CHAPTER 6

Vaccine-preventable diseases, vaccines and vaccination

General considerations

Vaccination is the administration of a vaccine to stimulate a protective immune response that will prevent disease in the vaccinated person if contact with the corresponding infectious agent occurs subsequently. Thus vaccination, if successful, results in immunization: the vaccinated person has been immunized. In practice, the terms "vaccination" and "immunization" are often used interchangeably.

Disease prevention

Vaccination is a highly effective method of preventing certain infectious diseases. For the individual, and for society in terms of public health, prevention is better and more cost-effective than cure. Vaccines are generally very safe and adverse reactions are uncommon. Routine immunization programmes protect most of the world's children from a number of infectious diseases that previously claimed millions of lives each year. For travellers, vaccination offers the possibility of avoiding a number of dangerous infections that may be encountered abroad. However, vaccines have not yet been developed against several of the most life-threatening infections, including malaria and HIV/AIDS.

Vaccination and other precautions

Despite their success in preventing disease, vaccines do not fully protect 100% of the recipients. The vaccinated traveller should not assume that there is no risk of catching the disease(s) against which he/she has been vaccinated. All additional precautions against infection (see Chapter 5) should be followed carefully, regardless of any vaccines or other medication that have been administered. These same precautions are important in reducing the risk of acquiring diseases for which no vaccines exist.

Planning before travel

The protective effect of vaccines takes some time to develop following vaccination. The immune response of the vaccinated individual will become fully effective within a period of time that varies according to the vaccine, the number of doses required and whether the individual has previously been vaccinated against the same disease. For this reason, travellers are advised to consult a travel medicine clinic or personal physician 4–6 weeks before departure if the travel destination is one where exposure to any vaccine-preventable diseases may occur.

Vaccine schedules and administration

The vaccines that may be recommended or considered for travellers are shown in Table 6.1. The schedule for administration of each vaccine is given, together with other information for each of the vaccine-preventable diseases, on pages 89–127. Time intervals for administration of vaccines requiring more than one dose are recommended; some slight variation can be made to accommodate the needs of travellers who may not be able to complete the schedule exactly as recommended. In general, it is acceptable to lengthen the time intervals between doses, but significant shortening of the intervals is not recommended.

The route of administration differs for individual vaccines and is critical for induction of the protective immune response. For injectable vaccines, the route of injection—subcutaneous, intramuscular or intradermal—determines the gauge and length of the needle to be used.

Safe injections

The same high standard of injection safety should be applied to the administration of vaccines as to any other injection. A sterile needle and syringe should be used for each injection and disposed of safely.

WHO recommends the use of single-use ("auto-disable") syringes or disposable monodose preparations whenever possible. Syringes should not be recapped (to avoid needle-stick injuries) and should be disposed of in a way that is safe to the recipient, the provider and the community.

Multiple vaccines

All commonly used vaccines can be given simultaneously at separate sites at least 2 cm apart. However, certain vaccines commonly cause local reactions, which

may be accentuated if a number of vaccines are given simultaneously. If possible, these vaccines should be given on separate occasions unless financial and time constraints dictate otherwise. Inactivated vaccines do not generally interfere with other inactivated or live vaccines and can be given simultaneously with, or at any time in relation to, other vaccines without prejudicing immune responses.

A number of combined vaccines are now available, providing protection against more than one disease, and new combinations are likely to become available in future years. For routine vaccination, the combined diphtheria/tetanus/pertussis (DTP) and measles/mumps/rubella (MMR) vaccines are in widespread use in children. Other examples of currently available combination vaccines are hepatitis A+B and hepatitis A + typhoid. In addition, other combination vaccines are available in certain countries: these include IPV+DTP, IPV+DTP+Hib and IPV+DTP+HepB+Hib.[1]

In adults, the combined diphtheria–tetanus vaccine (with reduced diphtheria—Td) is generally used in preference to monovalent (single-disease) vaccine.

Combined vaccines offer important advantages for travellers, by reducing the number of injections required and the amount of time involved, so aiding compliance. Combination vaccines are just as safe and effective as the individual single-disease vaccines.

Choice of vaccines for travel

Vaccines for travellers include: (1) those that are used routinely, particularly in children; (2) others that may be advised before travel; (3) those that, in some situations, are mandatory.

Most of the vaccines that are routinely administered in childhood require periodic booster doses throughout life to maintain an effective level of immunity. Adults in their country of residence often neglect to keep up the schedule of booster vaccinations, particularly if the risk of infection is low. Some older adults may never have been vaccinated at all. It is important to realize that diseases such as diphtheria and poliomyelitis, which no longer occur in most industrialized countries, may be present in those visited by travellers. Pretravel precautions should include booster doses of routine vaccines if the regular schedule has not been followed, or a full course of primary immunization for people who have never been vaccinated.

[1] IPV = inactivated poliomyelitis vaccine; Hib = *Haemophilus influenzae* type b [vaccine]; HepB = hepatitis B [vaccine].

Other vaccines will be advised on the basis of a travel risk assessment for the individual traveller (see also Chapter 1). In deciding which vaccines would be appropriate, the following factors are to be considered for each vaccine:

— risk of exposure to the disease
— age, health status, vaccination history
— special risk factors
— reactions to previous vaccine doses, allergies
— risk of infecting others
— cost.

Mandatory vaccination, as authorized by the International Health Regulations, nowadays concerns only yellow fever. Yellow fever vaccination is carried out for two different reasons: (1) to protect the *individual* in areas where there is a risk of yellow fever infection; and (2) to protect vulnerable *countries* from importation of the yellow fever virus. Travellers should therefore be vaccinated if they visit a country where there is a risk of exposure to yellow fever. They *must* be vaccinated if they visit a country that requires yellow fever vaccination

Table 6.1 **Vaccines for travellers**

Category	Vaccine
1. Routine vaccination	Diphtheria/tetanus/pertussis (DTP) Hepatitis B (HBV) *Haemophilus influenzae* type b (Hib) Measles (MMR) Poliomyelitis (OPV or IPV)[a]
2. Selective use for travellers	Cholera Influenza Hepatitis A (HAV) Japanese encephalitis Lyme disease Meningococcal meningitis Pneumococcal disease Rabies Tick-borne encephalitis Tuberculosis (BCG) Typhoid fever Yellow fever (for individual protection)
3. Mandatory vaccination	Yellow fever (for protection of vulnerable countries) Meningococcal meningitis (for Hajj, Umra)

[a] OPV = oral poliomyelitis vaccine; IPV = inactivated poliomyelitis vaccine.

as a condition of entry; this condition applies to all travellers who arrive from (including airport transit) a yellow fever endemic country.

Vaccination against meningococcal disease is required by Saudi Arabia for pilgrims visiting Mecca for the Hajj and is also required by some countries for returning pilgrims after the Hajj.

Travellers should be provided with a written record of all vaccines administered (patient-retained record), preferably using the international vaccination certificate (which is required in the case of yellow fever vaccination).

Vaccines for routine use

DIPHTHERIA

Disease

Diphtheria is a bacterial disease caused by *Corynebacterium diphtheriae*. The infection commonly affects the throat and may lead to obstruction of the airways and death. Transmission is from person to person, through close physical contact, and is increased in overcrowded and poor socioeconomic conditions. Exotoxin-induced damage occurs to organs such as the heart. Nasal diphtheria may be mild, and chronic carriage of the organism frequently occurs; asymptomatic infections are common. A cutaneous form of diphtheria is common in tropical countries and may be important in transmission of the infection.

Occurrence

Diphtheria is found worldwide, although it is not common in industrialized countries because of long-standing routine use of DTP vaccine. Recently, large epidemics have occurred in several east European countries.

Risk for travellers

Potentially life-threatening illness and severe, lifelong complications are possible in incompletely immunized individuals.

Vaccine

All travellers should be up to date with the vaccine, which is usually given as "triple vaccine"—DTP (diphtheria/tetanus/pertussis). After the initial course of three doses, additional doses may be given as DT until 7 years of age, after which a vaccine with reduced diphtheria content (Td) is given. Since both tetanus toxoid (see below) and diphtheria toxoid can reasonably be given on a booster basis about every 10 years, there is little reason to use monovalent diphtheria vaccine.

Precautions and contraindications

Avoid diphtheria-containing vaccines if a severe or life-threatening reaction has occurred to a previous dose. Use a vaccine with reduced diphtheria content (Td) from age 7 years onwards.

TETANUS

Disease

Tetanus is acquired through environmental exposure to the spores of *Clostridium tetani*, which are present in soil worldwide. The disease is caused by the action of a potent neurotoxin produced by the bacterium in dead tissue (e.g. dirty wounds). Clinical symptoms of tetanus are muscle spasms, initially muscles of mastication causing trismus or "lockjaw", which results in a characteristic facial expression—risus sardonicus. Trismus can be followed by sustained spasm of the back muscles (opisthotonus) and by spasms of other muscles. Finally, mild external stimuli may trigger generalized, tetanic seizures, which contribute to the serious complications of tetanus (dysphagia, aspiration pneumonia) and lead to death unless intense supportive treatment is rapidly initiated.

Occurrence

Dirty wounds can become infected with the tetanus spores anywhere in the world.

Risk for travellers

Every traveller should be fully protected against tetanus. Almost any form of injury, from a simple laceration to a motor-vehicle accident, can expose the individual to the spores.

Vaccine

All travellers should be up to date with the vaccine. The primary immunizing course of three doses of DTP is given in the first months of life. Booster doses are most easily given as Td, but certainly all doses given to individuals aged 7 years and above should be Td. A booster dose of Td should generally be used in preference to tetanus toxoid (TT) immediately following trauma. However, no such booster is needed if the last dose was given less than 5 (for dirty wounds) to 10 years (for clean wounds) previously.

Precautions and contraindications

Mild local reactions occur in up to 95% of vaccine recipients. Reactions increase in frequency and severity as the number of doses increases. After booster doses of TT, 50–80% of people experience some pain or tenderness at the injection site. True hypersensitivity reactions to TT occur very rarely.

PERTUSSIS

Disease

Pertussis (whooping cough) is a highly contagious acute bacterial disease involving the respiratory tract and caused by *Bordetella pertussis*. It is transmitted by direct contact with airborne discharges from the respiratory mucous membranes of infected persons. It causes a severe cough of several weeks' duration with a characteristic whoop, often with cyanosis and vomiting. In young infants, the cough may be absent and disease may manifest with spells of apnoea. Although pertussis can occur at any age, most serious cases and fatalities are observed in early infancy and mainly in developing countries. Major complications include pneumonia, encephalitis and malnutrition (due to repeated vomiting). Vaccination is the most rational approach to pertussis control.

Occurrence

Worldwide, *B. pertussis* causes at least 20 million cases of pertussis, 90% of which occur in developing countries, with an estimated 200 000 to 300 000 fatalities each year.

Risk for travellers

Unprotected infants are at high risk, but *all* children and young adults are at increased risk if they are not fully immunized. Exposure to pertussis is greater in developing countries, so children up to 7 years of age should be protected by vaccination. Pertussis vaccine is not generally recommended beyond 7 years.

Vaccine

All travellers should be up to date with the vaccine. Both whole-cell (wP) and acellular (aP) pertussis vaccines provide excellent protection. However, protection declines with time and probably extends only a few years. For several decades, wP vaccines have been widely used in national childhood vaccination programmes; aP vaccines, which cause fewer adverse effects, have been developed and are now being licensed in several countries. Both wP and aP are usually

administered in combination with diphtheria and tetanus toxoids (DTwP or DTaP). Three doses are required for initial protection.

Precautions and contraindications

Pertussis-containing vaccines are not used after the seventh birthday. Whole-cell vaccines should not be given to children with an evolving neurological disease (e.g. uncontrolled epilepsy or progressive encephalopathy). Minor adverse effects such as local redness and swelling and fever are common after wP; prolonged crying and seizures are less common (<1 in 100) and hypotonic–hyporesponsive episodes are uncommon (<1 in 2000). Acellular vaccines cause significantly fewer reactions. The DTaP vaccines have proved to be significantly less reactogenic than the DTwP vaccines in terms of high fever, seizures and hypotonic–hyporesponsiveness episodes. The local reactogenicity of aP vaccines seems to increase with successive doses.

Type of vaccine:	Tetanus as toxoid; diphtheria as toxoid; pertussis as whole-cell or acellular preparation. May also be monovalent (T), or bivalent (DT, Td)
Number of doses:	At least three, given i.m.
Schedule:	6, 10 and 14 weeks of age
Booster:	3–4 years of age; Td booster every 10 years
Contraindications:	Adverse reaction to a previous dose. Avoid wP vaccine in an evolving neurological disease (e.g. uncontrolled epilepsy, progressive encephalopathy)
Adverse reactions:	Mild local or systemic reaction is common
Before departure:	As long as possible. Some protection after second dose
Recommended for:	All, but particularly aid/health care workers
Special precautions:	Reduced diphtheria (Td instead of DT) content and no pertussis from 7 years of age

HAEMOPHILUS INFLUENZAE TYPE B

Disease

Haemophilus influenzae type b (Hib) is a common cause of bacterial meningitis and a number of other serious and potentially life-threatening conditions, including pneumonia, epiglottitis, osteomyelitis, septic arthritis and sepsis in infants and older children.

Occurrence

Hib is estimated to cause at least 3 million cases of serious disease and hundreds of thousands of deaths annually, worldwide. The most important manifestations of disease, namely pneumonia and meningitis, are seen mainly in children under 5 years of age, particularly in infants. Rarely occurring in infants under 3 months or after the age of 6 years, the disease burden is highest between 4 and 18 months of age. Hib is the dominant cause of sporadic (non-epidemic) bacterial meningitis in this age group, and is frequently associated with severe neurological sequelae despite prompt and adequate antibiotic treatment. In developing countries, it is estimated that 2–3 million cases of Hib pneumonia occur each year. The disease has practically disappeared in countries where routine vaccination of children is carried out.

Risk for travellers

All unprotected children are at risk at least up to the age of 5 years, and the risk may be increased by travel from a country with relatively low incidence to one where incidence is high.

Vaccine

All children who are not up to date with this vaccine should be offered it. Conjugate Hib vaccines have dramatically reduced the incidence of Hib meningitis in infants and of nasopharyngeal colonization by Hib. The vaccine is often given as a combined preparation with DTP or poliomyelitis vaccine. Hib vaccine is not yet used routinely in many developing countries where there is continuing high prevalence of the disease.

Precautions and contraindications

No serious side-effects have been recorded, and no contraindications are known, except for occasional hypersensitivity to a previous dose of the vaccine. All conjugate vaccines have an excellent safety record, and, where tested, do not interfere substantially with the immunogenicity of other vaccines given simultaneously.

Type of vaccine:	Conjugate
Number of doses:	Three or four depending on manufacturer and type of vaccine, given s.c.
Schedule:	6, 10 and 14 weeks of age

Contraindications:	Hypersensitivity to previous dose
Adverse reactions:	Mild local reaction
Before departure:	Full course up to date before departure
Recommended for:	All children up to 5 years of age
Special precautions:	None

HEPATITIS B

Disease and occurrence

See Chapter 5.

Risk for travellers

While only certain categories of traveller are clearly at risk because of their planned activities, any traveller may be involved in an accident or medical emergency that requires surgery. The vaccine should be considered for virtually all travellers to highly endemic areas. It can be administered to infants from birth. At particular risk are those who expose themselves to potentially infected blood or blood-derived fluids, or who have unprotected sexual contact. Principal risky activities include health care (medical, dental, laboratory or other) that entails direct exposure to human blood; receipt of a transfusion of blood that has not been tested for HBV; and dental, medical or other exposure to needles (e.g. acupuncture, piercing, tattooing or injecting drug use) that have not been appropriately sterilized. In addition, in less developed countries, skin lesions in children or adults suffering from impetigo, scabies or scratched insect bites may play a role in disease transmission if there is direct exposure to open wounds.

Vaccine

Hepatitis B vaccine produced both from plasma and by recombinant DNA technology (usually in yeast) is available; the two types are equally safe and effective. Three doses of vaccine constitute the complete series; the first two doses are usually given 1 month apart, with the third dose 1–12 months later. In some countries, a two-dose schedule has been introduced for adolescents, with the second dose given 6–12 months after the first. Immunization provides protection for at least 15 years. Because of the prolonged incubation period of hepatitis B, some protection will be afforded to most travellers following the second dose given before travel, provided that the final dose is given upon return. If the trip is to be a long one, a schedule of rapid vaccination is preferred (see

below). Prevaccination screening to determine immune status is generally not cost-effective in people from industrialized countries, but may be helpful in those from developing countries who have a high probability of having had asymptomatic infection during childhood.

The standard schedule of administration is three doses, given as follows: day 0; 1 month; 6–12 months.

A rapid schedule of administration of monovalent hepatitis B vaccine may be considered as follows: day 0; 1 month; 2 months.

In some countries of the European Union, another rapid schedule has been licensed, with doses given as follows: : day 0; day 7; day 21.

However, if either of the two rapid schedules is used, it is recommended that an additional dose is given after 6–12 months.

A combination vaccine that provides protection against both hepatitis A and hepatitis B may be considered for travellers potentially exposed to both organisms. This inactivated vaccine is administered as follows: day 0; 1 month; 6 months.

Precautions and contraindications

Hepatitis B vaccines are extremely safe. Mild, transient local reactions occur commonly, but anaphylactic reactions are extremely rare. Despite extensive press coverage of the subject, no scientific evidence exists to support the suggestion that hepatitis B vaccine might be a cause of multiple sclerosis.

Type of vaccine:	Inactivated
Number of doses:	Three (volume varies with manufacturer), given i.m. in the deltoid muscle; for some products, only two doses for adolescents
Schedule:	Several options (see text above)
Contraindications:	Adverse reaction to previous dose
Adverse reactions:	Local soreness and redness
Before departure:	Second dose at least 2 weeks before departure
Recommended for:	All who are not up to date
Special precautions:	Particularly important for travellers from low-incidence areas to hyperendemic regions and for those at high risk

MEASLES

Disease

Measles is a highly contagious infection; before vaccines became available this disease had affected most people by the time of adolescence. In developing countries, it still causes up to 875 000 deaths annually. The disease typically presents with fever, red rash and runny nose. Common complications include middle-ear infection and pneumonia. Transmission is primarily by large respiratory droplets. Measles is found worldwide, and occurs in a seasonal pattern. Transmission increases during the late winter and early spring in temperate climates, and after the rainy season in tropical climates. Epidemics occur every 2 or 3 years in areas where there is low vaccine coverage. In countries where measles has been largely eliminated, cases imported from other countries remain an important continuing source of infection.

Occurrence

Measles occurs worldwide, although far fewer cases now occur in industrialized countries and indigenous transmission has virtually stopped in the Americas. Virus transmission still occurs in most tropical countries.

Risk for travellers

Travellers who are not fully immunized against measles are at risk when visiting developing countries.

Vaccine

All travellers from 6 months of age who have not been immunized should be offered measles vaccine. One dose of vaccine in infancy protects around 80–90% of recipients for more than 20 years. The measles/mumps/rubella triple (MMR) or measles/rubella (MR) vaccine is given in many countries instead of monovalent measles vaccine. The appropriate age for administration is either 9 months or 12–15 months, depending on epidemiological and other factors relating to all three diseases. Many countries give additional doses either at a particular age (e.g. 5 years) or during mass campaigns.

Special attention must be paid to all children who have not been vaccinated against measles at the appropriate time. Measles is still common in many countries and travel in densely populated areas may favour transmission. For infants travelling to countries where measles is endemic, a dose of vaccine may be given as early as 6 months of age. However, children who receive the first dose between 6 and

8 months should also receive the scheduled dose at 9 months or 12–15 months of age.

It is generally recommended that individuals with a moderate degree of immune deficiency receive the vaccine if there is even a low risk of contracting measles infection from the community. There is a low level of risk in using measles vaccine in immunocompromised HIV-infected individuals. Where the risk of contracting measles infection is negligible, physicians who are able to monitor immune status, for instance CD4 counts, may prefer to avoid the use of measles vaccine.

Precautions and contraindications

Measles vaccine is generally extremely safe. However, since it is a live viral vaccine, it should be avoided during pregnancy. It should also be avoided if there is a known allergy to neomycin or gelatin, or if a severe reaction has occurred following a previous dose of measles (or MR or MMR) vaccine. Very rarely, encephalitis may follow measles vaccination. Measles vaccine is equally safe and effective when administered as a single vaccine or in combination. The mumps component may account for transient parotitis and, rarely, central nervous system symptoms due to aseptic meningitis. The rubella component may account for transient lymphadenopathy and, in 25% of rubella-susceptible women, joint symptoms.

Type of vaccine:	Live viral
Number of doses:	One, given i.m. or s.c., although many countries schedule more than one dose for high levels of control
Contraindications:	Pregnancy; adverse reaction to previous dose
Adverse reactions:	Malaise, fever, rash 5–12 days after vaccination, rarely encephalopathy
Before departure:	4 weeks
Recommended for:	All infants from 9 months of age,[1] children, young adults who have not had at least one dose previously, and adults who have no documented evidence of previous vaccination
Special precautions:	None

[1] Infants travelling to high-risk countries may have an additional dose as early as 6 months of age, as well as the scheduled dose at 9 or 12–15 months of age.

POLIOMYELITIS

Disease

Poliomyelitis is a disease of the central nervous system caused by three closely related enteroviruses, poliovirus types 1, 2 and 3. The virus is spread predominantly by the faecal–oral route, although rare outbreaks caused by contaminated food or water have occurred. After the virus enters the mouth, the primary site of infection is the intestine, although the virus can also be found in the pharynx. Poliomyelitis is also known as "infantile paralysis" because it most frequently causes paralysis in infants and young children: 60–70% of cases occur in children under 3 years of age and 90% in children under 5 years of age. The resulting paralysis is permanent, although some recovery of function is possible with physiotherapy. There is no cure.

Occurrence

Wild poliovirus transmission has ceased in almost all industrialized countries and much of the developing world (see map page 81). Remaining countries are expected to be free of poliomyelitis by 2005.

Risk for travellers

Until the disease has been certified as eradicated, the risk of acquiring it remains and travellers to endemic countries should be fully protected by vaccination. The consequences of infection are life-threatening or crippling. Infection and paralysis may occur in non-immune individuals and are by no means confined to infants. Infected travellers are potent vectors for transmission and possible reintroduction of the virus into polio-free zones now that worldwide eradication is near.

Vaccine

All travellers should be up to date with vaccination against poliomyelitis. There are two types of vaccine: inactivated (IPV), which is given by injection, and oral (OPV). OPV is composed of the three types of live attenuated polioviruses. Because of the low cost and ease of administration of the vaccine and its superiority in conferring intestinal immunity, OPV has been the vaccine of choice for controlling epidemic poliomyelitis in many countries. The immunity produced by OPV is apparently lifelong.

IPV is used in several European countries and the USA, either as the sole vaccine against poliomyelitis or in schedules combined with OPV. Although IPV suppresses pharyngeal excretion of wild poliovirus, this vaccine has only limited

effects in reducing intestinal excretion of poliovirus. For unvaccinated older children and adults, the second dose is given 1–2 months after the first, and the third 6–12 months after the second. A booster dose is recommended after 4–6 years. IPV is also the vaccine of choice for travellers with no history of OPV use, as well as for immunocompromised individuals and their contacts and family members.

For those who have received three or more doses of OPV in the past, it is advisable to offer another dose of polio vaccine as a once-only dose to those travelling to endemic areas of the world. Any unimmunized individuals intending to travel to such an area require a complete course of vaccine. Countries differ in recommending IPV or OPV in these circumstances: IPV has the advantage of avoiding any risk of vaccine-associated paralytic poliomyelitis (VAPP), but is more expensive and may not stop faecal excretion of the virus.

Precautions and contraindications

Both IPV and OPV are very safe vaccines. Reactions to IPV are extremely rare and tend to be limited to allergic responses among persons already sensitive to either the formaldehyde or the antibiotics used in the preparation of the vaccine.

The major adverse event associated with OPV is VAPP. The risk of VAPP is higher after the first dose of OPV than after subsequent doses, ranging from 1 case per 1.4 million to 1 case per 3.4 million first doses administered. VAPP is more common in individuals who are immunocompromised, for whom IPV is the vaccine of choice.

Type of vaccine:	Live oral (OPV) or killed inactivated injectable (IPV)
Number of doses:	Four of OPV; three of IPV
Schedule:	OPV at 6, 10 and 14 weeks of age (plus a dose at birth in endemic countries). IPV at 2, 4 and 12–18 months
Booster:	One lifetime dose before travel to endemic countries
Contraindications:	None
Adverse reactions:	Very rarely VAPP following OPV
Before departure:	4 weeks
Recommended for:	All travellers to developing countries where poliomyelitis is still transmitted
Special precautions:	Immunocompromised travellers should receive IPV rather than OPV

Vaccines for selective use

Vaccines in this section need be offered only to travellers who are going to certain specified destinations. The decision to recommend a vaccine will depend on a travel risk assessment for the individual.

CHOLERA

Disease and occurrence

See Chapter 5.

Risk for travellers

Travellers are not at significant risk from cholera provided that simple precautions are taken to avoid potentially contaminated food and water. Currently available new vaccines are not necessary for most travellers: the sensible selection of clean drinking-water and food is more important than vaccination in preventing cholera, and even the vaccinated traveller should continue to be prudent about food and drink. Vaccination is advisable for those at increased risk of the disease, particularly emergency relief and health workers in refugee situations.

Vaccine

Cholera vaccine is not required as a condition of entry to any country. The two new cholera vaccines (live and killed), given orally, are safe and effective. They have been licensed and are commercially available in a limited number of countries, making possible their use as an option for travellers to high-risk situations in endemic areas. The killed vaccine confers high-grade (85–90%) protection for 6 months after the second dose. Protection remains as high as 62% after 3 years in vaccine recipients over 5 years of age. Killed cholera vaccine confers some level of cross-protection against *Escherichia coli* and therefore against "travellers' diarrhoea".

The traditional injectable cholera vaccine conveys incomplete, unreliable protection of short duration; it is not recommended.

Precautions and contraindications

Antibiotics and malaria prophylaxis with proguanil should both be avoided from 1 week before until 1 week after administration of the live oral attenuated vaccine. Vaccination should be completed at least 3 days before the first prophylactic dose of mefloquine (see page 143).

Type of vaccine:	Killed and live attenuated oral
Number of doses:	Two, one week apart (killed vaccine); one (live vaccine)
Contraindications:	Hypersensitivity to previous dose
Adverse reactions:	Mild local reaction of short duration; mild systemic reaction
Before to departure:	3 weeks (killed vaccine), 1 week (live vaccine)
Consider for:	Travellers to endemic areas
Special precautions:	No antibiotics from 1 week before until 1 week after vaccination (live vaccine). Avoid proguanil from 1 week before to 1 week after vaccination (live vaccine). Strict precautions regarding food, water and hygiene

HEPATITIS A

Disease and occurrence

Although hepatitis A is rarely fatal in children and young adults, most infected adults and some older children become ill and are unable to work for several weeks or months. The case-fatality rate exceeds 2% among those over 40 years of age and may be 4% for those aged 60 years or more. (See also Chapter 5.)

Risk for travellers

Hepatitis A is the most common vaccine-preventable infection of travellers. Travellers from industrialized countries are likely to be susceptible to infection and should receive the hepatitis A vaccine before travelling to developing countries. While people travelling to rural areas of developing countries are at particularly high risk of infection, in practice most cases occur among travellers staying in resorts and good-quality hotels. People born and raised in developing countries, and those born before 1945 in industrialized countries, have often been infected in childhood and are likely to be immune. For such individuals, it may be cost-effective to test for anti-HAV antibodies so that unnecessary vaccination can be avoided.

Vaccine

The vaccine should be considered for all travellers to highly endemic zones, and those at high risk of acquiring the disease should be strongly encouraged to accept vaccination. A safe and highly effective inactivated (killed) hepatitis A vaccine became available in 1992. Since antibodies induced by the vaccine are

not detectable until 2 weeks after administration, travellers should be vaccinated 4 weeks before departure if possible. A booster dose given 6–24 months later is recommended. This schedule is expected to provide at least 10 years' protection.

In the case of emergency travel to a high-risk area, a dose of immunoglobulin (0.02 ml/kg), where this product is still available, may be given with the first dose of vaccine.

A combination hepatitis A/typhoid vaccine is available for those exposed to waterborne diseases. The vaccine is administered as a single dose, a minimum of 4 weeks before departure, and confers high levels of protection against both diseases. A second dose of hepatitis A vaccine is needed 6–12 months later and boosters of typhoid vaccine should be given at 3-yearly intervals.

Precautions and contraindications

Minor local and systemic reactions are fairly common.

Type of vaccine:	Inactivated, given i.m.
Number of doses:	Two
Schedule:	Second dose 6–24 months after the first
Booster:	May not be necessary—manufacturers propose at 10 years
Contraindications:	Hypersensitivity to previous dose
Adverse reactions:	Mild local reaction of short duration, mild systemic reaction
Before departure:	Protection 4 weeks after first dose; some protection immediately after first dose
Recommended for:	All non-immune travellers to highly endemic areas
Special precautions:	None

INFLUENZA

Disease and occurrence

See Chapter 5.

Risk for travellers

All travellers to areas of the world experiencing a seasonal (winter and spring) influenza outbreak are at potential risk of contracting the disease. Tourists are at

risk because they often travel in crowded vehicles and visit crowded places—both situations that promote transmission. Elderly people, individuals with respiratory and cardiac disease, diabetes mellitus, or any immunosuppressive condition, and health care workers are particularly at risk. The impact of an attack of influenza during travel can range from highly inconvenient to life-threatening.

Vaccine

Influenza viruses constantly evolve, with rapid changes in their antigenic characteristics. To be effective, influenza vaccines need to stimulate immunity to the principal strains of virus circulating at the time. The vaccine contains three strains, with the composition being modified every year to ensure protection against the strains prevailing in each influenza season. Since the antigenic changes in circulating influenza viruses occur very rapidly, there may be significant differences between prevailing strains during the influenza seasons of the northern and southern hemispheres, which occur at different times of the year (November–March in the north and April–September in the south). The vaccine composition is adjusted for the hemisphere in which it will be used. Consequently, vaccine obtainable in one hemisphere may offer only partial protection against influenza infection in the other.

Travellers in the high-risk groups for influenza should be regularly vaccinated each year. Anyone travelling from one hemisphere to the other shortly before, or early during, the influenza season, should arrange vaccination as soon as possible after arriving at the travel destination. Vaccine for the opposite hemisphere is unlikely to be obtainable before arrival.

Precautions and contraindications

Mild local and/or systemic reactions are common. Vaccination is contraindicated in case of egg allergy.

Type of vaccine:	Inactivated non-infectious viral
Number of doses:	One, given s.c. or i.m.
Booster:	Annual; immunocompromised individuals should receive a second dose 4 weeks after the first
Contraindications:	Hypersensitivity to previous dose or severe hypersensitivity to egg
Adverse reactions:	Local pain and tenderness at injection site (20%), fever, malaise

Before departure:	2 weeks
Recommended for:	High-risk groups before the influenza season, and optional for travellers to countries currently in influenza season
Special precautions:	None

JAPANESE ENCEPHALITIS

Disease and occurrence

See Chapter 5.

Risk for travellers

The risk of infection with Japanese encephalitis (JE) for travellers to south-east Asia is low but varies with the season (being higher during the monsoon), the type of accommodation and the duration of exposure. Short stays in good hotels with limited likelihood of mosquito bites result in very low levels of risk. In contrast, campers in rural areas may be at high risk. No more than one case per year is diagnosed in civilian travellers worldwide.

Vaccine

The vaccine should be considered for all travellers to rural endemic zones if they intend to stay there for at least 2 weeks. Those at high risk should be strongly encouraged to accept vaccination. Three types of JE vaccine are currently in large-scale production and use: inactivated mouse-brain-derived vaccine (IMB), cell-culture-derived inactivated vaccine and cell-culture-derived live attenuated vaccine. Only the IMB vaccine is widely commercially available.

Precautions and contraindications

A hypersensitivity reaction to a previous dose is a contraindication. The vaccine should be avoided in pregnancy unless the likely risk favours its administration. Rare, but serious, neurological side-effects attributed to IMB vaccine have been reported from endemic as well as non-endemic regions. Allergic reactions to components of the vaccine occur occasionally. As such reactions may occur within 2 weeks of administration, it is advisable to ensure that the complete course of vaccine is administered well in advance of departure.

Type of vaccine:	Inactivated mouse-brain-derived
Number of doses:	Standard 3-dose schedule or reduced 2-dose schedule, s.c.
Schedule:	3 doses at days 0, 7 and 28; or 2 doses given 1–4 weeks apart (1.0 ml for adults, 0.5 ml for children)
Booster:	After 1 year and then 3-yearly
Contraindications:	Hypersensitivity to previous dose or to the vaccine preservative thiomersal
Adverse reactions:	Occasional mild local or systemic reaction; occasional severe reaction with generalized urticaria, hypotension and collapse
Before departure:	At least two doses before departure
Recommended for:	Travellers over 1 year of age and staying in endemic rural areas for more than 2 weeks
Special precautions:	Avoiding mosquito bites is as important as being immunized

LYME DISEASE

Disease and occurrence

See Chapter 5.

Risk for travellers

Travellers at risk include hikers and campers in forested areas of known infested regions during the tick season (spring to early aumtumn). They may be offered the vaccine as well as being advised to minimize exposure to ticks by using insect repellent and wearing clothes that cover as much skin area as possible.

Vaccine

Vaccine is available only in the USA and is strain-specific for that region. The vaccine is administered intramuscularly in three doses of 0.5 ml at day 0, 1 month and 12 months. The level of seroprotection is 76% after three doses but only 49% after two doses, clearly indicating that use of the vaccine should be supplemented by the other methods of personal protection. The vaccine is licensed for use in those aged 15–70 years and is well tolerated. At present, it is uncertain whether this vaccine will provide protection against infection with other strains of *B. burgdorferi*. Available data indicate that a booster dose of vaccine will probably be necessary a year after completion of the primary course.

Precautions and contraindications

Only mild reactions are reported after vaccination. Daily checks should be made for ticks, which should be removed at once. If erythema migrans (an expanding annular zone of reddening of the skin) is observed, medical guidance should be sought immediately. Soreness, redness and swelling at the injection site occur occasionally.

Type of vaccine:	Killed, specific for north America
Number of doses:	Three, at day 0, 1 month and 12 months
Booster:	Probably needed after 1 year
Contraindications:	Children under 15 years of age; adverse reaction to previous dose
Adverse reactions:	Local side-effects only
Before departure:	2 months
Recommended for:	Walkers, campers, etc. in infested countryside
Special precautions:	Check daily for ticks and erythema migrans

MENINGOCOCCAL MENINGITIS

Disease and occurrence

See Chapter 5.

Risk for travellers

Vaccination should be considered for travellers to countries where outbreaks of meningococcal meningitis are known to occur.

- Travellers to industrialized countries are exposed to the possibility of sporadic cases. Outbreaks of meningococcal C disease occur in schools, colleges, military barracks and other places where large numbers of adolescents and young adults congregate.
- Travellers to the sub-Saharan meningitis belt may be exposed to outbreaks of serogroup A disease with comparatively very high incidence rates. Long-term travellers living in close contact with the indigenous population may be at greater risk of infection.
- Pilgrims to Mecca are at risk. The quadrivalent vaccine, (A, C, Y, W-135) is currently required for visiting pilgrims.

Vaccine

The vaccine should be offered only to travellers at significant risk of infection (see above). Internationally licensed meningococcal vaccines are monovalent (group A or C), bivalent (groups A and C) or quadrivalent (groups A, C, Y, and W-135). The vaccines are purified, heat-stable, lyophilized capsular polysaccharides from meningococci of the respective serogroups. The recommended single dose of the reconstituted vaccine contains 50 µg of each of the individual polysaccharides.

Both group A and group C vaccines have documented short-term efficacy levels of 85–100% in older children and adults. However, group C vaccines do not prevent disease in children under 2 years of age, and the efficacy of group A vaccine in children under 1 year of age is unclear. Group Y and W-135 polysaccharides have been shown to be immunogenic only in children over 2 years of age.

A monovalent serogroup C conjugate vaccine has recently been licensed for use in children and adolescents. This conjugate (T-cell dependent) vaccine has enhanced immunogenicity, particularly for children under 2 years of age.

A protective antibody response occurs within 10–14 days of vaccination. In schoolchildren and adults, both group A and group C vaccines appear to provide protection for at least 3 years, but in children under 4 years, the levels of specific antibodies decline rapidly after 2–3 years.

The currently available group A and group C meningococcal vaccines are recommended for immunization of specific risk groups as well as for large-scale immunization, as appropriate, in connection with epidemic outbreaks of group A or C meningococcal disease. The group A and group C vaccines do not provide any protection against group B meningococci, which are the leading cause of endemic meningococcal disease in some countries.

Precautions and contraindications

These vaccines are very safe, and significant systemic reactions have been extremely rare. The most common adverse reactions are erythema and slight pain at the site of injection for 1–2 days. Fever exceeding 38.5 °C occurs in up to 2% of vaccinees. No significant change in safety or reactogenicity has been observed when the different group-specific polysaccharides are combined into bivalent or tetravalent meningococcal vaccines. Cross-protection does not occur and travellers already immunized with conjugate vaccine against serogroup C are not protected against other serogroups.

Those at high risk of type C infection may be vaccinated with the conjugate C vaccine, followed 2 weeks later by the polysaccharide vaccine. All other antigens may be administered simultaneously with the conjugate C vaccine. In the case of other conjugate vaccines containing either diphtheria or tetanus toxoid as the carrier protein, it is advisable to administer at a 1-month interval to avoid enhanced reactogenicity.

Type of vaccine:	Purified bacterial capsular polysaccharide
Number of doses:	One
Booster:	Every 3 years; protection lasts at least 2 years after infancy
Contraindications:	Serious adverse reaction to previous dose
Adverse reactions:	Occasional mild local reactions; rarely, slight fever
Before departure:	2 weeks
Consider for:	All travellers to countries in the sub-Saharan meningitis belt, students at risk from endemic disease; Hajj pilgrims (mandatory)
Special precautions:	Children under 2 years of age are not protected by the vaccine

PNEUMOCOCCAL DISEASE

Disease

The term "pneumococcal disease" refers to a group of clinical conditions caused by the bacterium *Streptococcus pneumoniae*. Invasive pneumococcal infections include pneumonia, meningitis and febrile bacteraemia; the common non-invasive conditions include otitis media, sinusitis and bronchitis. Infection is acquired by direct person-to-person contact via respiratory droplets or oral contact. There are many healthy, asymptomatic carriers of the bacteria. There is no animal reservoir or insect vector.

Several chronic conditions predispose to serious pneumococcal disease (see below). Increasing pneumococcal resistance to antibiotics underlines the importance of vaccination.

Occurrence

Pneumococcal diseases are a worldwide public health problem. *S. pneumoniae* is the leading cause of severe pneumonia in children under 5 years of age, causing over 1 million deaths each year, mainly in developing countries. In industrialized countries, most pneumococcal disease occurs in the elderly.

Risk for travellers

Travellers with certain chronic conditions are at increased risk of pneumococcal disease and should be vaccinated. These predisposing conditions include sickle-cell disease, other haemoglobinopathies, chronic renal failure, chronic liver disease, immunosuppression after organ transplantation and other etiological factors, asplenia and dysfunctional spleen, leaks of cerebrospinal fluid, diabetes mellitus and HIV infection.

Vaccine

The current polysaccharide vaccines contain capsular antigens of 23 serotypes, which cause 90% of pneumococcal infections. The vaccines are immunogenic in those over 2 years of age. Children under 2 years of age and immunocompromised individuals do not respond well to the vaccine. Vaccination provides a relative protection against pneumococcal pneumonia in healthy elderly individuals.

Pneumococcal vaccine is recommended for selected groups, above the age of 2 years, with increased risk of pneumococcal disease. In some countries, such as the USA, routine vaccination is recommended for everyone aged above 65 years.

A new generation of conjugate pneumococcal vaccines is now being evaluated. These vaccines contain 9–11 selected polysaccharides bound to a protein carrier, and induce a T-cell-dependent immune response. Conjugate vaccines are likely to be protective even in children below 2 years of age.

Precautions and contraindications

Pneumococcal polysaccharide vaccine is generally considered very safe. Mild, local reactions persisting for up to 48 hours are common; more severe local reactions are unusual. Moderate systemic reactions (e.g. fever and myalgia) are unusual and severe adverse effects (e.g. anaphylactic reactions) are rare.

Revaccination after 3–6 years may be considered for those in certain high-risk groups in whom immunity following vaccination is known to decline rapidly.