

## 9. Special Situations

### Updates

Major revisions to this section of the best practices guidance include the timing of intramuscular administration and the timing of clotting factor deficiency replacement.

### Concurrent Administration of Antimicrobial Agents and Vaccines

With a few exceptions, use of an antimicrobial agent does not interfere with the effectiveness of vaccination. Antibacterial agents have no effect on inactivated, recombinant subunit, or polysaccharide vaccines or toxoids. They also have no effect on response to live, attenuated vaccines, except BCG vaccines. Antimicrobial or immunosuppressive agents may interfere with the immune response to BCG and should only be used under medical supervision (for additional information, see [www.merck.com/product/usa/pi\\_circulars/b/bcg/bcg\\_pi.pdf](http://www.merck.com/product/usa/pi_circulars/b/bcg/bcg_pi.pdf)).

Antiviral drugs used for treatment or prophylaxis of influenza virus infections have no effect on the response to inactivated influenza vaccine (2). However, live, attenuated influenza vaccine should not be administered until 48 hours after cessation of therapy with antiviral influenza drugs. If feasible, to avoid possible reduction in vaccine effectiveness, antiviral medication should not be administered for 14 days after LAIV administration (2). If influenza antiviral medications are administered within 2 weeks after receipt of LAIV, the LAIV dose should be repeated 48 or more hours after the last dose of zanamavir or oseltamivir. The LAIV dose should be repeated 5 days after peramivir and 17 days after baloxavir. Alternatively, persons receiving antiviral drugs within the period 2 days before to 14 days after vaccination with LAIV may be revaccinated with another approved vaccine formulation (e.g., IIV or recombinant influenza vaccine). Antiviral drugs active against herpesviruses (e.g., acyclovir or valacyclovir) might reduce the efficacy of vaccines containing live, attenuated varicella zoster virus (i.e., Varivax and ProQuad) (3,4). These drugs should be discontinued at least 24 hours before administration, if possible. If clinically appropriate, delay use or resumption of antiviral therapy for 14 days after vaccination. No data exist to suggest that commonly used

antiviral drugs have an effect on rotavirus vaccine or MMR.

## **Administration of Live Vaccines and Tuberculin Skin Tests (TSTs) and Interferon-gamma Release Assays (IGRAs)**

Measles illness, severe acute or chronic infections, HIV infection, and malnutrition can create a relatively anergic state during which the TST might have a false-negative reaction (5-7). Although live, attenuated measles vaccine theoretically can suppress TST reactivity, the degree of suppression is likely less than that occurring from acute infection from wild-type measles virus. Screening children for tuberculosis exposure is accomplished by medical history rather than TST testing; universal TST screening of all children is no longer recommended, though TST screening is sometimes indicated (e.g., for persons at increased risk for tuberculosis exposure based on medical history, or for employees for occupational health reasons).

In a general screening situation, a provider may find that: both TST and live vaccine are recommended; live vaccine is recommended, and TST has already been administered more than one day previous; or TST is indicated, and the live vaccine has already been administered more than one day previous. TST may be administered simultaneously with live vaccines, and this is the preferred scenario. If live vaccine is indicated, and TST has been administered more than one day previous, the live vaccine can be administered at any interval after the TST. If TST is recommended, and the live vaccine has already been administered more than one day previous, providers should ensure a 28 day interval, in other words defer the TST for 28 days after vaccination. A delay in performing the TST removes the concern of any theoretical transient suppression of TST reactivity. Some providers choose to perform TST screening and then delay the vaccine until the patient returns to have the TST read. This option is less favored compared with simultaneous TST/live vaccination, because it delays receipt of the measles-containing vaccine.

While the above rationale is based on measles suppression of TST response, because of similar concerns about smallpox vaccine and TST suppression, a TST should not be performed until 4 weeks after smallpox vaccination (8). No data exist regarding the potential degree of TST suppression that might be associated with other live, attenuated virus vaccines (e.g., varicella or yellow fever). However, in the absence of data, following

guidelines for measles-containing vaccine when scheduling TST screening and administering other live, attenuated virus vaccines is prudent. If the opportunity to vaccinate might be missed, vaccination should not be delayed only because of these theoretical considerations. TST can be repeated 4 weeks after vaccination if it is negative and concern for TB infection persists.

Interferon gamma release assays (IGRAs), such as the QuantiFERON-TB Gold In-Tube test and the T-Spot TB test, are blood-test alternatives to the TST for detecting *Mycobacterium tuberculosis* infection. The IGRA requires only a single visit to complete and may be less effected by previous BCG vaccination (9). The same timing guidelines that apply to the interval between a live vaccine and TST apply to IGRA (i.e., 28 days between live vaccine and IGRA if they do not occur on the same day), because IGRA (like TST) might be suppressed through immunologic mechanisms. The potential for a previous TST to cause boosting of future TST results should be considered in adults who have a negative initial TST (9). Two-step testing, in which TST is repeated in a short time frame (e.g., 1 to 3 weeks) after an initial negative TST, can illicit boosting and identify persons whose immune response may have waned with time since infection or BCG vaccination. For people undergoing serial screening for infection, for instance health care personnel who are tested yearly, differentiation of positive tests due boosting versus new infection is important (9). The 2-step test, in which the test is given twice in a short time frame, reduces the chance of these false negatives, which are important to identify among adults who may have had or plan to have repeat testing anyway—for example, healthcare personnel who are tested yearly (9). Because this test consists of 2 TSTs separated by an interval of 1-3 weeks, there is a greater window of time during which live vaccine replication could suppress reactivity. If a live vaccine is administered, the first dose of a 2-step TST should be delayed for 4 weeks, and if additional doses of live vaccines are indicated thereafter, they should be delayed until the second TST is measured.

TST or IGRA reactivity in the absence of active tuberculosis is not a contraindication to administration of any vaccine, including live, attenuated virus vaccines.

Note that TST screening of an asymptomatic individual is clinically different than testing a person suspected to have active tuberculosis. If a person is suspected to have active tuberculosis, MMR vaccine is typically not administered. Active tuberculosis should be

considered severe acute illness, and moderate or severe acute illness is a precaution for vaccination.

Although no studies have reported on the effects of MMR vaccine on persons with active untreated tuberculosis, a theoretical basis exists for concern that measles vaccine might exacerbate active tuberculosis (10). As a result, before administering MMR to persons with untreated active tuberculosis, initiating antituberculosis therapy is advisable (10).

Considering whether concurrent immunosuppression (e.g., immunosuppression caused by HIV infection) is present before administering live, attenuated vaccines also is necessary, because immunosuppression is a contraindication to MMR vaccine.

## **Vaccination of Preterm Infants**

In the majority of cases, preterm infants (infants born before 37 weeks' gestation), regardless of birth weight, should be vaccinated at the same chronological age and according to the same schedule and using the same precautions as for full-term infants and children. Birth weight and size are not factors in deciding whether to vaccinate a clinically stable preterm infant (11-15), except for hepatitis B vaccination. The full recommended dose of each vaccine should be used. Divided or reduced doses are not recommended.

Decreased seroconversion rates might occur among certain preterm infants (i.e., those with low birth weights [ $<2,000$  g]) after administration of hepatitis B vaccine at birth (16). However, by the chronological age of 1 month, all preterm infants, regardless of initial birth weight, are likely to respond as adequately as larger infants (17-19). Infants weighing  $<2,000$  g born to HBsAg-negative mothers should receive the first dose of the hepatitis B vaccine series at chronological age 1 month or hospital discharge, if hospital discharge occurs when the infant is younger than one month of age. Preterm low-birth-weight—infants born to HBsAg-positive mothers should receive immunoprophylaxis with hepatitis B vaccine within 12 hours after birth. The initial vaccine dose should not be counted toward completion of the hepatitis B series, and 3 additional doses of hepatitis B vaccine should be administered, beginning when the infant is aged 1 month. For mothers with unknown HBsAg status, hepatitis B vaccine is recommended within 12 hours of birth regardless of low-birth-weight status.

In addition to hepatitis B vaccines, hepatitis B Immunoglobulin (HBIG) is recommended for infants whose mothers are HBsAg positive or unknown. If the mother is HBsAg positive, HBIG must be given within 12 hours of birth. If the mother's HBsAg status is unknown, providers should first attempt to determine the mother's status. Regardless, if the infant is preterm or low birth weight, HBIG must be given within 12 hours of birth. If the infant is neither preterm nor low birth weight, providers have up to 7 days from birth to determine if the mother is HBsAg negative; because the protective efficacy of HBIG declines the longer that administration is delayed, if results are unlikely to be known by day 7 of life, HBIG should be given no later than day 7 if not earlier. If the mother is determined to be HBsAg positive, HBIG should be administered as soon as possible (20).

If a child aged at least 6 weeks has been in the hospital since birth, deferral of rotavirus vaccine is recommended until the time of discharge. If an infant were to be vaccinated with rotavirus vaccine while still needing care in the NICU or nursery, at least a theoretic risk exists for vaccine virus being transmitted to infants in the same unit who are acutely ill and to preterm infants who are not age-eligible for vaccine (21). The rotavirus vaccine series should not be initiated for infants aged  $\geq 15$  weeks, 0 days.

## **Breastfeeding and Vaccination**

With 2 exceptions, neither inactivated nor live-virus vaccines administered to a lactating woman affect the safety of breastfeeding for women or their infants. Although live viruses in vaccines can replicate in the mother, the majority of live viruses in vaccines have been demonstrated not to be excreted in human milk. Varicella vaccine virus has not been found in human milk (22). Although rubella vaccine virus has been excreted in human milk, the virus usually does not infect the infant. If infection does occur, it is well tolerated because the virus is attenuated (23). Inactivated, recombinant, subunit, polysaccharide, and conjugate vaccines, as well as toxoids, pose no risk for mothers who are breastfeeding or for their infants. Breastfeeding is a contraindication for smallpox vaccination of the mother because of the theoretical risk for contact transmission from mother to infant. Yellow fever vaccine should be avoided in breastfeeding women, because 2 cases (one confirmed, one probable) of yellow-fever vaccine associated acute neurotropic disease (YEL-AND) have been detected in infants whose mothers were vaccinated but were not vaccinated themselves. In both infants, vaccine virus was recovered from the cerebrospinal

fluid of the infant, but the exact mode of transmission was not precisely determined because vaccine virus was not recovered from breast milk (24). However, when nursing mothers cannot avoid or postpone travel to areas endemic for yellow fever in which risk for acquisition is high, these women should be vaccinated.

Limited data indicate that breastfeeding can enhance the response to certain vaccine antigens (25). There are no data to suggest that passive transfer of antibodies in human milk can affect the efficacy of live-virus vaccines. Breastfed infants should be vaccinated according to the recommended schedule (26-28).

## **Vaccination During Pregnancy**

No evidence exists of risk to the fetus from vaccinating pregnant women with inactivated virus or bacterial vaccines or toxoids (29,30). In spite of the lack of evidence of risk, HPV vaccine, an inactivated vaccine, is not recommended during pregnancy. Live vaccines administered to a pregnant woman pose a theoretical risk to the fetus; therefore, live, attenuated virus and live bacterial vaccines generally are contraindicated during pregnancy. Women should avoid conception for 4 weeks after vaccination with live vaccines. However, benefits of vaccinating pregnant women usually outweigh potential risks when the likelihood of disease exposure is high, when infection would pose a risk to the mother or fetus, and when the vaccine is unlikely to cause harm. Recommendations for vaccination during pregnancy are developed using ACIP's *Guiding Principles for Development of ACIP Recommendations for Vaccination During Pregnancy and Breastfeeding* (31).

Women who are pregnant should receive a dose of Tdap for the prevention of infant pertussis whether or not they have previously received Tdap. Vaccination of the mother generates antibodies that pass transplacentally to the fetus (32). Vaccination in the third trimester optimizes the duration of this antibody protection until after birth. Additionally, preventing pertussis in the mother reduces the risk that the infant is exposed to pertussis after birth (33). Health care personnel should administer Tdap during pregnancy, preferably during the third trimester. If Tdap is not administered during pregnancy to women who have never received it, it should be administered immediately postpartum. Pregnant women who are not vaccinated or are only partially vaccinated against tetanus

should complete the primary series (34). Women for whom Td is indicated but who did not complete the recommended 3-dose series during pregnancy should receive follow-up after delivery to ensure the series is completed. One dose of the tetanus vaccine series should be Tdap, if Tdap has not already been received.

Pregnant and postpartum women are at higher risk for severe illness and complications from influenza than women who are not pregnant (2, 35). Pregnant women have protective levels of anti-influenza antibodies after vaccination (36,37). Passive transfer of anti-influenza antibodies that might provide protection from vaccinated women to neonates has been reported (36, 38-41). Routine vaccination with inactivated influenza vaccine is recommended for all women who are or will be pregnant (in any trimester) during influenza season.

IPV can be administered to pregnant women who are at risk for exposure to wild-type poliovirus. This includes travelers to areas or countries where polio is epidemic or endemic; members of communities or specific population groups with disease caused by wild polioviruses; laboratory workers who handle specimens that might contain polioviruses; healthcare personnel who have close contact with patients who might be excreting wild polioviruses; and unvaccinated persons whose children will be receiving oral poliovirus vaccine (42). Hepatitis A, pneumococcal polysaccharide, meningococcal conjugate, and meningococcal polysaccharide vaccines should be considered for women at increased risk for those infections (43-45). Pregnant women who must travel to areas where there is a risk for acquiring yellow fever should receive yellow fever vaccine, because the limited theoretical risk from vaccination is outweighed substantially by the risk for yellow fever infection (24, 46). Hepatitis B vaccine is not contraindicated in pregnancy and should be given to a pregnant woman for whom it is indicated (20, 47).

Pregnancy is a contraindication for smallpox (vaccinia) vaccine and measles-, mumps-, rubella-, and varicella-containing vaccines. Smallpox vaccine is the only vaccine known to harm a fetus when administered to a pregnant woman. In addition, smallpox vaccine should not be administered to a household contact of a pregnant woman (8). Women who are pregnant should not have close contact with anyone who has recently (within the last 28 days) received the smallpox vaccine. Data from studies of children born to mothers inadvertently vaccinated with rubella vaccine during pregnancy demonstrate rubella

antibody in unvaccinated infants. This could represent passive transfer of maternal antibody or a fetal antibody response to vaccine virus infection in the fetus. No cases of congenital rubella or varicella syndrome or abnormalities attributable to fetal infection have been observed among infants born to susceptible women who inadvertently received rubella or varicella vaccines during pregnancy (48-50). Because of the importance of protecting women of childbearing age against rubella and varicella, reasonable practices in any vaccination program include asking women if they are pregnant or might become pregnant in the next 4 weeks; not vaccinating women who state that they are or plan to become pregnant within that interval; explaining the theoretical risk for the fetus if MMR, varicella, or MMRV vaccine were administered to a woman who is pregnant; and counseling women who are vaccinated not to become pregnant during the 4 weeks after MMR, varicella, or MMRV vaccination (10, 48-51). MMRV is an unlikely option for a pregnant woman because the vaccine is only licensed through 12 years of age. Routine pregnancy testing of women of childbearing age before administering a live-virus vaccine is not recommended (3, 10). If a pregnant woman is inadvertently vaccinated or becomes pregnant within 4 weeks after MMR or varicella vaccination, she should be counseled about the theoretical basis of concern for the fetus; however, MMR or varicella vaccination during pregnancy should not be considered a reason to terminate pregnancy (3, 10, 50).

Persons who receive MMR vaccine do not transmit the vaccine viruses to contacts (10). Transmission of varicella vaccine virus to contacts is exceedingly rare (3). MMR and varicella vaccines should be administered when indicated to children and other household contacts of pregnant women (10). Infants living in households with pregnant women should be vaccinated with rotavirus vaccine according to the same schedule as infants in households without pregnant women.

Pregnant women should be evaluated for evidence of immunity to rubella and varicella and be tested for the presence of HBsAg during every pregnancy (10, 20, 52). Women without evidence of immunity to rubella and varicella should be vaccinated immediately after delivery. A second dose of varicella vaccine should be administered 4-8 weeks later. A woman found to be HBsAg positive should be followed-up carefully to ensure that the infant receives HBIG and begins the hepatitis B vaccine series no later than 12 hours after birth and that the infant completes the recommended hepatitis B vaccine series on



schedule (20). No known risk exists for the fetus from passive immunization of pregnant women with immune globulin preparations.

## **Persons Vaccinated Outside the United States**

Clinicians have a limited ability to determine whether persons are protected on the basis of their country of origin and their vaccination records alone. Vaccines administered outside the United States generally can be accepted as valid if the schedule (i.e., minimum ages and intervals) is similar to that recommended in the United States. With the exception of influenza vaccine, only written documentation should be accepted as evidence of previous vaccination. Written records are more likely to predict protection if the vaccines, dates of administration, intervals between doses, and age at the time of vaccination are comparable to U.S. recommendations. Although vaccines with inadequate potency have been produced in other countries (53,54), the majority of vaccines used worldwide are produced with adequate quality control standards and are potent. Medscape has a guide to pediatric vaccines used in other countries, available at

<https://emedicine.medscape.com/article/2500038-overview>. Persons vaccinated outside of the United States can enter the country through a number of different mechanisms. Those seeking to immigrate to the United States may be vaccinated under the authority of a civil surgeon or a panel physician. Some enter the United States as refugees and are vaccinated under the authority of the Office of Refugee Resettlement, part of the Administration for Children and Families, in the Department of Health and Human Services.

Adopted children's birth countries often have vaccination schedules that differ from the recommended childhood vaccination schedule in the United States. Differences in the U.S. schedule and those used in other countries include the vaccines administered, the recommended ages of administration, and the number and timing of doses.

Data are inconclusive regarding the extent to which an internationally adopted child's vaccination record reflects the child's protection. A child's record might indicate administration of MMR vaccine when only single-antigen measles vaccine was administered. A study of children adopted from orphanages in the People's Republic of China, Russia, and countries in Eastern Europe determined that 67% of children with

documentation of >3 doses of DTP before adoption had nonprotective titers to these antigens (54). In contrast, children adopted from these countries who received vaccination in the community (not only from orphanages) and had documentation of  $\geq 1$  doses of DTP exhibited protective titers 67% of the time (54). However, antibody testing was performed by using a hemagglutination assay, which tends to underestimate protection and cannot directly be compared with antibody concentration (55). Data are likely to remain limited for areas other than the People's Republic of China, Russia, and Eastern Europe. Healthcare providers should ensure that household contacts of international adoptees are vaccinated adequately, particularly for measles, hepatitis A, and hepatitis B (56). Healthcare providers may use one of multiple approaches if the immunogenicity of vaccines or the completeness of series administered to persons outside the United States is in question. Repeating the vaccinations is an acceptable option that usually is safe and prevents the need to obtain and interpret serologic tests. If avoiding unnecessary injections is desired, judicious use of serologic testing might help determine which vaccinations are needed. For some vaccines, the most readily available serologic tests cannot document protection against infection. This best practices document provides guidance on possible approaches to evaluation and revaccination for each vaccine recommended in the United States ([Table 9-1](#)).

## DTaP Vaccine

Vaccination providers can revaccinate children younger than 7 years of age with DTaP vaccine without regard to recorded doses; however, data indicate increased rates of local adverse reactions after the fourth and fifth doses of DTaP (57). If a revaccination approach is adopted and a severe local reaction occurs, serologic testing for specific IgG antibody to tetanus and diphtheria toxins can be measured before administering additional doses. Protective concentration<sup>(a)</sup> indicates that additional doses are unnecessary and subsequent vaccination should occur as age appropriate. No established serologic correlates exist for protection against pertussis.

For a child whose record indicates receipt of  $\geq 3$  doses of DTP or DTaP, serologic testing for specific IgG antibody to both diphtheria and tetanus toxin before additional doses is a reasonable approach. If a protective concentration is present, recorded doses are considered valid, and the vaccination series should be completed as age appropriate. An

indeterminate antibody concentration might indicate immunologic memory but waning antibody; serologic testing can be repeated after a booster dose if vaccination providers or parents want to avoid revaccination with a complete series.

Alternately, for a child whose records indicate receipt of  $\geq 3$  doses, a single booster dose can be administered followed by serologic testing after 1 month for specific IgG antibody to both diphtheria and tetanus toxins. If the child has a protective concentration, the recorded doses are considered valid, and the vaccination series should be completed as age appropriate. Children with an indeterminate concentration after a booster dose should be revaccinated with a complete series.

## Hepatitis A Vaccine

Children aged 12-23 months without documentation of hepatitis A vaccination or serologic evidence of immunity should be vaccinated on arrival in the United States (45). Persons who have received 1 dose should receive the second dose if 6-18 months have passed since the first dose was administered.

## Hepatitis B Vaccine

Persons not known to be vaccinated for hepatitis B should receive an age-appropriate series of hepatitis B vaccine. A person whose records indicate receipt of a complete series of vaccine is considered protected<sup>(b)</sup>, and additional doses are not needed if  $\geq 1$  dose was administered at age  $\geq 24$  weeks. Persons who received their last hepatitis B vaccine dose at an age  $< 24$  weeks should receive an additional dose at age  $\geq 24$  weeks. People who have received no doses or a partial series of vaccine should complete the series at the recommended intervals and ages.

All foreign-born persons and immigrants, refugees, and internationally adopted children born in Asia, the Pacific Islands, Africa, and other regions of high or intermediate hepatitis B endemicity should be tested for HBsAg, regardless of vaccination status (58). Those determined to be HBsAg positive should be monitored for development of liver disease. Household members of HBsAg-positive children or adults should be vaccinated if they are not already immune.

## Hib Vaccine

Interpretation of a serologic test to verify whether children who were vaccinated >2 months previously are protected against Hib bacteria can be difficult. Because the number of vaccinations needed for protection decreases with age and because adverse events are rare (59), age-appropriate vaccination should be provided. Hib vaccination is not recommended routinely for persons aged  $\geq 5$  years (59).

## Meningococcal Vaccine

Quadrivalent meningococcal conjugate vaccines are not routinely used in other countries in adolescents (the United Kingdom is the exception). Unless patients have documented receipt they should be considered unvaccinated and receive the age-appropriate doses.

## MMR Vaccine

The simplest approach to resolving concerns about MMR vaccination is to revaccinate with 1 or 2 doses of MMR vaccine, depending on age. Serious adverse events after MMR vaccinations are rare (10). No evidence indicates that administering MMR vaccine increases the risk for adverse reactions among persons who are already immune to measles, mumps, or rubella as a result of previous vaccination or natural disease. Doses of measles-containing vaccine administered before the first birthday should not be counted as part of the series (10). Alternatively, serologic testing for IgG antibody to vaccine viruses indicated on the vaccination record can be considered. Serologic testing is widely available for measles and rubella IgG antibody. A person whose record indicates receipt of monovalent measles or measles-rubella vaccine on or after the first birthday and who has protective antibody against measles and rubella should receive 1 or 2 doses of MMR or MMRV as age appropriate to ensure protection against mumps and varicella (and rubella if measles vaccine alone had been administered). If a person whose record indicates receipt of MMR at age  $\geq 12$  months has a protective concentration of antibody to measles, no additional vaccination is needed unless a second dose is required for school entry.

## Pneumococcal Vaccines

Many industrialized countries now routinely use pneumococcal vaccines. Although recommendations for pneumococcal polysaccharide vaccine also exist in many countries,

the pneumococcal conjugate vaccine might not be routinely administered. PCV13 and PPSV23 should be administered according to age-appropriate vaccination schedules or as indicated by the presence of underlying medical conditions (43, 60).

## Poliovirus Vaccine

The simplest approach to vaccinating with poliovirus vaccine is to revaccinate persons aged <18 years with IPV according to the U.S. schedule. Adverse events after IPV are rare (42). Children appropriately vaccinated with 3 doses of OPV in economically developing countries might have suboptimal seroconversion, including to type 3 poliovirus (42).

## Rotavirus Vaccine

Rotavirus vaccination should not be initiated for infants aged  $\geq 15$  weeks, 0 days. Infants who began the rotavirus vaccine series outside the United States but who did not complete the series and who are still aged  $\leq 8$  months, 0 days, should follow the routine schedule and receive doses to complete the series. If the brand of a previously administered dose is live, reassortment pentavalent rotavirus vaccine or is unknown, a complete series of rotavirus vaccine should be documented for series completion<sup>(b)</sup>. All doses should be administered by age 8 months, 0 days.

## Td and Tdap Vaccines

Children aged  $\geq 7$  years who are not considered fully vaccinated for pertussis should receive Tdap vaccine. “Fully vaccinated” means at least 5 doses of DTaP before the seventh birthday or at least 4 doses of DTaP before the seventh birthday if the fourth dose is given after the fourth birthday. One dose of Tdap is recommended after the seventh birthday. If additional doses of vaccine are needed, Td should be administered as age appropriate.

## Varicella Vaccine

Varicella vaccine is not available in most countries. A person who lacks evidence of varicella immunity should be vaccinated as age appropriate (3, 59).

## Zoster Vaccine

In the United States, zoster vaccination is recommended for all persons aged  $\geq 50$  years who have no contraindications, including persons who report a previous episode of zoster or who have chronic medical conditions. For persons who do not have documentation of receipt of zoster vaccine, the vaccine should be offered at the patient's first clinical encounter with the healthcare provider. Two doses of vaccine are recommended 2-6 months apart, each dose a 0.5-mL intramuscular dose. Zoster vaccination is not indicated to treat acute zoster, to prevent persons with acute zoster from developing postherpetic neuralgia, or to treat ongoing postherpetic neuralgia. Patients do not need to be asked about their history of varicella or to have serologic testing conducted to determine zoster immunity prior to administration of zoster vaccine.

## Vaccinating Persons with Increased Bleeding Risk

Providers often avoid giving intramuscular injections or choose alternative routes for persons with bleeding disorders because of the risk for hematoma formation after injections. In one study, hepatitis B vaccine was administered intramuscularly to 153 persons with hemophilia. The vaccination was administered with a 23-gauge or smaller caliber needle, followed by application of steady pressure to the site for 1-2 minutes. The vaccinations resulted in a low (4%) bruising rate, and no patients required factor supplementation (61). Whether antigens that produce more local reactions (e.g., pertussis) would produce an equally low rate of bruising is unknown.

When hepatitis B or any other intramuscularly administered vaccine is indicated for a patient with a bleeding disorder, the vaccine should be administered intramuscularly if a physician familiar with the patient's bleeding risk determines that the vaccine can be administered by this route with reasonable safety. If the patient receives antihemophilia or similar therapy, intramuscularly administered vaccinations can be scheduled shortly after such therapy is administered. A fine-gauge needle (23-gauge or smaller caliber) should be used for the vaccination, followed by firm pressure on the site, without rubbing, for at least 2 minutes. The patient or family should be given information on the risk for hematoma from the injection. Patients receiving anticoagulation therapy presumably have the same bleeding risk as patients with clotting factor disorders and should follow the same guidelines for intramuscular administration. If possible, vaccination could be scheduled

**prior to the use of these medications, so that the patients' risk of bleeding is not increased by their therapeutic action.**

- (a) Enzyme immunoassay tests are available. Physicians should contact the laboratory performing the test for interpretive standards and limitations. Protective concentrations for antibody to diphtheria and tetanus toxins are defined as  $>0.1$  IU/mL.
- (b) A complete series may consist of two or three doses, depending on the brand of vaccine used in the country of origin.

**TABLE 9-1. Approaches to evaluation and vaccination of persons vaccinated outside the United States who have no (or questionable) vaccination records**

<b>Vaccine</b>	<b>Recommended approach</b>	<b>Alternative approach<sup>(a)</sup></b>
DTaP	Revaccination with DTaP, with serologic testing for specific IgG antibody to tetanus and diphtheria toxins in the event of a severe local reaction	Persons whose records indicate receipt of $\geq 3$ doses: serologic testing for specific IgG antibody to diphtheria and tetanus toxins before administering additional doses (see text), or administer a single booster dose of DTaP, followed by serological testing after 1 month for specific IgG antibody to diphtheria and tetanus toxins with revaccination as appropriate (see text)
HepA	Age-appropriate revaccination	Serologic testing for IgG antibodies to hepatitis A
HepB	Age-appropriate revaccination and serologic testing for HBsAg <sup>(b)</sup>	—
Hib	Age-appropriate revaccination	—
HPV	Age-appropriate revaccination	—
Meningococcal conjugate (MenACWY)	Age-appropriate revaccination	—
MMR	Revaccination with MMR	Serologic testing for IgG antibodies to measles, mumps, and rubella
Pneumococcal conjugate (or in some cases, both PCV13 and PPSV23)	Age-appropriate revaccination	—



Poliovirus	Revaccination with inactivated poliovirus vaccine	—
Rotavirus	Age-appropriate revaccination	—
Tdap	Age-appropriate revaccination of persons who are candidates for Tdap vaccine	—
Varicella	Age-appropriate revaccination of persons who lack evidence of varicella immunity	—
Zoster	Age-appropriate revaccination	—

**Abbreviations:** DTaP = diphtheria and tetanus toxoids and acellular pertussis; HBsAg = hepatitis B surface antigen; HepA = hepatitis A; HepB = hepatitis B; Hib = *Haemophilus influenzae* type b; HPV = human papillomavirus; IgG = immune globulin G; MMR = measles, mumps, and rubella; PCV13 = pneumococcal conjugate vaccine; PPSV23= pneumococcal polysaccharide vaccine; Tdap = tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis.

<sup>(a)</sup> There is a recommended approach for all vaccines and an alternative approach for some vaccines.

<sup>(b)</sup> In rare instances, hepatitis B vaccine can give a false-positive HBsAg result up to 18 days after vaccination; therefore, blood should be drawn to test for HBsAg before vaccinating (20).

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