Travel Immunizations

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Module Updated: 2012-08-30
CME Expiration: 2015-08-30

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1. Description

2.1 Immunizations are recommended for travelers to:

- Provide primary protection against common infectious diseases present both in the U.S. and abroad
- Protect against infectious diseases based on the assessed risk of encountering these diseases when traveling to specific destinations
- Boost protection when immunity wanes over time
- Limit transmission and introduction of infectious diseases
- Meet entry requirements for travel to certain countries, often under WHO International Health Regulations (2005)
2. Indications and Use

2.1 Ensure that children have received primary immunizations and boosters before travel.

Recommendations
- Follow the standard immunization schedule for children and adolescents issued by the ACIP, CDC, and AAP, including:
  - DTaP/Tdap/Td
  - Hepatitis A
  - Hepatitis B
  - HPV
  - Influenza
  - *H. influenzae* type b
  - Inactivated poliovirus
  - Meningococcus
  - MMR
  - Pneumococcus
  - Rotavirus
  - Varicella
- See table [Vaccine-preventable Disease Distribution, Transmission, and Other Preventive Measures](#).
- See table [Vaccine Technical Details](#).
- See module [Immunizations](#).

Evidence
- Routine [immunization schedules](#) for children and adolescents are established by the ACIP and CDC.
- In 2006, the ACIP [recommended](#) incorporating hepatitis A vaccine into the routine childhood immunization schedule to be given at age 1 ([1](#)).
- The ACIP issued [recommendations](#) in 2005 for infants, children, and adolescents ([2](#)) for the prevention of hepatitis B.
- Since 2005, two conjugated meningococcal vaccine have been licensed (Menactra®, Menveo®) and incorporated into the routine childhood and adolescent immunization schedule to be administered aged 11 to 12 years ([3](#)).
- The ACIP issued [recommendations](#) in 2009 for the prevention of poliomyelitis ([4](#)).

Comments
- Infants aged 6 to 11 months who are traveling to areas where there is an increased risk of measles should receive one dose of MMR vaccine before travel. Children aged 12 months or older who are traveling should receive two doses of MMR vaccine separated by at least 28 days. Children given a single dose of MMR vaccine at 6 to 11 months of age still should receive two doses of MMR vaccine after age 12 months ([5](#); [6](#); [7](#)).
- In 2008, an unvaccinated child became infected with measles during travel to Switzerland and was the index case of a measles outbreak in San Diego with an associated case in Hawaii ([6](#)).
- In January to February 2011, 13 imported measles cases were reported in U.S. residents, including 7 in children aged 6 to 23 months. During 2001 to 2010, a total of 159 imported measles cases were reported in U.S. residents, including 47 in children aged 6 to 23 months ([8](#)).
2.2 Provide immunizations and boosters to adults to prevent routine vaccine-preventable diseases acquired through travel.

**Recommendations**

- Follow the immunization schedule for adults issued by the ACIP and CDC, including:
  - Hepatitis B
  - HPV
  - Influenza
  - MMR
  - Pneumococcus
  - Td/Tdap
  - Varicella
  - Zoster
- See table [Vaccine-preventable Disease Distribution, Transmission, and Other Preventive Measures](#).
- See table [Vaccine Technical Details](#).
- See module [Immunizations](#).

**Evidence**

- Routine [immunization schedules](#) for adults are established by the ACIP and CDC ([9]).
- A study of 1450 Swiss travelers with paired sera before and after travel to tropical and subtropical countries found that 2.8% had seroconversion to influenza virus, including 1.2% with a more than four-fold increase, corresponding to one influenza-associated event per 100 persons per month of stay abroad ([10]).
- In 2008, imported measles was associated with travel to Switzerland, Israel, Belgium, India, and Italy and led to outbreaks in a number of U.S. states ([6]).
- In 2009, an 11-year-old boy from New York State was identified as the index case of mumps after he returned from the UK, where there was an ongoing outbreak; this led to outbreaks associated with summer camps and religious gatherings in New York and New Jersey, and further spread to Quebec, Canada ([11]).

2.3 Provide immunizations to travelers based on a disease risk assessment to protect them from infectious diseases and to limit transmission.

**Recommendations**

- Follow the CDC recommendations for travel immunizations depending on destination, including:
  - Cholera
  - Hepatitis A
  - Hepatitis B
  - Influenza
  - Japanese encephalitis
  - Meningococcal disease
  - Poliomyelitis
  - Rabies
  - Tick-borne encephalitis
  - Tuberculosis
  - Typhoid fever
  - Yellow fever
Travel Immunizations

- See the CDC [Travelers’ Health](https://www.cdc.gov/travel) recommendations.
- See the CDC [Yellow Book](https://www.cdc.gov/vaccines/hcp/programs/yellow-book/index.html) (Health Information for International Travel).
- See the AAP [Yellow Book](https://www.aap.org/en-us) recommendations in the [Red Book®](https://www.redbook.org/).
- See table [Vaccine-preventable Disease Distribution, Transmission, and Other Preventive Measures](https://www.cdc.gov/vaccines/schedules/hpv/datasheets/index.html).
- See figure [Incidence Rate per Month of Health Problems During a Stay in Developing Countries—2008](https://www.cdc.gov/ncidod/dvrd/dswhp/).

**Evidence**

- ACIP has issued [recommendations](https://www.cdc.gov/vaccines/hcp/rd/immunize.html) for the storage and handling of vaccines.

**Cholera**

- The risk of cholera for the international traveler is extremely low, estimated to be one case per 500,000 journeys in a Canadian study (12), one case per 100,000 journeys among Japanese travelers (13), and 2.7 cases per 1,000,000 air travelers in a U.S.-based CDC study (14).
- In 2010 to 2011, cholera outbreaks occurred in Haiti, with more than 500,000 cases and nearly 7000 deaths. Outbreaks in the Dominican Republic followed, as well as cases in travelers to both countries and relief workers to Haiti (15; 16).
- The risk of cholera for UK travelers to the Indian subcontinent is one case per 100,000 travelers (17).
- An oral cholera vaccine that combines whole cells of *V. cholerae* with a recombinant binding subunit of cholera toxin is marketed outside the U.S. (18; 19). This vaccine demonstrates a protective efficacy of 60% to 85% over 4 to 12 months and has modest cross-protection against heat-labile toxin-producing *E. coli* (17).

**Hepatitis A**

- Before the vaccine was available in the mid 1990s, hepatitis A occurred at a rate of 3 to 20 cases per 1000 travelers per month of stay but varied depending on the activities of the traveler (20). In U.S. Peace Corps volunteers, the rate of hepatitis A infection was 20 cases per 1000 persons per year (21).
- Analysis of surveillance data on hepatitis A in Switzerland showed a decreased incidence of imported HAV infections from 1988 to 2004. The overall incidence in travelers to high- or intermediate-risk countries was 3 to 11 cases per 100,000 person-months of travel, and the incidence in travelers presumed to be nonimmune was 6 to 28 cases per 100,000 person-months of travel (22).
- A double-blind, placebo-controlled trial that included 1037 seronegative children in a community with recurrent hepatitis A outbreaks in upstate New York showed a protective efficacy of 100% for hepatitis A vaccine. There were no clinical cases of hepatitis A up until 16 days after vaccination, suggesting that children who received the vaccine in the first days of virus incubation were protected (23).
- A study of 31 adults tested 12 years after their initial hepatitis A vaccination found that all still had detectable antibodies; all but one subject achieved an anamnestic response by 14 days after a booster dose, and all subjects did so after 30 days (24).
- A study of antibody persistence evaluated subjects from a hepatitis A study who had responded to a threedose primary schedule of immunization. Children were vaccinated with 360 ELU and adults with 720 ELU of hepatitis A vaccine. All 67 children tested at 10 years and 25 (96%) of 26 adults tested at 8 to 9 years had detectable anti-HAV. Projections suggest the antibody might persist for 21 to 27 years, although further study is required to establish whether antibody does indeed persist beyond 10 years, and whether immunogenicity is maintained with the currently recommended dose schedule (25).
- A randomized trial of 110 healthy adults receiving hepatitis A vaccination measured antibody decline and, using a mathematical model, found that protective levels of antibodies lasted more than 24 years (26).
- Data on long-term immunogenicity and protection conferred by hepatitis A vaccination showed that protective antibody levels persist beyond 10 years in healthy individuals, and underlying immune memory provides protection far beyond the duration of antibodies to HAV. The expert panel concluded that hepatitis A booster vaccination is not needed after a full primary vaccination course in a healthy individual (27).
• Screening certain travelers before hepatitis A immunization may be useful. In a 1992 U.S. surveillance study, 74% of persons over age 50 (these travelers would be over age 70 in 2012) were seropositive for hepatitis A (28).

• Hepatitis B

  • Hepatitis B vaccine should be considered for nonimmune persons traveling to countries with hepatitis B prevalence over 2% (9; 29).
  
  • The ACIP issued recommendations in 2006 for adults (29) for the prevention of hepatitis B.
  
  • An analysis of 181 clinical studies involving 32,904 subjects vaccinated with the Engerix-B® (24,277 subjects) or Recombivax HB®/H-B-Vax® II (8627 subjects) recombinant hepatitis B vaccines according to the three-dose schedule found seroprotection (anti-HBsAg titer ≥10 IU/L) in 95.8% and 94.3% of subjects, respectively (30).
  
  • A randomized, single-blind trial comparing three doses of Engerix-B® at monthly intervals with a fourth dose after 12 months found that seroconversion (≥100 mIU/mL) occurred at a rate similar to that of the standard three-dose schedule (31).
  
  • A study of 524 adults randomly assigned to three accelerated immunization schedules found that administering the hepatitis B vaccine on days 0, 7, and 21 achieved 65% seroprotection (seroconversion ≥10 IU/L) by day 28, and boosting at 12 months increased seroconversion to 99% (32).
  
  • Among 493 subjects followed up 22 years after primary hepatitis B immunization, 60% had an anti-HBs level ≥10 mIU/mL. A booster dose was administered to 164 persons whose titer was <10 mIU/mL, and 77% produced an anti-HBs level ≥10 mIU/mL at 10 to 14 days, and 81% did so by 60 days. Hepatitis B vaccine protection was shown in 87% of the participants by either maintaining an anti-HBs level ≥10 mIU/mL or responding to a booster (33).
  
  • Individuals born in countries with an intermediate or high prevalence of hepatitis B should be checked for chronic HBV infection. Also check for chronic HBV infection in individuals born in the U.S. to parents from countries with HBV incidence >2% and not immunized during infancy. See the CDC Yellow Book chapter on Infectious Diseases Related to Travel: Hepatitis B for countries with a hepatitis B prevalence of 2% or higher (34).

• Combined hepatitis A and hepatitis B

  • Six trials of the combined hepatitis A and B vaccine involving 843 healthy adults vaccinated on a 0-, 1-, and 6-month schedule found that more than 99% of the vaccinees were anti-HAV positive, and 84% were protected against hepatitis B at month 2. One month after completion of the vaccination course, nearly all vaccinees had protective titers against hepatitis B (35).
  
  • A randomized, open-label study of the combined hepatitis A and B vaccine administered on days 0, 7, and 21 and at 12 months found the anti-HBV seroprotection rate at 13 months to be 96.4% (CI, 92.7% to 98.5%) for the combined vaccine compared to 93.4% (CI, 89.0% to 96.4%) for the monovalent hepatitis B vaccine. The anti-HAV seroconversion rates were 100% for both the accelerated combined vaccine and the monovalent hepatitis A vaccine (36).
  
  • In an evaluation of two cohorts of adults 17 to 43 years of age who received combined hepatitis A and hepatitis B vaccine on a 0-, 1-, and 6-month immunization schedule, all 63 subjects were seropositive for anti-HAV and all had anti-HBs >10 mIU/mL at 1 month following the initial inoculation. At 10 years, 100% of subjects were seropositive for anti-HAV; 90% of subjects had anti-HBs ≥10 mIU/mL (37).

• Influenza, seasonal

  • The ACIP issued recommendations in 2011 for the prevention of influenza (38).
  
  • Influenza vaccination should be provided to any traveler who wishes to reduce the risk of influenza infection, preferably at least 2 weeks before departure. Influenza vaccine is recommended before travel for persons at risk for complications of influenza who did not receive influenza vaccine during the preceding fall or winter and who plan to travel to the tropics at any time of year, with large groups of tourists at any time of year, to the southern hemisphere from April through September, and or within the northern hemisphere from December through March (39).
  
  • In the summer of 2000, an outbreak of respiratory illnesses occurred on a Baltic cruise ship from the UK to Germany via Russia. There were more than 1800 passengers and crew members, and immunofluorescence staining and viral culture results implicated influenza B virus infection as the cause (40).
Another cruise ship outbreak was reported in 2000 on a ship traveling between Sydney and American Samoa, in which 37% of 836 passengers responding to a survey reported influenza-like illness (41).

Viral throat culture results in 500 Hajj pilgrims with upper respiratory symptoms were positive in 54 patients (10.8%), of which 27 (50%) showed influenza B and 3 (5.6%) showed influenza A. It was estimated that 24,000 cases of influenza occurred among the 2 million Hajj pilgrims in 2003 (42).

A study of 1450 Swiss travelers with paired sera before and after travel to tropical and subtropical countries found that 2.8% had seroconversion to influenza virus, including 1.2% with a more than four-fold increase, corresponding to 1.0 influenza-associated event per 100 persons per month of stay abroad (10).

**Influenza, pandemic A (H1N1)**

A novel influenza A (H1N1) virus was first recognized in North America in the spring of 2009 and spread globally, leading to a pandemic (43; 44; 45).

An analysis using data from the International Air Transport Association showed the early spread of H1N1 associated with travel to Mexico and predicted its further spread globally during the first wave of the epidemic (46).

**Japanese encephalitis**

The ACIP issued recommendations in 2010 for the prevention of Japanese encephalitis (47).

A review found 55 cases of Japanese encephalitis in travelers and expatriates from 1973 to 2008, with an estimated risk of less than 1 case per 1 million travelers to Japanese encephalitis-endemic countries; the most common countries of exposure were Thailand, Indonesia, China, Philippines, Japan, and Vietnam, with Thailand and Indonesia accounting for 49% of cases (48).

Based on reported cases from the UK and Switzerland, investigators estimated the risk of Japanese encephalitis to be 1.3 cases per year for 7.1 million European travelers who are at a potential risk of infection (49).

Between 2003 and 2008, four U.S. travelers returning from Asia were confirmed with Japanese encephalitis (50).

Two cases of Japanese encephalitis were reported in 2010, including a fatal case in a U.S. child who had visited relatives in the Philippines and a refugee who became ill while traveling from Thailand to the United States (51).

A Vero cell culture-derived vaccine against Japanese encephalitis was licensed in the U.S., Europe, and Australia in 2009 as a two-dose series administered 28 days apart, with excellent safety and tolerability (52).

The ACIP recommends using the Vero cell-derived vaccine for the prevention of Japanese encephalitis in persons aged 17 or older (47). Production of an inactivated mouse brain-derived vaccine (JE-VAX, Biken) (53) was discontinued in 2005.

The supply of mouse brain-derived vaccine, which could be administered to children, was exhausted as of May 2011. The CDC now recommends that children at risk for Japanese encephalitis could: 1) enroll in a clinical trial with the Vero cell-derived Japanese encephalitis vaccine; 2) receive the Vero cell-derived vaccine off-label; or 3) receive a locally available Japanese encephalitis vaccine at the travel destination (54).

In a Phase II trial in 60 healthy Indian children between 1 and 3 years old, the Vero cell-derived Japanese encephalitis vaccine demonstrated good immunogenicity and safety; the Japanese encephalitis-specific neutralizing antibody seroconversion rate was 95.7% on day 56 (55).

A booster of the Vero cell-derived vaccine is recommended if a person remains at risk for more than 12 months after completing the initial two-dose series (56).

**Meningococcal disease**

In 2007, ACIP issued an update of recommendations for the prevention of meningococcal disease (3).

The ACIP recommends revaccinating persons at prolonged increased risk for meningococcal disease, defined as those with increased susceptibility (e.g., due to a complement deficiency), those with asplenia (functional or anatomic), and those with prolonged exposure (e.g., microbiologists working with N. meningitidis or travelers to or residents of areas with hyperendemic or epidemic disease). Persons in any of these risk groups should be revaccinated with quadrivalent meningococcal conjugate vaccine (MCV4) as follows: Persons who were vaccinated at 7 years or older should be revaccinated 5 years after their previous meningococcal vaccine; persons who were vaccinated at ages 2 to 6 should be revaccinated 3
years after their previous meningococcal vaccine; persons who remain in one of these increased risk groups indefinitely should continue to be revaccinated at 5-year intervals. The ACIP also noted that college freshmen living in dormitories and previously vaccinated with quadrivalent polysaccharide vaccine (MPSV4) more than 5 years previously should be vaccinated with MCV4 (57).

- Meningococcal disease causes annual epidemics in the meningitis belt of sub-Saharan Africa during the months of December through June (58; 59).
- Following outbreaks of serogroup W-135 meningococcal disease among religious pilgrims in 2000 and 2001, Saudi Arabia started requiring the quadrivalent meningococcal vaccine (ACYW135) for pilgrims traveling to the Hajj or Umrah (60).

- Poliomyelitis

  - The ACIP issued recommendations in 2009 for the prevention of poliomyelitis (4).
  - National surveillance data in the U.S. showed five cases of imported poliomyelitis from 1980 to 1992 (61).
  - In 1992, the risk of poliomyelitis for U.S. travelers was estimated to be four cases per 10,000,000 travelers (61).
  - A resurgence of poliomyelitis in Nigeria and India led to polio importation into countries in Africa and Asia that had previously been declared poliomyelitis free (62; 63).
  - Persons traveling to poliomyelitis-endemic countries should have completed the primary series against poliovirus and receive a single lifetime adult booster of vaccine (64).
  - The WHO published updated polio circulation information in 2011 (65).
  - The CDC published updated polio circulation information in 2009 and 2011 (66; 67; 68).
  - The Global Polio Eradication Initiative publishes a regularly updated global case count.

- Rabies

  - The ACIP issued recommendations in 2010 on the prevention of human rabies. For healthy persons without pre-exposure immunization who have possible rabies exposure, ACIP recommends human rabies immune globulin and four doses (on days 0, 3, 7, and 14) of rabies vaccine (69). This strategy was endorsed by WHO (70).
  - A 3-year (1996 to 1998) prospective study conducted at the Canadian International Water and Energy Consultants Clinic Travel Medicine Center in Kathmandu, Nepal, identified 99 patients with possible rabies exposure, 56 of whom were tourists, and 43 of whom were resident expatriates. The incidence of possible rabies exposure was 1.9 exposures per 1000 persons per year for tourists, 5.7 per 1000 persons per year for resident expatriates, and 1.2 per 1000 persons per year for trekkers (71).
  - Young children may be at higher risk of contracting rabies because they are more easily bitten near the head and neck, with introduction of rabies virus closer to the central nervous system. They also may not inform adults of the bite and, therefore, may not receive appropriate postexposure wound care (72).
  - A GeoSentinel Surveillance Network analysis of animal-associated injuries in returned travelers found 320 recorded cases from 1998 to 2005, mostly in tourists with relatively short trips (median duration of 23 days). Exposures most commonly occurred in children aged 15 years or younger and in Southeast Asia and the rest of Asia, followed by Australia-New Zealand, Africa, Latin America, North America, and Europe (73).
  - A preexposure three-dose series of rabies vaccine can be administered before a trip and simplifies rabies prevention if a traveler is bitten overseas, eliminating the need for rabies immune globulin, which has limited availability worldwide (74).
  - After an animal bite, an individual who has previously received a preexposure series of rabies vaccine should thoroughly cleanse the wound and receive two additional doses of a WHO-approved rabies vaccine (74).
  - In the U.S., preexposure immunization can be accomplished with intramuscular administration of either the human diploid cell vaccine or the purified chick embryo cell vaccine (74).

- Tick-borne encephalitis

  - Five cases of tick-borne encephalitis were identified in U.S. travellers from 2000 to 2009 and were acquired in Europe, Russia, and China; the estimated risk for tick-borne encephalitis during the virus transmission season is approximately 1 per 10,000 person-months, mostly between March and November (75).
Two vaccines against tick-borne encephalitis are available in Canada and many European countries: TicoVac® and Encepur®. Standard immunization with these vaccines consists of three doses administered over 1 year, although vaccination may be accelerated over 1 month (76; 77; 78).

Tuberculosis

The Advisory Council for the Elimination of Tuberculosis and the ACIP published recommendations in 1995 on the prevention and control of tuberculosis. BCG vaccination is not recommended (79).

A 1993 meta-analysis that reviewed data from 10 randomized clinical trials and 8 case-control studies found a protective effect of the BCG vaccine against meningeal or miliary tuberculosis of 86% and 75%, respectively (80).

A 1994 meta-analysis of 14 clinical trials and 12 case-control studies estimated the protective effect of the BCG vaccine to be 51% and 50%, respectively, when vaccinated before the age of 1 year (81).

A study of PPD conversion and acute tuberculosis cases among Peace Corps volunteers between 1996 and 2005 found that positive PPD conversion occurred at a rate of 1.3 per 1000 volunteer-months, and acute tuberculosis occurred at a rate of 0.06 per 1000 volunteer-months (1540 cases per 100,000 volunteer-years and 69 cases per 100,000 volunteer-years, respectively) (82).

A study of Dutch long-term (3 to 12 months) travelers to countries with a high incidence of tuberculosis found that PPD conversion occurred at a rate of 2.8 per 1000 person-months of travel, but health care workers had the highest rate of PPD conversion (7.9 per 1000 person-months of travel) (83).

Travelers at high risk for tuberculosis can have pre- and post- (at two months) travel tuberculin skin testing or interferon-gamma release assay testing to evaluate infection with M. tuberculosis, though the effectiveness of these strategies is not well studied (84).

Typhoid

The ACIP issued recommendations in 1994 on the prevention of typhoid (85).

An analysis published in 2010 found that enteric fever (typhoid fever) was the most common diagnosis among 580 ill returned travelers with vaccine preventable diseases reported in the GeoSentinel Surveillance Network, accounting for 276 of the 580 cases. Typhoid was especially associated with travel to visit friends and relatives in South Central Asia (86).

Surveillance of imported typhoid fever in England, Wales, and Northern Ireland showed that the highest risk of enteric fever was from travel to India (6 cases per 100,000 visits), Pakistan (9 cases per 100,000 visits), and Bangladesh (21 cases per 100,000 visits). Eighty-six percent of cases occurred in persons traveling to visit friends and relatives (87).

A cross-sectional, laboratory-based surveillance study for 1902 cases of typhoid reported to the CDC and 2016 S. typhi isolates from 1999 to 2006 found that 79% of cases that contained epidemiologic information were associated with foreign travel. Risk was highest for India (89 per 1 million travelers). Regional rates were 1.3 per 1 million travelers to Latin American and the Caribbean, 7.6 per 1 million to Africa, and 10.5 per 1 million to Asia (88).

Eight of nine cases of ciprofloxacin-resistant S. typhi submitted to the National Antimicrobial Resistance Monitoring System from 1999 to 2008 were in patients who had traveled within a month of infection (89).

A 1998 meta-analysis of randomized trials including 1,866,951 subjects in 17 efficacy trials of the parenteral whole-cell, oral Ty21a, and parenteral Vi typhoid vaccines found the 3-year cumulative efficacy to be 51% (CI, 35% to 63%) for a three-dose series of Ty21a vaccine and 55% (CI, 30% to 71%) for the Vi vaccine (90).

In the U.S., four doses of the Ty21a typhoid vaccine are given, which improves vaccine efficacy (91).

Yellow fever

The ACIP issued recommendations in 2010 for the prevention of yellow fever (92).

Fatal yellow fever infection has occurred in short-term travelers to infected areas who were not immunized (93; 94; 95).

From 1996 to 2002, six fatal cases of yellow fever were reported in unimmunized travelers from the U.S. and Europe; the exposures occurred in Brazil, Venezuela, Côte d’Ivoire, and Gambia (96).

The live, attenuated yellow fever vaccine (17D) is effective in preventing the infection (96; 97; 98; 99).
Travel Immunizations

- The CDC's Traveler's Health: Destinations site and the UK's National Travel Health Network and Centre's Country Information site can be searched by country to obtain specific recommendations and requirements on immunizations.
- The WHO's international travel and health site has disease distribution maps and vaccine information.
- The CDC issues travel notices for international travelers about specific outbreaks and situations.
- The WHO issues updates for travelers.
- The CDC has outlined the risk of Japanese encephalitis by country, region, and transmission season.
- The Global Polio Eradication Initiative lists countries with endemic and introduced poliomyelitis.
- The CDC publishes yellow fever vaccination requirements and recommendations that can be searched by country and routinely posts updates.
- WHO publishes a country list for yellow fever vaccination requirements and recommendations.
- The cholera vaccine is not available in the U.S. but can be obtained in several countries, including Canada and some in Europe.
- The tick-borne encephalitis vaccine is not available in the U.S. but can be obtained in Canada and Europe.
- A tissue culture-derived Japanese encephalitis vaccine received FDA approval in March 2009 (52).
- There are two licensed typhoid vaccines in the U.S.: a live, attenuated, oral vaccine and the capsular polysaccharide (Vi antigen) vaccine. Typhoid vaccines are only protective against S. typhi.
- The WHO Working Group on Yellow Fever completed its review of vaccination guidance for yellow fever in May 2011 (100).

2.4 Provide immunizations as needed to meet WHO International Health Regulations and country-specific requirements.

Recommendations

- Administer the yellow fever vaccine at least 10 days before arrival at a destination, in accordance with WHO International Health Regulations (2005). In persons previously vaccinated against yellow fever, there is no required or recommended interval between vaccination and travel.
  - Consult the CDC and WHO resources for help in determining yellow fever vaccination requirements
  - Record the yellow fever vaccination in an International Certificate of Vaccination or Prophylaxis
  - Administer the quadrivalent meningococcal vaccine to religious pilgrims going to the Hajj or Umrah according to the requirements specified by Saudi Arabia.
  - Administer seasonal influenza vaccine to pilgrims going to the Hajj or Umrah if available.
  - See table Vaccine-preventable Disease Distribution, Transmission, and Other Preventive Measures.
  - See table Vaccine Technical Details.

Evidence

- Following an outbreak of group A meningococcal meningitis during the pilgrimage to Mecca in 1987, Saudi Arabia requires meningococcal vaccination for religious pilgrims traveling to the Hajj (59; 101).
- Saudi Arabia requires proof of quadrivalent meningococcal vaccination (vaccine administered within 3 years and more than 10 days before arrival in Saudi Arabia) from travelers making the pilgrimage to Mecca (Hajj or Umrah) (102).
Comments
- The CDC and WHO routinely publish updates to travel immunization requirements and recommendations.
- Under the WHO International Health Regulations (2005), the yellow fever vaccine currently is the only vaccine that may be required for entry by some countries, with the primary aim of reducing the likelihood of introducing yellow fever into their countries and populations.

2.5 Be aware of immunization recommendations for special patient populations.

Recommendations
- Avoid administering live vaccines to immunosuppressed individuals and pregnant women.
- Use caution when considering yellow fever vaccine in breast-feeding women.
- See table Vaccine-preventable Disease Distribution, Transmission, and Other Preventive Measures.
- See table Vaccine Risks, Complications, Contraindications, and Precautions.
- See table Vaccine Technical Details.

Evidence
- The CDC has published immunization guidelines for immunosuppressed patients (103; 104) and pregnant and breast-feeding women (105).
- Three cases of yellow fever vaccine virus transmission via breast-feeding to infants who developed neurologic symptoms have been reported (106; 107; 108). All infants were less than 1 month old when their mothers were vaccinated.

Comments
- Following a careful risk assessment and consultation with an expert, yellow fever vaccine can be administered to some pregnant and HIV-infected patients.

2.6 Provide passive immunization to certain travelers who are not immunized.

Recommendations
- Consider administering immune globulin in addition to hepatitis A vaccine to travelers who are immunocompromised and may not achieve immunity through hepatitis A vaccine alone.
- See table Vaccine-preventable Disease Distribution, Transmission, and Other Preventive Measures.
- See table Vaccine Technical Details.

Evidence
- Data regarding hepatitis A vaccine protection are primarily based on healthy individuals; the addition of immune globulin can be considered for older or immunosuppressed travelers who are departing within 2 weeks (109).

Comments
- Passive prophylaxis with immune globulin provides a protective efficacy of approximately 90% against hepatitis A for periods of 3 to 6 months, depending on the dose administered (1; 110).
3. Contraindications

3.1 Be aware of the general contraindications to and precautions regarding immunizations.

Recommendations

- Do not administer an immunization if:
  - The patient has had a severe allergic reaction to the same vaccine previously
  - The patient has a known allergy to a component of the vaccine
- See table Vaccine Risks, Complications, Contraindications, and Precautions.
- See table Contents of Travel Vaccines.

Evidence

- The CDC has published guidelines on general contraindications to and precautions regarding immunizations (104; 111).

3.2 Be aware of the contraindications to and precautions regarding immunizations in pregnant women.

Recommendations

- Do not administer the following travel immunizations to pregnant women:
  - BCG
  - Live, attenuated influenza
  - Measles
  - Mumps
  - Live, attenuated poliovirus (no longer used in the U.S.)
  - Rubella
  - Live, attenuated typhoid (Ty21a)
  - Varicella
- Administer the following travel immunizations to pregnant women only when the benefits outweigh the risks and seek specialist advice to assess necessity:
  - Oral, inactivated cholera (not available in the U.S.)
  - Hepatitis A and B
  - Japanese encephalitis
  - Meningococcal conjugate
  - Inactivated poliovirus (data are lacking but can be considered)
  - Rabies
  - Tick-borne encephalitis (not available in the U.S.)
  - Typhoid polysaccharide
  - Yellow fever
- See table Vaccine Risks, Complications, Contraindications, and Precautions.

Evidence

- Live viral vaccines can be associated with viremia that can cross the placenta and infect the fetus. The ACIP has published guidelines on immunizing pregnant women (104; 105).
- A retrospective study of women in Trinidad receiving the yellow fever vaccine during unrecognized pregnancy found that congenital yellow fever virus infection occurred in 1 of 41 pregnancies (112).
• A prospective study of 40 women at various stages of pregnancy who were vaccinated during a yellow fever outbreak in Nigeria found that no congenital yellow fever virus infection occurred, and follow-up for 3 to 4 years did not identify any developmental abnormalities attributed to the vaccine (113).

• A case-control study comparing 39 women who had spontaneous abortion with women attending an antenatal clinic found that spontaneous abortion was associated with yellow fever vaccination during early pregnancy; there was an odds ratio of 2.29 in women who had received the yellow fever vaccine inadvertently during early pregnancy (114).

• A study of 433 women in Brazil who received the yellow fever vaccine early in pregnancy documented one case of transplacental infection, but there was no increase in spontaneous abortion (115).

• Seroconversion to yellow fever virus may be lower when the vaccine is administered during pregnancy. One study documented seroconversion in only 39% of subjects (113). However, another study reported seroconversion in 98% of women when the vaccine was administered early in pregnancy (115).

• The ACIP has published recommendations regarding the use of vaccines in pregnant women, including hepatitis A (1), hepatitis B (29), influenza (116), Japanese encephalitis (53), meningococcus (60), poliovirus (64), rabies (74), typhoid (117), yellow fever (118), MMR (119), and Tdap (120).

Comments
• Randomized, controlled vaccine trials in pregnant women have not been conducted, and data are lacking for most travel vaccines. Theoretical concerns during pregnancy are greatest during the first trimester with live vaccines.

• When routine vaccines, such as rubella or varicella, are given inadvertently during pregnancy, it is not necessary to interrupt the pregnancy.

3.3 Be aware of the precaution regarding the administration of yellow fever vaccine in breast-feeding women.

Recommendations
• Administer the yellow fever vaccine to breast-feeding women only when the benefits outweigh the risks, and seek specialist advice to assess necessity.

Evidence
• Three cases of yellow fever vaccine transmission via breast-feeding to infants have been reported, with associated seizure, fever, and meningoencephalitis. Each of the infants recovered (106; 107; 108).

Comments
• Administration of yellow fever vaccine to breast-feeding women should be avoided except where exposure to yellow fever cannot be avoided, or postponed until the infant is more than 6 months old.

3.4 Be aware of the contraindications to and precautions regarding the administration of live vaccines in immunosuppressed persons and be aware that recommendations may vary based on the degree of immune compromise.

Recommendations
• Do not administer the following travel immunizations to severely immunosuppressed patients:
Travel Immunizations

- BCG
- Live, attenuated influenza
- Live, attenuated poliovirus (no longer used in the U.S.)
- Live, attenuated typhoid (Ty21a)
- Live, attenuated yellow fever
- Varicella
- Administer the following travel immunizations to certain immunosuppressed patients only if the benefit outweighs the risk, but do not administer them to those who are severely immunosuppressed:
  - Measles
  - Mumps
  - Rubella
  - Zoster
- See table Vaccine Risks, Complications, Contraindications, and Precautions.

Evidence
- Live, attenuated vaccines can be associated with vaccine dissemination in immunosuppressed patients (103).
- Immunosuppressed patients may develop suboptimal immunity to vaccines (103).
- The ACIP has published recommendations addressing immunization of immunosuppressed patients (104).
- The CDC has issued recommendations for immunocompromised travelers.
- Fatal myeloencephalitis occurred after yellow fever vaccination in a patient with unrecognized HIV infection and a low CD4 count (121).

Comments
- Immunosuppressed patients include those with congenital immunodeficiency diseases, HIV infection, or hematopoietic malignancies, as well as those being treated with radiation or immunosuppressive drugs, such as corticosteroids (at least 20 mg/d prednisone orally for 2 or more weeks), alkylating agents, and antimetabolites, TNF inhibitors, and other biologically active agents.
4. Alternatives

4.1 Recommend specific measures to prevent diseases in addition to immunization or when immunization cannot be performed.

Recommendations

- In addition to administering vaccines, prevent diseases by advising patients to:
  - Avoid travel to risk areas when a vaccine cannot be administered
  - Consider inactivated vaccines or passive immunization when a live vaccine is contraindicated
  - Alter the itinerary to avoid exposure in high-risk destinations or areas with outbreaks
  - Reduce exposure to hepatitis A, cholera, polio, and typhoid by consuming only safe food and water and washing hands before eating
  - Reduce exposure to Japanese encephalitis, tick-borne encephalitis, and yellow fever by wearing long clothing, applying insect repellent, impregnating clothing with insecticide, sleeping under insecticide-treated bed nets, and staying in well-screened accommodations
  - Reduce exposure to rabies by avoiding close contact with mammals, particularly dogs, in low-income countries
  - Reduce exposure to hepatitis B by avoiding contact with blood or body fluid, including potentially contaminated needles, dental work, piercing, tattoos, and unprotected sexual activity
  - Carry sterile medical kits to reduce exposure to HBV and other blood-borne viruses
  - Obtain early assessment for influenza-like illness; initiate oseltamivir or zanamivir early in persons with increased risk for influenza-associated complications
  - See table Vaccine-preventable Disease Distribution, Transmission, and Other Preventive Measures.

Evidence

- The CDC publishes guidelines for the prevention of diseases encountered during travel in the Yellow Book.
- The ACIP has published recommendations regarding the prevention of influenza (116).
5. Accuracy/Efficacy

5.1 Understand that evidence in support of vaccine efficacy varies.

**Recommendations**

- All marketed vaccines have been shown to be safe and immunogenic, though evidence that their use results in fewer traveler infections may be variable.

**Evidence**

- A double-blind, placebo-controlled trial that included 1037 seronegative children in a community with recurrent hepatitis A outbreaks in upstate New York showed a protective efficacy of 100% for hepatitis A vaccine. There were no clinical cases of hepatitis A up until 16 days after vaccination, suggesting that children who received the vaccine in the first days of virus incubation were protected (23).

- An analysis of 181 clinical studies involving 32,904 subjects vaccinated with the Engerix-B® (24,277 subjects) or Recombivax HB®/H-B-Vax® II (8627 subjects) recombinant hepatitis B vaccines according to the three-dose schedule found seroprotection (anti-HBsAg titer ≥10 IU/L) in 95.8% and 94.3% of subjects, respectively (30).

- A Vero cell culture-derived vaccine against Japanese encephalitis was licensed in the U.S., Europe, and Australia in 2009 as a two-dose series administered 28 days apart, with excellent safety, and tolerability (52).

- A 1993 meta-analysis that reviewed data from 10 randomized clinical trials and 8 case-control studies found a protective effect of the BCG vaccine against meningeal or miliary tuberculosis of 86% and 75%, respectively (80).

- A 1994 meta-analysis of 14 clinical trials and 12 case-control studies estimated the protective effect of the BCG vaccine to be 51% and 50%, respectively, when vaccinated before the age of 1 year (81).

- A 1998 meta-analysis of randomized trials including 1,866,951 subjects in 17 efficacy trials of the parenteral whole-cell, oral Ty21a, and parenteral Vi typhoid vaccines found the 3-year cumulative efficacy to be 51% (CI, 35% to 63%) for a three-dose series of Ty21a vaccine and 55% (CI, 30% to 71%) for the Vi vaccine (90).
6. Complications

6.1 Be aware of general side effects of vaccines.

Recommendations

- Be aware of common side effects associated with immunizations, including:
  - Soreness at the injection site
  - Myalgia
  - Malaise
  - Fatigue
  - Low-grade fever
- Be aware of rare but more serious adverse events associated with vaccines, including:
  - Hematoma
  - Nerve damage
  - Rare viscerotropic and neurologic severe adverse events associated with yellow fever vaccine
  - Guillain-Barré syndrome associated with the live, attenuated influenza vaccine and yellow fever vaccine
- Be aware of additives, preservatives, and adjuvants in vaccines, and do not administer vaccines that contain components to which the recipient may be allergic.
- See table Vaccine Risks, Complications, Contraindications, and Precautions.
- See table Contents of Travel Vaccines.

Evidence

- The ACIP has issued information on adverse events associated with vaccines (111).
- The AAP Red Book® contains a chapter on reporting of vaccine adverse events.
- The Institute of Medicine has published a consensus report, Adverse Effects of Vaccines: Evidence and Causality.
- In 2001, seven cases of severe viscerotropic adverse events associated with the yellow fever vaccine were reported (122; 123; 124; 125; 126), and advanced age was found to be a risk factor (127).
- An analysis of 722 adverse event reports after yellow fever vaccination submitted to the U.S. Vaccine Adverse Event Reporting System from 1990 to 2002 showed that older age (age 60 years or older) is associated with a six-fold increase in the risk of adverse events associated with the yellow fever vaccine (128). In an analysis of 660 adverse events reported to the Vaccine Adverse Event Reporting System from 2000 to 2006, the rates of yellow fever vaccine-associated neurologic disease and yellow fever vaccine-associated viscerotropic disease among vaccinees aged 60 years or older were 1.8 per 100,000 and 1.4 per 100,000, respectively (92; 129).
- Thymus disorders are a risk factor for severe adverse events following yellow fever vaccination (130; 131).
- Cases of Guillain-Barré syndrome possibly in association with the conjugated meningococcal vaccine have been reported; the risk estimate is 1.78 compared to the background incidence (132).

Comments

- Guillain-Barré syndrome has been associated with tetanus toxoid-containing vaccines.
7. Patient Counseling

7.1 Provide patients with information on vaccines before immunization.

Recommendations

- Conduct a complete risk assessment for each vaccine-preventable disease by discussing disease epidemiology, planned travel activities, and the health status of the traveler.
- Discuss nonvaccine preventive measures.
- Discuss the benefits of the recommended immunization, severity of disease, route of administration, timing of doses, and level and duration of protection.
- Review precautions, contraindications, and possible side effects and how to respond to them.
- Provide Vaccine Information Statements in a language that the patient understands.
- Provide an opportunity for the patient to ask questions, and respond to their satisfaction.
- Provide the patient with a record of the vaccines administered.
- Review the need for follow-up doses or booster doses, if indicated.

Evidence

- The CDC publishes patient education materials on vaccines and immunizations, including Vaccine Information Statements based on recommendations established by the ACIP.
- The National Childhood Vaccine Injury Act requires Vaccine Information Statements to be provided to patients before vaccinating for any vaccine containing diphtheria, tetanus, pertussis, measles, mumps, rubella, polio, hepatitis A, hepatitis B, H. influenzae type b, influenza, pneumococcal conjugate, meningococcal, rotavirus, HPV, or varicella vaccine.
8. Periprocedure Management

8.1 Provide follow-up to patients who have received travel immunizations and counsel patients about potential adverse events.

Recommendations

- Inform patients about potential adverse events and how to manage them:
  - Advise ice or other local care as needed to the vaccine site
  - Advise patients to call if there is apparent local infection at the vaccine site
  - Advise patients about signs or symptoms for which they should return for additional care
- Instruct travelers on the duration of protection of vaccines, inform them when booster or additional vaccine doses are needed, and schedule follow-up visits as necessary.
- Maintain a history of immunizations in the patient's medical record, and forward the record of vaccinations to the primary care physician, if appropriate.
- Maintain a record of vaccines administered in the clinic, including the vaccine lot numbers.
- Report serious adverse events to the Vaccine Adverse Event Reporting System.
- Report travel-related diseases that occur in spite of immunization (vaccine failures) to public health authorities.
- In the event of manufacturer vaccine recalls, contact patients who received the affected vaccines and follow up according to recommendations.

Evidence

- The ACIP has published General Recommendations on Immunization, including record keeping and reporting of vaccine adverse events (104).
Travel Immunizations

References


Travel Immunizations


Travel Immunizations


120. Centers for Disease Control and Prevention (CDC). Updated recommendations for use of tetanus toxoid, reduced diphtheria toxoid and acellular pertussis vaccine (Tdap) in pregnant women and persons who have or anticipate having close contact with


Glossary

AAP
American Academy of Pediatrics

ACIP
Advisory Committee on Immunization Practices

anti-HAV
antibody to hepatitis A virus

anti-HBV
antibody to hepatitis B virus

BCG
bacille Calmette-Guérin

CD4
cluster of differentiation 4

CDC
Centers for Disease Control and Prevention

CI
confidence interval

DTaP
diphtheria-tetanus-acellular pertussis

DTP
diphtheria, tetanus, pertussis

EDTA
ethylenediaminetetraacetic acid

ELU
enzyme-linked immunosorbent assay units

ETEC
enterotoxigenic E. coli

FDA
Food and Drug Administration

HAV
hepatitis A virus

HBV
hepatitis B virus

HBsAg
hepatitis B surface antigen

HIV
human immunodeficiency virus

HPV
human papillomavirus

im
intramuscular

MMR
measles-mumps-rubella

po
orally
Travel Immunizations

PPD
purified protein derivative

sc
subcutaneous

Td
tetanus and diphtheria toxoids

Tdap
combined tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis

TNF
tumor necrosis factor

WHO
World Health Organization
## Tables

### Vaccine-preventable Disease Distribution, Transmission, and Other Preventive Measures

<table>
<thead>
<tr>
<th>Travel-related, Vaccine-preventable Disease</th>
<th>Risk Areas</th>
<th>Transmission</th>
<th>Other Preventive Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholera</td>
<td>Low-income countries in Africa and Asia</td>
<td>Ingestion of contaminated food and water</td>
<td>Vaccine is not available in the U.S.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Avoid disease by adhering to strict food, water, and personal hygiene practices</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>Worldwide; highest risk is in low-income countries</td>
<td>Ingestion of contaminated food and water</td>
<td>Adhere to strict food, water, and personal hygiene practices</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>Worldwide; higher carrier rates of HBsAg in Asia, Africa, and Central and South America</td>
<td>Blood and body fluids</td>
<td>Avoid contact with blood and body fluids, including by way of needles, dental work, piercing, tattoos, medical procedures, and unprotected sex</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>Asia, particularly Southeast Asia and South Asia</td>
<td><em>Culex</em> mosquitoes, night biting</td>
<td>Avoid mosquito bites by wearing long-sleeved shirts and trousers, applying insect repellent, treating clothing with permethrin, and sleeping under mosquito nets</td>
</tr>
<tr>
<td>Meningococcal meningitis</td>
<td>Worldwide; sub-Saharan Africa; Saudi Arabia during Hajj; areas with outbreaks</td>
<td>Person to person</td>
<td>Avoid areas with outbreaks and crowded gatherings</td>
</tr>
<tr>
<td>Poliomyelitis</td>
<td>Endemic in India, Pakistan, Afghanistan, and Nigeria, with importation into other countries of Africa and South Asia</td>
<td>Fecal-oral</td>
<td>Adhere to strict food, water, and personal hygiene practices</td>
</tr>
<tr>
<td></td>
<td>See the Global Polio Eradication Initiative's <em>Polio This Week</em> for details of risk areas</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rabies</td>
<td>Worldwide; highest number of reported human cases is in India and China</td>
<td>Mammals, particularly dogs in low-income countries</td>
<td>Avoid contact with mammals</td>
</tr>
<tr>
<td>Tick-borne encephalitis</td>
<td>Central Europe and Russia</td>
<td>Ticks, unpasteurized dairy products</td>
<td>Vaccine is unavailable in the U.S.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>When traveling to risk areas, avoid infection by wearing long trousers, tucking trouser legs into socks, applying insect repellent, treating clothing with permethrin, and checking for ticks. Avoid unpasteurized dairy products</td>
</tr>
<tr>
<td>Typhoid</td>
<td>All low-income countries but highest risk is in South Asia</td>
<td>Ingestion of contaminated food and water</td>
<td>Adhere to strict food, water, and personal hygiene practices</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>Some countries in sub-Saharan Africa and South America and parts of eastern Panama and the Republic of Trinidad and Tobago</td>
<td>Mosquitoes, day biting</td>
<td>Avoid mosquito bites by wearing long-sleeved shirts and trousers, applying insect repellent, and treating clothing with permethrin</td>
</tr>
</tbody>
</table>
Travel Immunizations

CDC = Centers for Disease Control and Prevention; HBsAg = hepatitis B surface antigen; WHO = World Health Organization.
## Vaccine Risks, Complications, Contraindications, and Precautions

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Serious Complications</th>
<th>Contraindications</th>
<th>Precautions</th>
<th>Reference(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cholera</strong> (not available in the U.S.)</td>
<td></td>
<td>Severe allergic reaction to vaccine components</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Hepatitis A</strong></td>
<td>No clear association</td>
<td>Severe allergic reaction to a previous dose or a component of the vaccine</td>
<td>Pregnancy</td>
<td>1</td>
</tr>
<tr>
<td><strong>Hepatitis B</strong></td>
<td>No clear association</td>
<td>Severe allergic reaction to yeast or other vaccine components</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Influenza</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Inactivated</td>
<td>Possible rare association with Guillain-Barré syndrome</td>
<td>Severe allergic reaction to egg</td>
<td>History of Guillain-Barré syndrome within 6 wk of previous inactivated influenza vaccine</td>
<td>116</td>
</tr>
<tr>
<td>Live, attenuated</td>
<td>No clear association</td>
<td>Pregnancy</td>
<td>Use in children younger than 5 y is not FDA approved, but studies have demonstrated safety and efficacy</td>
<td>116</td>
</tr>
<tr>
<td><strong>Japanese encephalitis</strong></td>
<td>Urticaria, angioedema, hypotension, respiratory distress</td>
<td>Severe allergic reaction to a previous dose or a component of the vaccine</td>
<td>Pregnancy (no data)</td>
<td>56</td>
</tr>
<tr>
<td>Tissue culture-derived (Ixiaro)</td>
<td></td>
<td></td>
<td>CellTxtL::History of multiple allergies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>History of urticaria (after Hymenoptera envenomation, medications, physical or other provocations, or of idiopathic origin)</td>
<td></td>
</tr>
<tr>
<td><strong>MMR</strong></td>
<td>Thrombocytopenia</td>
<td>Pregnancy</td>
<td>Recent (&lt;3 mo) receipt of an antibody-containing blood product (specific interval depends on product)</td>
<td>119</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Known immunosuppression (e.g., hematologic and solid tumors, receiving chemotherapy, congenital immunodeficiency, receiving long-term immunosuppressive therapy, or severe immunocompromise due to HIV infection)</td>
<td>CellTxtL::History of thrombocytopenia or thrombocytopenic purpura</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Moderate or severe acute illness with or without fever</td>
<td></td>
</tr>
<tr>
<td><strong>Meningococcal</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conjugate</td>
<td>Possible rare association with Guillain-Barré syndrome</td>
<td>History of Guillain-Barré syndrome</td>
<td>Pregnancy (no data)</td>
<td>60</td>
</tr>
<tr>
<td>Polysaccharide</td>
<td>Rare anaphylaxis</td>
<td>Severe allergic reaction to a previous dose or a component of the vaccine</td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>Poliovirus, inactivated</td>
<td>No clear association</td>
<td>Severe allergic reaction to streptomycin, polymyxin B, or neomycin</td>
<td>Pregnancy (no data)</td>
<td>64</td>
</tr>
<tr>
<td>Immunization</td>
<td>Side Effects</td>
<td>Reactions</td>
<td>Contraindications</td>
<td></td>
</tr>
<tr>
<td>--------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Rabies</td>
<td>Systemic hypersensitivity has occurred following booster vaccination with human diploid cell vaccine (6% of vaccinees). Rare Guillain-Barré syndrome-like neurologic syndromes</td>
<td>Severe allergic reaction to a previous dose or a component of the vaccine</td>
<td>Avoid concurrent administration of corticosteroids or other immunosuppressive agents and administration during immunosuppressive illnesses due to possible interference with the development of active immunity. In a patient receiving immunosuppressive therapy, the antibody response to the rabies vaccine can be reduced, and, therefore, the preexposure series may not achieve a level that can be easily boosted after exposure.</td>
<td></td>
</tr>
<tr>
<td>Td</td>
<td>Uncommon, severe local reactions; Guillain-Barré syndrome</td>
<td>Severe allergic reaction to a previous dose or a component of the vaccine</td>
<td>Guillain-Barré syndrome &lt;6 wk after a previous dose of tetanus toxoid-containing vaccine History of Arthus-type hypersensitivity reactions following a previous dose of tetanus toxoid-containing vaccine</td>
<td></td>
</tr>
<tr>
<td>Tdap</td>
<td>Guillain-Barré syndrome</td>
<td>Encephalopathy (e.g., coma, decreased level of consciousness, and prolonged seizures) not attributable to another identifiable cause within 7 d of administration of previous dose of DTP, DTaP, or Tdap</td>
<td>Pregnancy (no data) Guillain-Barré syndrome &lt;6 wk after previous dose of tetanus toxoid-containing vaccine Progressive or unstable neurologic disorder, uncontrolled seizures, or progressive encephalopathy History of Arthus-type hypersensitivity reactions following a previous dose of tetanus toxoid-containing vaccine</td>
<td></td>
</tr>
<tr>
<td>Tick-borne encephalitis (not available in the U.S.)</td>
<td>Meningitis, neuritis</td>
<td>Severe allergic reaction to eggs</td>
<td>Pregnancy or lactation Known or suspected autoimmune disease Preexisting cerebral disorders</td>
<td></td>
</tr>
<tr>
<td>Typhoid</td>
<td>No clear association</td>
<td>Pregnancy</td>
<td>Avoid vaccination in patients taking antibiotics CellTtxt:::If the patient is also taking mefloquine, separate doses by 24 h Refrigerate capsules</td>
<td></td>
</tr>
<tr>
<td>Live, attenuated (Ty21a)</td>
<td>No clear association</td>
<td>Pregnancy</td>
<td>Pregnancy (no data)</td>
<td></td>
</tr>
<tr>
<td>Polysaccharide</td>
<td>No clear association</td>
<td>Severe allergic reaction to a previous dose or a component of the vaccine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow fever</td>
<td>Severe allergic reaction; rare, severe vaccine-associated viscerotrophic disease (3-5/1,000,000 doses); rare vaccine-associated neurologic disease (5-8/1,000,000 doses)</td>
<td>Immunosuppression Age &lt;6 mo Thymus disorder Severe allergic reaction to egg</td>
<td>Pregnancy CellTtxt:::Age 6-8 mo or ≥60 y HIV infection</td>
<td></td>
</tr>
</tbody>
</table>
Travel Immunizations

DTaP = diphtheria-tetanus-acellular pertussis; DTP = diphtheria, tetanus, pertussis; FDA = Food and Drug Administration; HIV = human immunodeficiency virus; MMR = measles-mumps-rubella; Td = tetanus and diphtheria toxoids; Tdap = combined tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis.
## Contents of Travel Vaccines*

<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Cell Culture Materials, If Applicable</th>
<th>Additives, Adjuvants, Preservatives, Inactivation Residues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Havrix®</td>
<td>Human fibroblasts</td>
<td>Formalin, aluminum hydroxide, 2-phenoxyethanol</td>
</tr>
<tr>
<td>VAQTA®</td>
<td>Human fibroblasts</td>
<td>Formalin, aluminum hydroxide, formaldehyde</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recombivax HB®</td>
<td>Yeast</td>
<td>Aluminum hydroxyphosphate sulfate</td>
</tr>
<tr>
<td>Eengerix-B®</td>
<td>Yeast</td>
<td>Aluminum hydroxide</td>
</tr>
<tr>
<td>Combined hepatitis A and B</td>
<td>Human fibroblasts</td>
<td>Formalin, aluminum hydroxide, 2-phenoxyethanol</td>
</tr>
<tr>
<td>Influenza</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inactivated</td>
<td>Egg</td>
<td>± thimerosal in multidose vials, formaldehyde</td>
</tr>
<tr>
<td>Live, attenuated</td>
<td>Egg</td>
<td>Gelatin, gentamicin, arginine</td>
</tr>
<tr>
<td>Japanese encephalitis</td>
<td>Mouse brain</td>
<td>Formaldehyde, ammonium sulfate, gelatin, thimerosal</td>
</tr>
<tr>
<td>MMR</td>
<td>Chick embryo fibroblasts</td>
<td>Gelatin</td>
</tr>
<tr>
<td>Meningococcal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conjugate</td>
<td></td>
<td>Diphtheria toxoid</td>
</tr>
<tr>
<td>Polysaccharide</td>
<td></td>
<td>Lactose, thimerosal</td>
</tr>
<tr>
<td>Poliomyelitis</td>
<td>Vero cell culture (monkey kidney cells)</td>
<td>Formaldehyde, 2-phenoxyethanol, neomycin, streptomycin, polymyxin B</td>
</tr>
<tr>
<td>Rabies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Imovax®</td>
<td>Human diploid cells</td>
<td>Neomycin sulfate, albumin, phenol red, β-propiolactone</td>
</tr>
<tr>
<td>RabAvert®</td>
<td>Purified chick embryo cells</td>
<td>Polygeline, albumin, potassium glutamate, sodium EDTA, ovalbumin, neomycin, chlorotetracycline, amphotericin B, β-</td>
</tr>
<tr>
<td>Typhoid</td>
<td></td>
<td>propiolactone</td>
</tr>
<tr>
<td>Live, attenuated (Vivotif Berna®)</td>
<td></td>
<td>Sucrose, ascorbic acid, amino acid mix, lactose, magnesium acetate</td>
</tr>
<tr>
<td>Polysaccharide (Typhim Vi™)</td>
<td></td>
<td>Phenol, polymethylsiloxane</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>Chick embryo</td>
<td>Gelatin, sorbit</td>
</tr>
</tbody>
</table>

*Vaccines available in the U.S. The lists of components are not comprehensive, and the full manufacturer's prescribing information should be reviewed before administering the vaccine.

EDTA = ethylenediaminetetraacetic acid; MMR = measles-mumps-rubella.
<table>
<thead>
<tr>
<th>Vaccine</th>
<th>Brand Name (Manufacturer or Distributor)</th>
<th>Type of Vaccine</th>
<th>Adult Dose</th>
<th>Pediatric Dose</th>
<th>Route</th>
<th>Standard Schedule of Immunization</th>
<th>Alternate or Accelerated Schedule</th>
<th>Duration of Protection</th>
<th>Patient Education Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cholera*</td>
<td>Dukoral™ (Crucell)</td>
<td>Killed whole-cell V. cholerae vaccine combined with recombinant B subunit of cholera toxin</td>
<td>1 sachet</td>
<td>Age 2-6 y: ½ sachet; 3 doses 1-6 wk apart; booster dose after 6 mo</td>
<td>po</td>
<td>2 doses 1-6 wk apart; booster dose after 2 y</td>
<td>None</td>
<td>4-6 mo; lower levels of protection continue for 3 y</td>
<td>Also used for prevention of enterotoxigenic E. coli in some countries</td>
</tr>
<tr>
<td>Hepatitis A</td>
<td>Havrix® (GlaxoSmithKline)</td>
<td>Inactivated virus</td>
<td>1440 ELU (1 mL)</td>
<td>Age 1-18 y: 720 ELU (0.5 mL)</td>
<td>im</td>
<td>2 doses 6-12 mo apart</td>
<td>None</td>
<td>Modeling demonstrated persistence of antibodies to HAV for &gt;25 y</td>
<td>Consider checking for immunity before vaccination in patients from endemic areas or those with possible history of disease. Do not check antibodies after immunization</td>
</tr>
<tr>
<td></td>
<td>VAQTA® (Merck)</td>
<td>Inactivated virus</td>
<td>50 U (1 mL)</td>
<td>Age 2-18 y: 25 U (0.5 mL)</td>
<td>im</td>
<td>2 doses 6-12 mo apart</td>
<td>None</td>
<td>Modeling demonstrated persistence of antibodies to HAV for &gt;25 y</td>
<td>Consider checking for immunity before vaccination in patients from endemic areas or those with possible history of disease. Do not check antibodies after immunization</td>
</tr>
<tr>
<td>Hepatitis B</td>
<td>Engerix-B® (GlaxoSmithKline)</td>
<td>Recombinant hepatitis B surface antigen</td>
<td>20 mcg (1 mL)</td>
<td>Age ≤20 y: 10 mcg</td>
<td>im</td>
<td>3 doses: day 0, 1 mo, and 6 mo</td>
<td>4 doses: day 0, 7, 21, and 12 mo</td>
<td>&gt;15 y</td>
<td>Check for chronic HBV prior to vaccination in patients from countries with prevalence of hepatitis B (≥2%). See the CDC Yellow Book</td>
</tr>
<tr>
<td></td>
<td>Recombivax HB® (Merck)</td>
<td>Recombinant hepatitis B surface antigen</td>
<td>10 mcg (1 mL)</td>
<td>Age ≤20 y: 5 mcg</td>
<td>im</td>
<td>3 doses: day 0, 1 mo, and 6 mo</td>
<td>Adolescents (age 11-15 y): 2 10-mcg doses 4-6 mo apart</td>
<td>&gt;15 y</td>
<td>Check for chronic HBV prior to vaccination in patients from countries with prevalence of hepatitis B (≥2%). See the CDC Yellow Book</td>
</tr>
</tbody>
</table>
### Travel Immunizations

<table>
<thead>
<tr>
<th>Condition</th>
<th>Vaccine(s)</th>
<th>Type of Vaccine</th>
<th>Dosage</th>
<th>Route(s)</th>
<th>Age(s)</th>
<th>Serological Protection Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combined hepatitis A and B</td>
<td>Twinrix® (GlaxoSmithKline)</td>
<td>Inactivated virus and recombinant viral antigen</td>
<td>720 ELU of hepatitis A and 20 mcg of Engerix-B®</td>
<td>im</td>
<td>None</td>
<td>3 doses: day 0, 1 mo, and 6 mo</td>
</tr>
<tr>
<td>Inactivated influenza</td>
<td>Multiple products and manufacturers</td>
<td>Inactivated virus</td>
<td>0.5 mL</td>
<td>im</td>
<td>Age 6-35 mo: 0.25 mL, Age ≥36 mo: 0.5 mL</td>
<td>1 dose</td>
</tr>
<tr>
<td>Live, attenuated influenza</td>
<td>FluMist® (MedImmune)</td>
<td>Live, attenuated virus</td>
<td>Age ≤49 y: 0.2 mL</td>
<td>Age ≥5 y: 0.2 mL</td>
<td>Intranasal spray</td>
<td>1 dose</td>
</tr>
<tr>
<td>Japanese encephalitis, mouse brain-derived</td>
<td>Biken (Sanofi Pasteur)</td>
<td>Inactivated virus</td>
<td>1 mL</td>
<td>sc</td>
<td>Age 1-3 y: 0.5 mL</td>
<td>3 doses: days 0, 7, and 30</td>
</tr>
<tr>
<td>Japanese encephalitis, tissue culture-derived</td>
<td>Ixiaro (Novartis)</td>
<td>Inactivated virus</td>
<td>0.5 mL</td>
<td>im</td>
<td>Age ≥17 y: 0.5 mL</td>
<td>3 doses: days 0, 7, and 14</td>
</tr>
<tr>
<td>Meningococcal polysaccharide</td>
<td>Menomune- A/C/Y/W-135® (Sanofi Pasteur)</td>
<td>Bacterial polysaccharide</td>
<td>50 mcg (0.5 mL)</td>
<td>1 dose</td>
<td>None</td>
<td>Up to 3 y</td>
</tr>
<tr>
<td>Meningococcal conjugate</td>
<td>Menactra® (Sanofi Pasteur)</td>
<td>Bacterial polysaccharide, conjugated</td>
<td>0.5 mL</td>
<td>im</td>
<td>Age ≥11 y: 0.5 mL</td>
<td>None</td>
</tr>
<tr>
<td>Poliovirus</td>
<td>IPOL® (Sanofi Pasteur)</td>
<td>Inactivated virus</td>
<td>0.5 mL</td>
<td>sc</td>
<td>None</td>
<td>Lifelong protection after primary series plus an adult (age ≥18 y) booster</td>
</tr>
<tr>
<td>Rabies human diploid cell</td>
<td>Imovax® (Sanofi Pasteur)</td>
<td>Inactivated virus</td>
<td>1 mL</td>
<td>im</td>
<td>3 doses: days 0, 7, and 28</td>
<td>None</td>
</tr>
</tbody>
</table>

**Notes:**
- **Travelers can be exposed out of the North American season:** Because of the potential for a delayed allergic reaction, the vaccine course should be completed ≥10 days before departure.
- **Vaccination does not eliminate carrier state:**
- **Previously unvaccinated travelers should receive a 3-dose primary series (day 0, 1 mo, and 7 mo):**
- **Advise travelers regarding bite avoidance, wound care, and postexposure treatment:**

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### Travel Immunizations

<table>
<thead>
<tr>
<th>Vaccine Type</th>
<th>Manufacturer</th>
<th>Route</th>
<th>Age</th>
<th>Dose</th>
<th>Dose Details</th>
<th>Incidence</th>
<th>Recommended Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rabies</td>
<td>RabAvert® (Chiron)</td>
<td>Inactivated virus</td>
<td>1 mL</td>
<td>1 mL</td>
<td>im</td>
<td>3 doses preexposure: days 0, 7, and 21 or 28</td>
<td>4 total doses are required after rabies exposure: days 0, 3, 7, 14 plus immune globulin. Routine boosting of travelers is not recommended.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Advise travelers regarding bite avoidance, wound care, and postexposure treatment. Celltxt: Check rabies antibody every 6 to 24 months in travelers with occupational exposure to the rabies virus.</td>
</tr>
<tr>
<td>Tick-borne encephalitis*</td>
<td>TicoVac® (Baxter)</td>
<td>Inactivated virus</td>
<td>0.5 mL</td>
<td>Age 3-16 y: 0.25-mL initial dose followed by 0.5 mL</td>
<td>im</td>
<td>3 doses: day 0, 1-3 mo, and 5-12 mo</td>
<td>Second dose can be given 2 wk after first dose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The vaccine is available in Canada and in many European countries.</td>
</tr>
<tr>
<td>Typhoid Vi capsular polysaccharide</td>
<td>Typhim Vi™ (Sanofi Pasteur)</td>
<td>Bacterial polysaccharide</td>
<td>25 mcg Vi polysaccharide (0.5 mL)</td>
<td>Age ≥2 y: 0.5 mL</td>
<td>im</td>
<td>1 dose</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protective efficacy following vaccination may be incomplete. Emphasize food and water precautions.</td>
</tr>
<tr>
<td>Live, attenuated, oral typhoid (Ty21a)</td>
<td>Vivotif Berna® (Crucell)</td>
<td>Live, attenuated bacteria</td>
<td>Four capsules</td>
<td>Age ≥6 y: 4 capsules</td>
<td>po</td>
<td>4-capsule series, one every other day</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Protective efficacy following vaccination may be incomplete. Emphasize food and water precautions. Vaccine requires refrigeration and is self-administered.</td>
</tr>
<tr>
<td>Yellow fever</td>
<td>YF-Vax® (Sanofi Pasteur)</td>
<td>Live, attenuated virus</td>
<td>0.5 mL</td>
<td>Age ≥9 mo: 0.5 mL</td>
<td>sc</td>
<td>1 dose</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Under WHO International Health Regulations (2005), some countries require documentation of yellow fever vaccination before entry.</td>
</tr>
</tbody>
</table>
Travel Immunizations

* Not available in the U.S.

CDC = Centers for Disease Control and Prevention; ELU = enzyme-linked immunosorbent assay units; FDA = Food and Drug Administration; HAV = hepatitis A virus; HBV = hepatitis B virus; im = intramuscular; po = orally; sc = subcutaneous.
**Figures**

**Incidence Rate per Month of Health Problems During a Stay in Developing Countries—2008**

ETEC = enterotoxigenic *E. coli*; HIV = human immunodeficiency virus; PPD = purified protein derivative.

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- Traveler’s diarrhea (ETEC >15% of total) - 100%
- Malaria (no chemoprophylaxis West Africa) - 10%
- Influenza A or B - 1%
- Dengue infection (symptomatic) - 1%
- Animal bite with rabies risk - 1%
- PPD conversion - 0.1%
- Malaria (with and without chemoprophylaxis tropical Africa) - 0.1%
- Hepatitis A - 0.01%
- Typhoid (South Asia, North/West/Central Africa) - 0.01%
- Tick-borne encephalitis (rural Austria) - 0.001%
- Hepatitis E - 0.001%
- Typhoid (other areas) - 0.001%
- HIV infection - 0.001%
- Fatal accident - 0.001%
- Cholera - 0.0001%
- Legionella infection - 0.0001%
- Japanese encephalitis - 0.0001%
- Meningococcal disease - 0.0001%
- Poliomyelitis - 0.0001%