Association	http://www.nursingworld.org
Association of State and Territorial Health Officials	http://www.astho.org
Association of Teachers of Preventive Medicine	http://www.atpm.org
Canadian Paediatric Society	http://www.caringforkids.cps.ca
Infectious Diseases Society of America	http://www.idsociety.org
National Foundation for Infectious Diseases	http://www.nfid.org
National Medical Association	http://www.nmanet.org
Nonprofit groups and universities	
Albert B. Sabin Vaccine Institute	http://www.sabin.org
Allied Vaccine Group	http://www.vaccine.org
Center for Vaccine Awareness and Research	http://www.texaschildrens.org/CareCenters/Vaccine/Team.aspx
Children's Vaccine Program	http://www.childrensvaccine.org
Every Child by Two	http://www.ecbt.org
Global Alliance for Vaccines and Immunization	http://www.gavialliance.org/
Group on Immunization Education, Society of Teachers and Family Medicine	http://www.immunizationed.org
Health on the Net Foundation	http://www.hon.ch
National Healthy Mothers, Healthy Babies Coalition	http://www.hmhb.org
Immunization Action Coalition	http://www.immunize.org
Institute for Vaccine Safety, Johns Hopkins University	http://www.vaccinesafety.edu
Institute of Medicine	http://www.iom.edu/IOM/IOMHome.nsf/Pages/immunization+safety+review
National Alliance for Hispanic Health	http://www.hispanichealth.org
National Network for Immunization Information	http://www.immunizationinfo.org
Parents of Kids with Infectious Diseases	http://www.pkids.org
Texas Children's Hospital Vaccine Center	http://www.vaccine.texaschildrenshospital.org
The Vaccine Education Center at the Children's Hospital of Philadelphia	http://www.vaccine.chop.edu
The Vaccine Page	http://www.vaccines.com
Government organizations	
Centers for Disease Control and Prevention	http://http://phil.cdc.gov/phil (image library), http://wwwn.cdc.gov/travel/contentVaccinations.aspx, and http://www.cdc.gov/vaccines
US Food and Drug Administration	http://www.fda.gov/cber/vaccines.htm
National Vaccine Program Office	http://www.hhs.gov/nvpo/
National Institute of Allergy and Infectious Diseases	http://www3.niaid.nih.gov/dmid/vaccines
World Health Organization	http://www.who.int/immunization/en/

before arrival in the United States. Adopting parents are required to sign a waiver indicating their intentions to comply with US-recommended immunizations within 30 days after the child arrives in the United States [121].

The ability of a health care provider in the United States to determine that an adoptee is protected against vaccine-preventable diseases is limited. Only written documentation should be accepted as evidence of previous vaccination [22]. Written records are more likely to predict protection if the dates of vaccine administration, intervals between doses, and the person's age at the time of vaccination are compatible with US recommendations. Not all vaccines in the US childhood immunization schedule are administered to children worldwide. The majority of vaccines used worldwide are produced with

adequate control standards and are potent if handled, transported, and stored as recommended.

Physicians can follow one of several approaches if a question exists about whether vaccines administered to an internationally adopted child were immunogenic or actually administered. Evaluation of antibody titers can be helpful for some of the antigens (eg, diphtheria, tetanus, polio, hepatitis B, measles, mumps, and rubella). Protective levels of antitoxin to diphtheria and tetanus may be a surrogate means of assessing pertussis immunity, because the vast majority of tetanus and diphtheria toxoids administered to children are combined with pertussis vaccine. An acceptable alternative when doubt exists is to reimmunize the child. Tables providing recommended and alternative approaches to evaluation and immunization of internationally adopted children with no or questionable vaccination records are available elsewhere [22, 121].

Diseases have been transmitted from adoptees to household members of the international adoptees' new families [13, 14, 62, 122, 123]. Health care providers should ensure that household contacts of internationally adopted children are appropriately immunized (http://www.cdc.gov/vaccines/recs/schedules/adult-schedule.htm) and that all people traveling to countries to bring their internationally adopted children to the United States are adequately immunized, including receiving hepatitis A vaccine and any other recommended travel- or country-specific vaccines (http://www.cdc.gov/travel/contentVaccinations.aspx).

USEFUL WEB SITES FOR ADDITIONAL INFORMATION

Many Web sites are available to direct the reader to useful information about immunizations. Table 6 categorizes these Web sites into those from health care professional organizations, nonprofit groups and universities, and government organizations.

PERFORMANCE MEASURES

1. Disease incidence, as measured through postlicensure surveillance for vaccine-preventable diseases, should be reduced in accordance with Healthy People 2010 and 2020 goals.
2. New vaccines recommended for routine use by the ACIP should be implemented by providers within 6 months of a published recommendation. Coverage levels of ⩾90% should be achieved within 5 years of a published recommendation.
3. Immunization coverage should be monitored for vaccines recommended for routine use in the general population in each of the 50 states and among people of different racial or ethnic backgrounds.
4. Each practice should measure the immunization rates of patients in their care on a regular basis.
5. Quality standards should be implemented in each complementary setting in which immunizations are offered.
6. Immunizations—including those administered in complementary settings—should be entered into state or community population-based immunization information systems.

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