

PART 2: VACCINATION FOR SPECIAL RISK GROUPS

2.1 VACCINATION FOR ABORIGINAL AND TORRES STRAIT ISLANDER PEOPLE

Aboriginal and Torres Strait Islander people historically had a very high burden of infectious diseases, including those for which vaccines were subsequently developed. These high rates of disease in the early period of European colonisation were mainly due to a lack of previous exposure and acquired immunity,¹ and in more recent years have been associated with lower standards of living and poorer access to water, housing and health care.² For some vaccine-preventable diseases (VPDs), such as diphtheria, polio, tetanus, hepatitis B, measles, mumps and rubella, vaccination has been very successful in eliminating or substantially reducing disease in all Australians, and has made a substantial contribution to improvements in Aboriginal and Torres Strait Islander child mortality in recent decades.³ For some other VPDs, in particular invasive pneumococcal disease and influenza in adults, greater burdens of illness still occur in Indigenous compared to non-Indigenous people and remain a major cause of illness and death.³ Detailed information on the current status of VPDs and vaccination status in Aboriginal and Torres Strait Islander people is available elsewhere.³

This chapter discusses the vaccines for which there are different recommendations for Aboriginal and Torres Strait Islander people in at least some parts of Australia. These are, for children, BCG, hepatitis A, *Haemophilus influenzae* type b, and pneumococcal vaccines, and, for adults, influenza and pneumococcal polysaccharide vaccines.

CHILDREN

BCG vaccine and tuberculosis

In the past, Aboriginal and Torres Strait Islander people have suffered from much higher rates of tuberculosis, more than 20 times the rate of non-Indigenous Australian-born people in some areas.⁴ While there have been substantial improvements in disease rates in recent decades, tuberculosis remains more common in Indigenous than non-Indigenous Australian-born people in many parts of Australia, particularly northern and central Australia.^{5,6} Although there is uncertainty about the efficacy of BCG in preventing pulmonary tuberculosis, it provides substantial protection against disseminated forms of the disease in young children.⁷ BCG is therefore recommended for Aboriginal and Torres Strait Islander neonates in regions of high incidence (Northern Territory, far northern Queensland, some regions of both Western Australia and South

Australia), where infants are at higher risk of acquiring this serious, and often fatal, condition. State and Territory guidelines should be consulted where BCG is being considered for neonates <2.5 kg in weight. Nevertheless, as the incidence of pulmonary tuberculosis in adults and the risk of disseminated tuberculosis in infants decreases, the risk of severe complications of BCG, documented in native peoples elsewhere, may become a significant consideration.⁸ State/Territory health authorities should be consulted to determine the recommendations for particular areas. It is usually administered to eligible infants by hospital staff (ie. midwives or nurses who have been specially trained) soon after delivery. Injection technique is particularly important for BCG vaccination which must be administered intradermally. Adverse events, such as regional lymphadenitis, are less common when administration is performed by trained staff.⁹ See Chapter 3.22, *Tuberculosis* for more information.

Haemophilus influenzae type b

Before the introduction of an effective *Haemophilus influenzae* type b (Hib) vaccine, not only was the incidence of invasive Hib disease very high in Aboriginal and Torres Strait Islander children, particularly in more remote areas, it also occurred at a younger age than in non-Indigenous children. Thus, a vaccine to prevent Hib disease in Aboriginal and Torres Strait Islander children needed to be immunogenic as early as possible in infancy. The vaccine known by the abbreviation PRP-OMP (PedvaxHIB or COMVAX) is more immunogenic at 2 months of age than the other conjugate Hib vaccines, and so was the preferred Hib vaccine for Aboriginal and Torres Strait Islander children from the inception of the Hib vaccination programs in 1993. Since then, there has been a dramatic decline of Hib disease in Aboriginal and Torres Strait Islander children.^{10,11} The experience in other high incidence populations indicates that it is important to continue to use PRP-OMP vaccine in Aboriginal and Torres Strait Islander populations demonstrated to be at highest risk, as in central and northern Australia. However, the available data indicate that Indigenous children in areas of low incidence, and non-Indigenous children, have a pattern of Hib disease which is adequately covered by a vaccine not prompting significant immune response until after the second dose.¹² New combination vaccines which include a Hib (PRP-T) component have the advantage of reducing the number of injections required. Therefore, in the Northern Territory, Queensland, South Australia and Western Australia, all Aboriginal and Torres Strait Islander children should receive a Hib vaccine with a PRP-OMP component, while Indigenous children in other jurisdictions, and non-Indigenous children, may receive either PRP-T or PRP-OMP Hib vaccines (see Chapter 3.4, *Haemophilus influenzae type b*). State/Territory health authorities should be contacted about the vaccination schedule for each jurisdiction.

Hepatitis A

Hepatitis A infection has been shown to be very common in Aboriginal and Torres Strait Islander children across northern Australia.¹³⁻¹⁵ Although the symptoms of infection in early childhood are usually mild or absent, cases complicated by liver failure and death have been reported among Indigenous children in far north Queensland¹⁵ and the Kimberley¹³ and recorded hospitalisation rates have been found to be at least 50 times higher in Indigenous children compared to non-Indigenous children.³ A vaccination program for Indigenous children was introduced in north Queensland in 1999, which resulted in substantial decreases in disease rates not only in Indigenous but also in non-Indigenous children, suggesting a substantial herd immunity effect.¹⁶ Vaccination is now recommended for Aboriginal and Torres Strait Islander children in those jurisdictions with high incidence: the Northern Territory, Queensland, South Australia and Western Australia (see Chapter 3.5, *Hepatitis A*). Two doses should be given, commencing in the second year of life. As the exact recommended ages of administration vary between States and Territories, jurisdictional health authorities should be contacted about their vaccination schedules.

Pneumococcal vaccines

Some of the highest rates of invasive pneumococcal disease (IPD) ever reported in the world were in young central Australian Aboriginal children before the availability of the conjugate vaccine,¹⁷ and very high rates were also reported in Indigenous children in other parts of northern Australia.^{18,19} High rates of pneumococcal pneumonia have also been documented in central Australian children,²⁰ and *Streptococcus pneumoniae* has been implicated in the high rates of otitis media.²¹ In response to this, the 7-valent pneumococcal conjugate vaccine (7vPCV) was made available for Aboriginal and Torres Strait Islander children from 2001. As well as higher rates of IPD, a wider range of serotypes is responsible for disease in Aboriginal and Torres Strait Islander children, resulting in a lower percentage of cases (below 60%) caused by serotypes included in the 7vPCV.^{18,19} Therefore, a booster dose of 23-valent pneumococcal polysaccharide vaccine at 18–24 months of age, following the primary course of 7vPCV, is recommended in areas of high incidence, ie. the Northern Territory, Queensland, South Australia and Western Australia. See Chapter 3.15, *Pneumococcal disease* for more information. There has been a rapid decline in invasive pneumococcal disease in Indigenous children since the introduction of the pneumococcal vaccines in 2001.²²

ADULTS

Influenza

Influenza and/or pneumonia is the primary cause of around 2.5% of deaths in Aboriginal and Torres Strait Islander people, the vast majority being adults.² The disease burden is greatest in the elderly, with hospitalisation and death more than twice as frequent in Indigenous adults aged ≥50 years, compared

to non-Indigenous adults.³ Younger Indigenous adults suffer an even greater relative burden than non-Indigenous younger adults, at least 7 times higher for hospitalisations, and 28 times higher for death,³ probably related to a high prevalence of risk factors such as diabetes, renal disease and excessive alcohol use.² The most common complication of influenza is secondary bacterial pneumonia, and influenza vaccine has been shown to be effective in preventing pneumonia and death in the elderly.²³ Therefore, yearly influenza vaccination is recommended for all Aboriginal and Torres Strait Islander adults aged ≥ 15 years.

Pneumococcal polysaccharide vaccine

Studies in far north Queensland and the Kimberley have demonstrated a favourable impact of the 23-valent pneumococcal polysaccharide vaccine (23vPPV) on rates of invasive pneumococcal disease in Indigenous adults,^{18,24,25} but, at a national level, disparities in disease rates between Indigenous and non-Indigenous adults remain. As is the case for influenza and pneumonia, rates of invasive pneumococcal disease are highest in older Indigenous adults, with rates around 4 times higher in Indigenous compared to non-Indigenous adults aged ≥ 50 years.³ Rates in younger adults are slightly lower, but the relative difference between Indigenous and non-Indigenous is much greater, around 12 times higher in Indigenous compared to non-Indigenous adults aged 25–49 years.³ This has been attributed to a high prevalence of at-risk conditions such as diabetes, renal disease and excessive alcohol use.²⁶

23vPPV is recommended for all Aboriginal and Torres Strait Islander people aged ≥ 50 years, and for those aged 15–49 years who have high-risk underlying conditions, and has been funded nationally for people in these categories since 1999. Eligibility for Indigenous adults may be broader than this in some regions; jurisdictional health authorities should be contacted for further information. A single revaccination is recommended after 5 years, and a second revaccination is recommended in some circumstances. See Chapter 3.15, *Pneumococcal disease* for more details.

Other vaccines

The first ever outbreak of Japanese encephalitis (JE) in Australia occurred in the remote outer islands of the Torres Strait in 1995. JE vaccine was first offered to the residents of these islands in late 1995 and, since then, the vaccine has been integrated into the childhood vaccination schedule commencing at 12 months of age (see Chapter 3.10, *Japanese encephalitis*).²⁷

Service delivery

General Practitioners, Aboriginal Community Controlled Health Services, Community Health Services, the Royal Flying Doctor Service and State/Territory Corrective Services all provide substantial levels of vaccination services to Aboriginal and Torres Strait Islander people, and are important to the success of programs to vaccinate Indigenous people. While vaccination coverage estimates

vary over time and between communities, a relatively consistent finding has been higher coverage in Aboriginal and Torres Strait Islander people in remote compared to urban areas.^{28,29} Recent estimates suggest that, for vaccines recommended for both Indigenous and non-Indigenous people, coverage is as high or higher in Indigenous people as non-Indigenous people,³ but vaccination is more frequently delayed.³⁰ Coverage for vaccines recommended only for Aboriginal and Torres Strait Islander people is generally lower than for vaccines which are funded for all people in a particular age group.³¹ This points to the importance of identification of Indigenous status, particularly in mainstream health services, and particularly in urban areas. The use of patient information systems to record Indigenous status and schedule preventive health services has the potential to increase opportunistic vaccination and enable the provision of patient reminders, with improved coverage and timeliness.³²

References

Full reference list available on the electronic *Handbook* or website <http://immunise.health.gov.au>.

2.2 VACCINATION FOR INTERNATIONAL TRAVEL

Introduction

The number of Australians who travel overseas has increased steadily over recent years and now between 3.5 and 4.5 million exits are made annually. Although many of these trips are to countries where health risks exist, the majority of Australians travelling overseas do not seek pre-travel health advice.¹ Every year, Australian travellers are injured, become ill, or even die, while travelling abroad. Some of the infectious diseases that cause some of this morbidity and mortality are preventable through vaccination.^{2,3}

There is a range of travel vaccines that target infectious diseases that are more common in different or less-developed environments, and therefore travel itineraries should be assessed for the level of risk for these diseases.³ Factors such as the interval between the initial presentation and the departure date, destination, length of stay, activities during travel, type of accommodation, personal medical history, age of the traveller, previous vaccination status and financial constraints, all have a potential impact on vaccine recommendations. It is important to identify travellers who may be at increased risk for travel related illness, such as pregnant women, children, people with chronic systemic illness or people with impaired immunity. Recent immigrants and their Australian-born children are at particular risk of acquiring some of these infections when they return to their country-of-origin to visit relatives and friends.⁴

Infections acquired by travellers

Common infections acquired by travellers include those which follow ingestion of contaminated food or water.^{2,5} Most of these are diarrhoeal diseases due to enteric pathogens, but infections with extra-intestinal manifestations, such as hepatitis A and typhoid, are also acquired this way. Vaccines are available for cholera, hepatitis A and typhoid.

Insect-borne (particularly mosquito) infections, such as malaria and dengue, are important causes of fever in Australian travellers returning from endemic areas, southeast Asia and Oceania in particular.⁵ Japanese encephalitis occurs throughout much of Asia and probably throughout Papua New Guinea. Yellow fever occurs only in parts of Africa and Central and South America, while tick-borne encephalitis occurs in parts of Europe and Asia. Vaccines are available for Japanese encephalitis, yellow fever and tick-borne encephalitis.

Vaccine-preventable infections transmitted via respiratory droplets include influenza, invasive meningococcal disease and measles; influenza may be the most frequent vaccine-preventable infection among travellers.⁶ Tuberculosis, although rare, is mostly acquired by expatriates who live in high-risk areas for long periods.

Blood-borne infections, such as hepatitis B, hepatitis C and human immunodeficiency virus (HIV), may pose a threat to some Australian travellers. In remote areas of some countries, there is the possibility that these viruses are transmitted by healthcare workers using non-sterile medical equipment. Hepatitis B vaccine is relevant to many travellers.

Travellers may be exposed to a variety of other exotic infections such as rabies from dog (and other mammal) bites in many countries, schistosomiasis after swimming in African lakes, and leptospirosis after rafting or wading in contaminated streams. Of these, only rabies can be prevented by vaccination.

Practical aspects of travel vaccine administration

Consider each traveller individually, in the context of the specific itinerary. There is no 'correct' list of vaccines for any single country. Ideally the vaccinations should be started early, to minimise any adverse events around the time of departure and allow sufficient time for adequate immunity to develop.

First, consider routine vaccines; all travellers should be up-to-date with current standard vaccine recommendations. Then consider any other vaccines that may be relevant to the individual's usual health status, occupation or lifestyle (eg. pneumococcal polysaccharide vaccine for an elderly person, hepatitis B vaccine for a first aid officer). These should be offered before consideration of the travel vaccines.

Travel vaccines should be considered according to risk. Priority should be given to vaccines for diseases that are common and of significant impact (such as influenza and hepatitis A), and to those diseases which, although less common, have severe potential adverse outcomes (such as Japanese encephalitis and rabies). Booster doses should be considered where appropriate (see Table 2.2.1); a 'rapid schedule' for a combined hepatitis A/B vaccine is available for those ≥ 16 years of age with limited time before travel (see the appropriate vaccine chapters). For children, consider the lower age limits for recommendation of selected vaccines (see Table 2.2.2).

It is important to document travel vaccines appropriately, not only in the clinic's record but also in a suitable record that can be carried by the traveller.

Vaccines

All intending travellers should have been vaccinated according to the recommended vaccination schedule for the traveller's age. All children should be vaccinated according to the National Immunisation Program (NIP) schedule. In exceptional circumstances, the NIP vaccines may be administered at the minimum age rather than the recommended age (see Section 1.3.5, *Catch-up*, Table 1.3.7 *Minimum age for the first dose of vaccine in exceptional circumstances*). Children vaccinated using the minimum age rather than the recommended age may require extra vaccine doses to ensure adequate protection. The minimum

interval between doses must be adhered to (see Section 1.3.5, *Catch-up*, Table 1.3.6 *Minimum dose intervals for NIP vaccines for children <8 years of age*).

Measles

Most measles outbreaks now follow infection imported by inadequately vaccinated young travellers. Therefore, Australians born during or since 1966 who have not received 2 doses of a measles-containing vaccine should be vaccinated with MMR before travelling. Varicella vaccine should be offered to travellers who have not had clinical disease or where serology demonstrates lack of immunity (remembering that 2 doses, separated by at least a month, are required by those ≥ 14 years of age).

Tetanus

Adult travellers should be adequately protected against tetanus before departure, particularly if there could be delays in accessing health services. They should receive a booster dose of dT if more than 10 years have elapsed since the last dose. Protection against pertussis may also be offered at this opportunity (as dTpa) if no previous dose of dTpa has been given.

Poliomyelitis

All travellers should be age-appropriately immunised against polio. If travelling to countries where wild polio virus still exists (Afghanistan, India, Nigeria, and Pakistan), inactivated poliomyelitis vaccine (IPV) should be offered to those who have not completed a 3-dose primary course of any polio vaccine, and a single booster dose should be given to those who have previously completed the primary course. For an up-to-date list of affected countries see <http://www.polioeradication.org>.

Influenza and pneumococcal disease

Travellers aged ≥ 65 years, and those with any medical risk factor, should receive the seasonal influenza vaccine and should have received the 23-valent pneumococcal polysaccharide vaccine. All travellers should consider influenza vaccine, especially when heading to the northern hemisphere winter.

Hepatitis B

All children and adolescents should have been vaccinated against hepatitis B according to the NIP schedule. As they could be exposed to hepatitis B virus during unplanned medical procedures, all travellers intending to spend a month or more in Central and South America, Africa, Asia or Oceania should be vaccinated against hepatitis B.

Hepatitis A

Hepatitis A vaccine should be given to all travellers ≥ 1 year of age travelling to moderately to highly endemic countries (including all developing countries). There is no place for the routine use of normal human immunoglobulin to prevent hepatitis A in travellers (see Chapter 3.5, *Hepatitis A*).

Typhoid

Typhoid vaccine should be given to travellers ≥ 2 years of age travelling to endemic regions, which include the Indian subcontinent, most southeast Asian countries, many south Pacific nations and Papua New Guinea (see Chapter 3.23, *Typhoid*).

Cholera

Cholera vaccination is rarely indicated for travellers,³ as the risk of acquiring cholera is extremely low, and the protection is of relatively short duration. It is only indicated for those travellers at considerable risk, such as those working in humanitarian disaster situations. However, it can also be considered for those travellers with achlorhydria and for those at increased risk of severe or complicated diarrhoeal disease (see Chapter 3.2, *Cholera*).

Certification of cholera vaccination has been abandoned globally, and no countries have official entry requirements for cholera vaccination (see Chapter 3.2, *Cholera*).

Rabies

Travellers to rabies-endemic regions should be advised of the risk, and to avoid close contact with either wild or domestic animals, and they should be advised on what to do should they be either bitten or scratched by an animal while abroad (see Chapter 3.1, *Australian bat lyssavirus infection and rabies* and also refer to the World Health Organization website www.who.int).

Pre-travel (ie. pre-exposure) rabies vaccination (or, if appropriate, booster doses) is recommended for expatriates and travellers who will be spending prolonged periods (ie. more than a month) in rabies-endemic areas. (NB. This time interval, of more than a month, is arbitrary, and rabies has occurred in travellers following shorter periods of travel). Vaccination before travel simplifies the management of a subsequent exposure because fewer doses of vaccine are needed, and because rabies immunoglobulin (which is often difficult or even impossible to obtain in many developing countries) is not required.

Japanese encephalitis

Vaccination is recommended for travellers spending a month or more in either the rural areas of Asia or in Papua New Guinea, particularly if travel is during the wet season and/or there is considerable outdoor activity and/or the standard of accommodation is suboptimal. Vaccination is also recommended for expatriates spending a year or more in Asia, even if much of the stay is in urban areas (see Chapter 3.10, *Japanese encephalitis*).

Meningococcal infections

All children ≥ 12 months of age and all teenagers should have received the meningococcal C conjugate vaccine. In addition, the tetravalent meningococcal polysaccharide vaccine (4vMenPV) is recommended for those who intend travelling to parts of the world where epidemics of meningococcal disease occur, in particular the 'meningitis belt' of sub-Saharan Africa.⁷ Of note, large epidemics of meningococcal meningitis occurred in Delhi, India, in 1966, 1985 and 2005.⁸ The Saudi Arabian authorities require that all pilgrims attending the annual Hajj have evidence of recent vaccination with 4vMenPV⁹ (see Chapter 3.12, *Meningococcal disease*).

Yellow fever

The World Health Organization no longer routinely reports on yellow fever 'infected areas'. Rather, the yellow fever vaccine is now recommended for travellers to yellow fever-endemic countries, in particular those that have reported yellow fever since 1950 (see Chapter 3.25, *Yellow fever*, Table 3.25.1 *Yellow fever endemic countries*).¹⁰

Briefly, provided there is no specific contraindication, the vaccine is recommended for all those ≥ 9 months of age travelling anywhere in any country in West Africa, and for all those ≥ 9 months of age travelling outside urban areas of all other yellow fever-endemic countries (see Table 3.25.1).

Tuberculosis

Vaccination is generally recommended for tuberculin-negative children < 5 years of age who will be living in developing countries for more than 3 months. There is less evidence of the benefit of vaccination in older children and adults, although consideration should be given to vaccination of tuberculin-negative children < 16 years of age who may be living for long periods in high-risk countries (defined as having an incidence ≥ 100 per 100 000 population) (see Chapter 3.22, *Tuberculosis*).

Tick-borne encephalitis

This disease is prevalent in central and northern Europe and across northern Asia during the summer months. The vaccine is available only through Special Access Scheme arrangements in Australia.

Table 2.2.1: Dose and routes of administration of commonly used vaccines in adult travellers (≥15 years of age)

Vaccine (adults)	Brand name	Main constituents	Dose (adults)	Route	Primary schedule	Duration of immunity/booster recommendations
Hepatitis A	Avaxim	160 EIA U inactivated HAV antigen	0.5 mL	IM	0, 6 to 12 months	All probably give life-long immunity.
	Havrix 1440	1440 EIA U inactivated HAV antigen	1 mL	IM	0, 6 to 12 months	
	VAQTA Adult	50 U inactivated HAV antigen	1 mL	IM	0, 6 to 18 months	
Hepatitis A/B combined	Twinrix (720/20)	720 EIA U inactivated HAV antigen and 20 µg recombinant hepatitis B virus surface antigen	1 mL	IM	0, 1, 6 months, or *0, 7, 21 days, and 12 months	A completed series probably gives life-long immunity to both hepatitis A and B.
Hepatitis A/ typhoid combined	Vivaxim* NB. Only for use in people ≥16 years of age	25 µg <i>S. typhi</i> polysaccharide and 160 EIA U inactivated HAV antigen	1 mL combined vaccine	IM	Single dose	A dose of monovalent hepatitis A vaccine given 6–36 months later probably gives life-long immunity. The duration of protection against typhoid is probably 3 years.
Hepatitis B	Engerix-B	20 µg hepatitis B surface antigen protein	1 mL	IM	0, 1, 6 months, or 0, 1, 2, 12 months, or *0, 7, 21 days, and 12 months	A completed series probably gives life-long immunity.
	H-B-VAX II	10 µg hepatitis B surface antigen protein	1 mL	IM	0, 1, 6 months	
Influenza	Various	15 µg haemagglutinin of 2 current influenza A and 1 influenza B strains	0.5 mL	IM	Single dose	As different strains circulate from year to year, annual vaccination with the current formulation is necessary.
Japanese encephalitis	JE-VAX	Inactivated Japanese encephalitis virus	1 mL	SC	0, 7, 28 days	Boosters at 3-yearly intervals.
Measles-mumps-rubella	Priorix	Live attenuated measles-mumps-rubella viruses	0.5 mL	IM/SC	Australians born during or since 1966 who do not have documented evidence of having received 2 doses of a measles-containing vaccine should receive at least 1 dose of MMR before travel.	

Vaccine (adults)	Brand name	Main constituents	Dose (adults)	Route	Primary schedule	Duration of immunity/booster recommendations
Meningococcal (tetraivalent polysaccharide)	Mencevax ACWY or Menomune	50 µg capsular polysaccharides from <i>N. meningitidis</i> serogroups A, C, W ₁₃₅ & Y	0.5 mL	SC	Single dose	Revaccinate 3–5-yearly if at continuing risk.
Rabies (pre-exposure prophylaxis)	Mérieux Inactivated Rabies Vaccine	2.5 IU inactivated rabies virus antigens	1 mL	IM/SC	0, 7, 28 days	If at continued high risk of exposure, either measure rabies antibody titres (and boost if titres reported as inadequate) or give single booster dose 2-yearly.
	Rabipur Inactivated Rabies Vaccine	2.5 IU inactivated rabies virus antigens	1 mL	IM	0, 7, 28 days	
Tetanus, diphtheria (dT) + pertussis (dTpa)	ADT Booster	≥20 IU tetanus toxoid, ≥2 IU diphtheria toxoid	0.5 mL	IM		Provides protection for 10 years.
	Boostrix or Adacel	≥20 IU tetanus toxoid, ≥2 IU diphtheria toxoid, purified antigens of <i>B. pertussis</i>	0.5 mL	IM		Providing pertussis (as well as tetanus and diphtheria) immunity is preferred.
Typhoid	Vivotif Oral	Live attenuated typhoid bacteria	A single capsule	Oral	Days 1, 3 and 5 (+/- day 7) [‡]	Repeat 3-dose course after 3 years if 3 doses given initially; 4-dose course after 5 years if 4 doses given initially.
	Typherix or Typhim Vi	25 µg purified Vi capsular polysaccharide	0.5 mL	IM	Single dose	Booster doses at 3-yearly intervals
	Yellow fever	Stamaril	Live attenuated yellow fever virus	0.5 mL	IM/SC	Single dose

* Vivaxim is registered for use in people aged ≥16 years.

† This 'rapid' schedule should be used only if there is very limited time before departure to endemic regions.

‡ A fourth capsule of oral typhoid vaccine can be given on day 7 (see Chapter 3.23, *Typhoid*).

Vaccinating the traveller with special risk factors

See Chapter 2.3, *Groups with special vaccination requirements* and the specific vaccine chapters for recommendations for travellers who are either pregnant or have impaired immunity. Children should receive the relevant travel vaccines, according to age (see Table 2.2.2). Particular effort should be made to encourage the families of recent migrants to Australia to seek health advice before travelling to their country of origin to visit relatives and friends.¹¹

Table 2.2.2: Recommended lower age limits of travel vaccines for children

Vaccine	Lower age limit	Dose/route	Primary schedule	Comments
Hepatitis A				
Avaxim	2 years	0.5 mL IM	0, 6 to 12 months	Recommended for travel to developing countries.
Havrix Junior	2 years	0.5 mL IM	0, 6 to 12 months	
VAQTA Paediatric/ Adolescent	1 year	0.5 mL IM	0, 6 to 18 months	
Hepatitis A/B combined				
Twinrix Junior (360/10)	1 year	0.5 mL IM	0, 1, 6 months	Recommended for travel to developing countries.
Twinrix (720/20)	1 year	1.0 mL IM	*0, 6 to 12 months	
Japanese encephalitis				
JE-VAX	1 year	1–3 years of age: 0.5 mL SC	0, 7, 28 days	Recommended for travellers spending more than 4 weeks in rural areas of Asia and Papua New Guinea, or those staying in urban areas of Asia for more than 1 year.
		>3 years of age: 1.0 mL SC	0, 7, 28 days	
Meningococcal ACW₁₃₅ Y				
Mencevax ACWY or Menomune	2 years	0.5 mL SC	Single dose	Revaccinate 3–5-yearly if at continuing risk. Should be preceded by MenCCV by at least 2 weeks.
Rabies				
Mérieux	No lower age limit	1.0 mL IM/SC	Pre-exposure: 0, 7, 28 days	The doses of rabies vaccines for pre-exposure are the same for both children and adults (1.0 mL).
Rabipur			0, 7, 28 days	

Vaccine	Lower age limit	Dose/route	Primary schedule	Comments
Typhoid				
Vivotif Oral (oral live vaccine)	6 years	Oral capsule	One capsule on days 1, 3, and 5 (+/- day 7) [†]	Recommended for travel to developing countries. Do not give live oral vaccine with antibiotics or anti-malarials. Do not give within 8 hours of inactivated oral cholera vaccine.
Typherix or Typhim Vi (parenteral vaccine)	2 years	0.5 mL IM	Single dose	
Yellow fever				
Stamaril	9 months	0.5 mL IM/SC	Single dose	Yellow fever vaccine is contraindicated in infants <9 months of age.

* This schedule is not recommended if prompt protection against hepatitis B is required.

† A fourth capsule of oral typhoid vaccine can be given on day 7 (see Chapter 3.23, *Typhoid*).

Further information

It should be noted that information on travellers' risks is changing constantly. Up-to-date knowledge requires an understanding of the changing epidemiology of a variety of infectious and emerging diseases. The World Health Organization's comprehensive publication *International Travel and Health* is available at www.who.int/ith and the CDC's publication *Health Information for International Travel, 2005–2006 (the 'Yellow Book')* is available at www.cdc.gov/travel/index.htm. As recommendations for specific countries change frequently, such sources should be checked regularly.

References

Full reference list available on the electronic *Handbook* or website <http://immunise.health.gov.au>.

2.3 GROUPS WITH SPECIAL VACCINATION REQUIREMENTS

This chapter considers the use of vaccines in people who have special vaccination requirements, those who may experience more frequent adverse events, and those who may have a suboptimal response to vaccination. Recommendations for vaccination of those at occupational risk are also included.

2.3.1 Vaccination of children who have had a serious adverse event following immunisation (AEFI)

Children who have had a serious AEFI (other than a contraindication, such as anaphylaxis) may be subsequently vaccinated under close medical supervision (see Appendix 6, *Definitions of adverse events following immunisation*). Not all States and Territories offer an adverse event immunisation clinic. However, in States or Territories where there are no clinics, there is often a paediatrician or infectious diseases specialist who will review families who have concerns regarding future vaccinations following a previous adverse event.

To make an enquiry, or for more information about making a referral to a vaccination serious adverse events service, please go to the website below:

<http://immunise.health.gov.au/internet/immunise/publishing.nsf/Content/provider-reactions>.

2.3.2 Vaccination of women planning pregnancy, pregnant or breastfeeding women, and preterm infants

(i) Women planning pregnancy

The need for measles, mumps, rubella, varicella, diphtheria, tetanus and pertussis vaccination should be assessed as part of any pre-conception health check. Where previous vaccination history or infection is uncertain, relevant serological testing should be undertaken to ascertain immunity. Influenza vaccine is recommended routinely and pneumococcal vaccination is recommended for women with risk factors, including smokers. Women receiving live viral vaccines must be advised against falling pregnant within 28 days of vaccination. Please refer to individual disease chapters for more information about primary vaccination for these diseases.

(ii) Pregnancy

Although the use of most vaccines during pregnancy is not usually recommended on precautionary grounds, there is no convincing evidence that pregnancy should be an absolute contraindication to the use of any vaccine, particularly inactivated vaccines. The only exception is vaccinia virus (smallpox vaccination), which has been shown to cause fetal malformation. There is some evidence, however, that fever *per se* is teratogenic.^{1,2} With the exception of the use of influenza vaccine, the NHMRC takes the conservative position that the use of vaccines during pregnancy might cause fever and should be avoided other than in situations of increased risk, where the benefits of protection from vaccination outweigh the risks. Eliminating the risk of exposure to vaccine-preventable diseases during pregnancy (eg. by changing travel plans, avoiding high-risk behaviours or occupational exposures) is an alternative to vaccination.

Live attenuated vaccines are contraindicated for pregnant women because of the hypothetical risk of harm to the fetus should transmission occur. If a live attenuated vaccine is inadvertently given to a pregnant woman, or if a woman becomes pregnant within 4 weeks of vaccination, she should be counselled about the potential transmission, albeit extremely unlikely, to the fetus. There is, however, no indication to consider termination of a pregnancy in this situation.

The following table may be used as a guide to the recommended use of vaccinations in pregnancy. Information regarding pregnancy status in women of reproductive age should be part of the routine pre-vaccination screening checklist (see Section 1.3.4, *Pre-vaccination screening*).

Table 2.3.1: Vaccinations in pregnancy

Live attenuated vaccines		
Bacterial	Recommendation	Comments
BCG vaccine (Live attenuated strain <i>M. bovis</i>)	Contraindicated.	Hypothetical risk only. BCG has not been shown to cause fetal damage.
Rotavirus vaccine	Contraindicated. Not registered for use in adults.	Rotavirus vaccine can be safely administered to household contacts of pregnant women.
Oral typhoid vaccine	Contraindicated.	Studies in animals are inadequate but available data show no evidence of an increased occurrence of fetal damage with oral live attenuated vaccine. Inactivated typhoid Vi polysaccharide vaccine is preferred.
Live attenuated vaccines		
Viral	Recommendation	Comments
Measles-mumps-rubella (MMR) vaccine	Contraindicated.	Hypothetical risk only. Despite concerns that attenuated rubella vaccine virus might cause congenital abnormalities, rubella vaccine (either monovalent or as MMR) has been given to pregnant women (usually inadvertently) without harm to the fetus. Even though the rubella vaccine virus can infect the fetus if given in early pregnancy, there is no evidence that it causes congenital rubella syndrome in infants born to susceptible mothers vaccinated during pregnancy and, in particular, rubella vaccination during pregnancy is not an indication for termination. ³ Women of child-bearing age should avoid pregnancy for 28 days after vaccination. It is standard practice to test all pregnant women for immunity to rubella, and to vaccinate susceptible women as soon as possible after delivery (preferably using MMR).
Smallpox vaccine	Contraindicated.	Should not be given to women who are pregnant or considering becoming pregnant. Pregnancy should be avoided for 3 months after vaccination.
Varicella vaccine	Contraindicated.	Hypothetical risk only. Congenital varicella syndrome has (to date) not been identified in women who have been inadvertently vaccinated in early pregnancy. ⁴ This provides some reassurance of the safety of the vaccine. Women of child-bearing age should avoid becoming pregnant for 28 days after vaccination.
Yellow fever vaccine	Contraindicated, unless travelling to yellow fever endemic area.	Hypothetical risk only. Yellow fever vaccine has been given to a large number of pregnant women with no adverse outcomes. ⁵ Pregnant women who travel to a yellow fever-endemic area against medical advice should receive yellow fever vaccine. The administration of yellow fever vaccine in early pregnancy is not an indication for termination.

Inactivated vaccines		
Bacterial	Recommendation	Comments
Cholera (oral) vaccine	Not recommended.	Inadequate information on safety of oral cholera vaccine in pregnancy.
Adolescent/adult formulation dTpa vaccine	Recommended for pregnant women who work in close contact with infants eg. childcare, neonatal units.	Data on use of adolescent/adult formulation dTpa during pregnancy are not available, so it should be given in pregnancy only when the possible advantages outweigh the possible risks to the fetus. All women who are planning pregnancy should be encouraged to receive a single dose of dTpa before pregnancy; if not given before pregnancy, it should be given as soon as possible after delivery.
<i>Haemophilus influenzae</i> type b (Hib) vaccine	Recommended for pregnant women at increased risk of Hib disease (eg. hyposplenia, asplenia).	Available clinical data suggest that it is unlikely that use of Hib vaccine in pregnant women would have any deleterious effects on the pregnancy.
Meningococcal C conjugate vaccine (MenCCV)	Recommended for pregnant women at increased risk of meningococcal disease (eg. hyposplenia, asplenia), or possible exposure to serogroup C.	Although no clinical study data are available on the use of MenCCV in pregnant women, it is unlikely that it would have any deleterious effects on the pregnancy.
Meningococcal polysaccharide vaccine (4vMenPV)	Recommended for pregnant women at increased risk of meningococcal disease who have not been vaccinated with 4vMenPV in the past 3 years (eg. hyposplenia, asplenia), or possible exposure to serogroup A, W ₁₃₅ or Y.	No documented adverse events in either pregnant women or their newborns when vaccinated with 4vMenPV administered in the second and third trimesters of pregnancy. The number of pregnant vaccinees reported in the literature is small.
7-valent pneumococcal conjugate vaccine (7vPCV)	Not recommended.	Vaccination during pregnancy has not been evaluated for potential harmful effects to mother or fetus. Although unlikely to result in adverse effects, the vaccine is currently only registered for use in children ≤ 9 years of age.
23-valent pneumococcal polysaccharide vaccine (23vPPV)	Recommended for pregnant women at increased risk of invasive pneumococcal disease (IPD) (eg. asplenia, impaired immunity, chronic illness, CSF leak) who have not received 23vPPV in the past 5 years (and provided they have not received 2 previous doses).	No adverse effects when administered in pregnancy. Data are limited to clinical trials and deferral of vaccine is recommended unless there is an increased risk of IPD. Women of reproductive age with known risk factors for IPD (including smokers) should be vaccinated before planned pregnancy.
Q fever vaccine	Not recommended.	Safety of use in pregnancy has not been established.
Typhoid Vi polysaccharide vaccine	In pregnant women travelling to endemic countries where water quality and sanitation is poor.	There is no evidence of risk to the fetus from vaccination with Vi polysaccharide vaccine.

Inactivated vaccines		
Viral	Recommendation	Comments
Hepatitis A vaccine	Recommended for susceptible pregnant women travelling to areas of moderate to high endemicity or who are at increased risk of exposure through lifestyle factors, or where severe outcomes may be expected (eg. pre-existing liver disease).	Hepatitis A vaccine should only be given to pregnant women who are non-immune and where there is a clear indication. As for any inactivated viral vaccines, although data are limited, no adverse effects on the developing fetus are expected.
Hepatitis B vaccine	Recommended for susceptible pregnant women for whom this vaccine would otherwise be recommended.	Hepatitis B vaccine should only be given to pregnant women who are non-immune and where there is a clear indication. As for any inactivated viral vaccines, although data are limited, no adverse effects on the developing fetus are expected.
Human papillomavirus (HPV) vaccine	Not recommended.	There are no concerns that HPV vaccines are teratogenic and animal studies have found no evidence of teratogenicity or adverse fetal outcomes. However, where vaccine has inadvertently been administered during pregnancy, further doses should be deferred until after delivery.
Influenza vaccine	Recommended for all pregnant women who will be in the second or third trimester during the influenza season, including those in the first trimester at the time of vaccination.	There is no evidence of congenital defects or adverse effects on the fetus of women who are vaccinated against influenza in pregnancy.
Japanese encephalitis (JE) vaccine	Recommended for pregnant women at risk of acquiring JE.	No adverse effects on pregnancy have been attributed to JE vaccine, whereas JE infection is associated with miscarriage.
Inactivated polio vaccine (IPV)	Recommended for pregnant women at risk of poliovirus exposure (eg. travel to endemic countries).	IPV should only be given to pregnant women when clearly indicated. There is no convincing evidence of risk to the fetus from IPV administered in pregnancy.
Rabies vaccine	Recommended for pregnant women for whom this vaccine would otherwise be recommended (eg. travellers to rabies endemic countries).	Pregnancy is never a contraindication to rabies vaccination in situations where there is a significant risk of exposure (related to occupation or travel), or where there has been a possible exposure to rabies virus or Australian bat lyssavirus.
Toxoids and immunoglobulins		
Tetanus/diphtheria toxoid	Recommended for pregnant women.	Toxoids are safe in pregnancy.
Pooled or hyperimmune immunoglobulins	Recommended for susceptible pregnant women exposed to: measles, hepatitis A, hepatitis B, rabies or Australian bat lyssavirus, varicella viruses and tetanus.	There is no known risk to the fetus from passive immunisation of pregnant women with immunoglobulins.

Contact between pregnant women and individuals who have recently received live vaccines

Although there is no risk of transmission of the MMR vaccine viruses (MMR vaccine viruses are not transmissible), and an almost negligible risk of transmission of varicella vaccine virus, there is a very small risk of transmission of the rotavirus vaccine viruses to a susceptible pregnant woman. However, there is no evidence that there is any risk to the fetus if pregnant women are in contact with recently vaccinated individuals. Therefore, it is safe to administer varicella vaccine and rotavirus vaccine to household contacts of pregnant women.

(iii) Breastfeeding and vaccination

The rubella vaccine virus may be secreted in human breast milk and transmitted to breastfed infants but, where infection has occurred in an infant, it has been mild. Otherwise, there is no evidence of risk to the breastfeeding baby if the mother is vaccinated with any of the live or inactivated vaccines described in this *Handbook*. Breastfeeding does not adversely affect immunisation and is not a contraindication for the administration of any vaccine to the baby.

(iv) Preterm babies

Preterm (premature) infants have a special need for protection and, despite their immunological immaturity, they generally respond well to vaccines. Provided they are well and there are no contraindications to vaccination they should be vaccinated according to the recommended schedule at the usual chronological age.⁶⁻¹⁴

Routine childhood vaccines can cause an increase in apnoea in preterm babies vaccinated in hospital, particularly babies still requiring special care, but these are generally self-limiting and do not affect the clinical course.⁸ Preterm babies in hospital should be monitored for apnoea or bradycardia for up to 48 hours post vaccination.⁶⁻⁸ Vaccinations have not caused an increase in apnoeas in babies at home, and are not associated with an increased risk of SIDS.⁶⁻⁸

- **Vaccines as recommended on the National Immunisation Program (NIP) schedule**

Preterm babies produce good antibody responses to most vaccines in the NIP. They should be vaccinated at the standard recommended ages without correction for prematurity.¹⁴

- **Pneumococcal vaccines**

All preterm babies born at less than 28 weeks' gestation or with chronic lung disease should be offered the 7-valent pneumococcal conjugate vaccine at 2, 4 and 6 months of age, with a fourth dose at 12 months of age, and a 23-valent pneumococcal polysaccharide vaccine booster at 4–5 years of age (see Chapter 3.15, *Pneumococcal disease*).

- ***Haemophilus influenzae* type b vaccine**

Some smaller preterm babies do not respond as well as term babies to PRP-OMP (Liquid PedvaxHIB or COMVAX) Hib vaccine.⁹⁻¹⁴ When PRP-OMP is used in an extremely preterm baby (<28 weeks' gestation or <1500 g birth weight), an extra dose of vaccine should be given at 6 months of age (ie. doses should be given at 2, 4, 6 and 12 months of age) (see Chapter 3.4, *Haemophilus influenzae* type b).

- **Hepatitis B vaccine**

Preterm babies do not respond as well to hepatitis B-containing vaccines as term babies.^{7,12,13,15} Thus, for babies born at <32 weeks' gestation or <2000 g birth weight, it is recommended to give vaccine at 0, 2, 4 and 6 months of age and either:

- (a) measure anti-HBs at 7 months of age and give a booster at 12 months of age if antibody titre is <10 mIU/mL, or
- (b) give a booster at 12 months of age without measuring the antibody titre.

(See Chapter 3.6, *Hepatitis B*.)

- **Influenza vaccine**

Preterm infants with ongoing problems at 6 months of age, particularly respiratory, cardiac or neurological disease, should receive influenza vaccine.

2.3.3 Vaccination of individuals with impaired immunity due to disease or treatment¹⁶⁻¹⁸

The vaccination of individuals with impaired immune systems presents several problems. First, the immune response to vaccines may be inadequate and, second, there is a risk that some live vaccines may themselves cause progressive infection. Degrees of impaired immunity vary from insignificant to profound, and this should be taken into account when considering a vaccination schedule, as should the risk of acquiring the vaccine-preventable diseases.

Although it may seem logical to give higher or more frequent doses of vaccines to these patients, in many cases there are insufficient data to advocate such measures. Because of the uncertainty of the immune response in some patients with impaired immunity, it may be useful to measure post-vaccination antibody titres in groups such as children who have received haematopoietic stem cell transplants (see '2.3.3.3 Re-vaccination following haematopoietic stem cell transplantation (HSCT)' below).

Administration of certain vaccines is a priority for some patients with medical conditions that increase the risk from infectious diseases, even in the absence of specific immune defects. These include: the use of influenza vaccine in individuals with severe asthma, chronic lung disease, congenital heart disease, diabetes and Down syndrome; pneumococcal conjugate vaccine in children

with renal failure, persistent nephrotic syndrome and certain anatomical abnormalities; and pneumococcal polysaccharide vaccine in adults with certain chronic medical conditions. See the appropriate chapters for current recommendations.

Live viral and bacterial vaccines

Although most live vaccines are contraindicated in patients with significantly impaired immunity, the risk of progressive infection varies. The following is a list of current recommendations:

- Vaccines for smallpox (vaccinia virus) and tuberculosis (BCG) are *always* contraindicated.
- Live vaccines such as MMR and varicella vaccines must not be given to people with severely impaired immunity, but are safe to be given to the siblings or other household contacts of such people.
- MMR and varicella vaccines may be given to children with HIV infection with mildly impaired immunity (see '2.3.3.4 HIV-infected individuals' below).
- Travellers with impaired immunity should not receive oral typhoid vaccines. Use parenteral typhoid Vi polysaccharide vaccine instead.
- Yellow fever vaccine is contraindicated in travellers with impaired immunity going to endemic countries. If they must proceed with the travel, they should obtain a letter from a doctor, clearly stating the reason for withholding the vaccine. The letter should be formal, signed and dated, and on the practice's letterhead.

Household contacts vaccinated with live vaccines who live with a person who has impaired immunity

Healthy siblings and household contacts of children with impaired immunity should be vaccinated with MMR, varicella and rotavirus vaccines (where indicated) to prevent them from infecting the children with impaired immunity. Although there is no risk of transmission of the MMR vaccine viruses, and an almost negligible risk of transmission of varicella vaccine virus, there is a small risk of transmission of the rotavirus vaccine viruses (see Chapter 3.18, *Rotavirus* and Chapter 3.24, *Varicella*). Annual influenza vaccination is recommended for contacts (including children ≥ 6 months of age) of people with impaired immunity.

Influenza and pneumococcal vaccines

Morbidity and mortality from influenza and invasive pneumococcal disease are increased in all people with severely impaired immunity. Annual influenza vaccination should be given to all people ≥ 6 months of age with severely impaired immunity. Such individuals should also receive either the 7-valent pneumococcal conjugate vaccine (7vPCV), or 23-valent pneumococcal polysaccharide vaccine (23vPPV), depending on their age (see Chapter 3.15, *Pneumococcal disease*). Although the immune response to 23vPPV may be suboptimal in those who most need protection, the vaccine is nevertheless strongly recommended for these individuals.

While it may seem logical to give 7vPCV followed by 23vPPV to adults with impaired immunity, studies evaluating the effectiveness of such a regimen are not yet available.

Impaired immunity associated with corticosteroid administration

In adults, daily doses of oral corticosteroids in excess of 60 mg of prednisolone (or equivalent) and, in children, doses in excess of either 2 mg/kg per day for more than a week or 1 mg/kg per day for more than 4 weeks, are associated with significantly impaired immunity. However, even lower doses may be associated with some impairment of the immune response.¹⁹

Children on daily doses of ≤ 2 mg/kg per day of systemic corticosteroids for less than 1 week, and those on lower doses of 1 mg/kg per day or alternate-day regimens for periods of up to 4 weeks, may be given live viral vaccines.

Children receiving > 2 mg/kg per day or ≥ 20 mg per day in total of prednisolone (or equivalent) for > 14 days can receive live viral vaccines after corticosteroid therapy has been discontinued for at least 1 month.

For adults treated with systemic corticosteroids in excess of 60 mg per day, live vaccines (such as MMR and varicella vaccines) should be postponed until at least 3 months after treatment has stopped.

2.3.3.1 Oncology patients^{16,20-24}

- **Paediatric and adult patients undergoing cancer chemotherapy who have not completed a primary vaccination schedule before diagnosis**

Live viral vaccines, including varicella and MMR vaccines, are contraindicated in cancer patients receiving immunosuppressive therapy and/or with poorly controlled malignant disease. These vaccines may be administered to seronegative children at least 3 months after completion of chemotherapy and/or high-dose steroid therapy, provided the underlying malignancy is in remission. Administration of live viral vaccines (MMR, varicella or MMRV [when available]) should be deferred if blood products or immunoglobulins have been recently administered (see Table 2.3.5 *Recommended intervals between either immunoglobulins or blood products and MMR, MMRV or varicella vaccination*).

Influenza vaccination is recommended annually in all cancer patients ≥ 6 months of age and should be started as close to the time of cancer diagnosis as possible.

During chemotherapy, and for 6 months afterwards, patients may receive inactivated vaccines (eg. DTPa if < 8 years old, Hib if < 5 years old, hepatitis B, IPV) according to the routine vaccination schedule, but it should be remembered that patients are unlikely to mount a full immune response while they are on therapy. Antibody responses to hepatitis B should be checked 4 weeks after completing the third dose and, where antibody titres are < 10 IU/mL, HBsAg carriage should be investigated. If HBsAg negative, then patients should be given a fourth double dose of vaccine or a further 3 doses of vaccine at monthly intervals (see Chapter 3.6, *Hepatitis B*).

Vaccines should not be administered during times of severe neutropenia (absolute neutrophil count $< 0.5 \times 10^9/L$), to avoid precipitating an acute febrile episode.

Pneumococcal vaccination is recommended in oncology patients with an increased risk of invasive pneumococcal disease (IPD), especially patients with underlying haematological malignancies (multiple myeloma, Hodgkin's lymphoma, non-Hodgkin's lymphoma, chronic lymphocytic leukaemia). In patients ≥ 10 years of age, 23vPPV should ideally be given as early as possible after diagnosis and before chemotherapy and/or radiotherapy is initiated.^{25,26} When this is not practicable, vaccination should be given after completion of chemotherapy.²⁷ For children < 10 years of age with haematological malignancies, primary and catch-up pneumococcal vaccination should be administered as detailed in Table 1.3.11 *Recommendations for pneumococcal catch-up vaccination for children ≤ 5 years of age with underlying medical conditions* (see footnote accompanying this Table).

Any deviations from these guidelines should be discussed with an oncologist.

- **Paediatric and adult patients with cancer who have completed cancer therapy and have received a primary course of vaccination before diagnosis**

The following schedule of booster vaccination is recommended if the patient is well and infection-free 6 months after chemotherapy, and if the underlying disease is in remission:

- DTPa if < 8 years of age (use dT or adolescent/adult formulation dTpa if ≥ 8 years of age),
- MMR, IPV, hepatitis B, 7vPCV and Hib (if < 5 years of age or with previous splenectomy/hyposplenism).

These vaccines may be given without checking antibody titres beforehand, and may be given together on 1 day. Measles and rubella antibody status should be checked 6 to 8 weeks after vaccination. Patients who have not seroconverted should receive a further dose.

Children who are seronegative to varicella-zoster virus, especially those with acute lymphoblastic leukaemia, should receive a 2-dose schedule of varicella vaccine, at least 3 months after chemotherapy has been ceased.²⁸ Administration of live vaccines (MMR, varicella or MMRV [when available]) should be deferred if blood products or immunoglobulins have been recently administered (see Table 2.3.5 *Recommended intervals between either immunoglobulins or blood products and MMR, MMRV or varicella vaccination*).

2.3.3.2 Solid organ transplant recipients²³

For solid organ transplant (SOT) recipients, depending on the transplanted organ, and to prevent rejection, differing doses of immunosuppressive agents are needed, which may influence the effectiveness of vaccines. Where possible, children undergoing solid organ transplantation should be vaccinated well before transplantation, and inactivated vaccines can be used 6 to 12 months after transplantation. Live vaccines are contraindicated in most post-transplantation protocols due to concerns of disseminated infection, although data in this population are limited. Recommended vaccinations for child and adult SOT recipients are given in Table 2.3.2.

Table 2.3.2: Recommendations for vaccinations for solid organ transplant (SOT) recipients

Vaccine	Vaccines recommended before transplantation		Vaccines recommended after transplantation if not given beforehand		Comments
	Child	Adult	Child	Adult	
Hib vaccine	Yes		Yes		If possible complete vaccination at least 6 weeks before transplantation. ²³
Hepatitis A vaccine	Yes	Yes, if seronegative	Yes	Yes, if seronegative	Recommended for all seronegative SOT recipients.
Hepatitis B vaccine	Yes	Yes, depending on serological status	Yes	Yes, depending on serological status	Recommended for all seronegative SOT recipients. Accelerated schedules can be used (see Table 3.6.2 <i>Accelerated hepatitis B vaccination schedules</i>).
Influenza vaccine	Annual vaccination starting before transplantation for people ≥6 months of age.				
7-valent pneumococcal conjugate vaccine (7vPCV)	Yes, if <10 years of age		Yes, if <10 years of age		The primary schedule should be completed before transplantation. For children <10 years of age, 7vPCV should be administered as detailed in Table 1.3.11 <i>Recommendations for pneumococcal catch-up vaccination for children ≤5 years of age with underlying medical conditions</i> (see footnote accompanying this Table).
23-valent pneumococcal polysaccharide vaccine (23vPPV)	Yes [If <10 years of age see Table 1.3.11.]	Yes	Yes [If <10 years of age see Table 1.3.11.]	Yes	See Table 3.15.3 <i>Revaccination with 23vPPV for people ≥10 years of age</i> .

Vaccine	Vaccines recommended before transplantation		Vaccines recommended after transplantation if not given beforehand		Comments
	Child	Adult	Child	Adult	
Inactivated poliovirus vaccine (IPV)	Yes	Yes, if no booster in past 10 years	Yes	Yes, if no booster in past 10 years	The primary schedule should be completed before transplantation.
Diphtheria-tetanus-pertussis vaccine (DTiPa for children <8 years of age; dTpa for people ≥8 years of age)	Yes	Yes, provided dTpa has not been given previously	Yes	Yes, provided dTpa has not been given previously	The primary schedule should be completed before transplantation.
Meningococcal C conjugate vaccine (MenCCV)	Yes, if ≥1 year of age	Yes	Yes, if ≥1 year of age	Yes	
Meningococcal polysaccharide vaccine (4vMenPV)	Yes, if >2 years of age	Yes	Yes, if >2 years of age	Yes	Give 4vMenPV at an interval of at least 2 weeks after MenCCV.
MMR vaccine	Yes	Yes, unless 2 previous documented doses	Contraindicated		The primary schedule should be completed before transplantation provided the recipient is no longer on immunosuppressive therapy.
Varicella vaccine	Yes	Yes	Contraindicated		Vaccination should be completed before transplantation provided the recipient is no longer on immunosuppressive therapy.

2.3.3.3 Re-vaccination following haematopoietic stem cell transplantation (HSCT)²⁹⁻³³

Haematopoietic stem cells are sourced from peripheral blood, bone marrow or umbilical cord. Protective immunity to vaccine-preventable diseases is partially or completely lost following either allogeneic or autologous stem cell transplantation. Impaired immunity following allogeneic transplantation is caused by a combination of the preparative chemotherapy given before transplantation, graft-versus-host disease (GVHD), and immunosuppressive therapy following transplantation. Persisting impaired immunity is common, particularly in patients with chronic GVHD. Immunity is also impaired in autologous stem cell transplant recipients due to high-dose chemotherapy and radiotherapy, but GVHD is not a concern as donor and recipient are the same. In most cases, autologous transplant recipients will recover their immunity more quickly than allogeneic transplant recipients.

Separate transplant schedules for autologous and allogeneic transplant recipients have not been supported in published guidelines because of limited data. For practical purposes, a similar schedule is therefore recommended, regardless of donor source (peripheral blood, bone marrow or umbilical cord), preparative chemotherapy (ablative or reduced intensity), or transplant type (allogeneic or autologous).^{32,34}

HSCT recipients with ongoing GVHD or remaining on immunosuppressive therapy should *not* be given live vaccines. Chronic GVHD (cGVHD) is associated with functional hyposplenism and patients are therefore susceptible to infections with encapsulated organisms, especially *Streptococcus pneumoniae*. For patients with cGVHD who remain on active immunosuppression, antibiotic prophylaxis is recommended.³⁵

The immune response to vaccinations is usually poor during the first 6 months after HSCT. Donor immunisation with hepatitis B, tetanus, Hib and pneumococcal conjugate vaccines before stem cell harvesting has been shown to elicit improved early antibody responses in HSCT recipients vaccinated in the post-transplantation period.³⁶⁻³⁹ However, practical and ethical considerations currently limit the use of donor immunisation.

Routine serological testing for several infectious agents increases costs, and antibody levels conferring protective immunity are poorly defined. For those vaccines that are recommended for all HSCT recipients (tetanus, diphtheria, polio, influenza, pneumococcal, Hib), pre-vaccination testing is not recommended as the response to a primary course of these vaccines is generally adequate. The serological response to pneumococcal polysaccharide vaccine is less predictable. Pneumococcal serology is only available in a few specialised laboratories and is not routinely recommended. Immunity testing before and after vaccination for hepatitis B, measles, rubella and varicella is recommended, as antibody levels will determine the need for revaccination.³⁴

A recommended schedule of vaccination is outlined in Table 2.3.3.^{31,32,34}

Table 2.3.3: Post-transplantation vaccination schedules for allogeneic and autologous haematopoietic stem cell transplant recipients^{32,34}

Vaccine	Months after HSCT			Comments
	12	14	24	
Diphtheria-tetanus-pertussis (DTPa for children <8 years of age; dTpa for people ≥8 years of age)	Yes	Yes	Yes	For recipients ≥8 years of age, give first dose as dTpa followed by 2 doses dT. If dT unavailable, dTpa may be used for all 3 doses.
Hib	Yes	Yes	Yes	
Hepatitis A	Not routinely recommended, see Chapter 3.5, <i>Hepatitis A</i> .			
Hepatitis B	Yes	Yes	Yes	High dose (H-B-VAX II dialysis formulation) vaccine is recommended.
Influenza	Annual vaccination for life, starting 6 months post HSCT, for people ≥6 months of age.			
MMR	No	No	Yes	Vaccination of measles or rubella seronegative HSCT recipients at 24 months post HSCT is recommended, provided that immunosuppressive therapy has been discontinued, there is no chronic GVHD, and cell-mediated immunity has been reconstituted.
MenCCV	Yes, ≥1 year of age			People ≥1 year of age should receive 1 dose of MenCCV.
4vMenPV	Yes, ≥2 years of age (see comment)			People ≥1 year of age should receive 1 dose of MenCCV (as above). This should be followed by a dose of 4vMenPV when ≥2 years of age or, if already aged >2 years, give after an interval of at least 2 weeks following the MenCCV.
7vPCV	Although there are limited data on the effectiveness of 7vPCV in HSCT recipients, vaccination is recommended for children ≤9 years of age starting 6 months post HSCT (see Table 3.15.1 <i>Summary table – pneumococcal vaccination schedule for children ≤9 years of age</i>).			
23vPPV	Yes			See Table 3.15.3 <i>Revaccination with 23vPPV for people ≥10 years of age</i> . Adjunctive antibiotic prophylaxis is recommended for patients with chronic GVHD.
IPV	Yes	Yes	Yes	
Varicella vaccine	No	No	Yes	Vaccination of seronegative HSCT recipients at 24 months post HSCT is recommended, provided that immunosuppressive therapy has been discontinued, there is no chronic GVHD, and cell-mediated immunity has been reconstituted.

2.3.3.4 HIV-infected individuals

Vaccination schedules for HIV-infected patients should be determined by the patient's age, degree of impaired immunity (CD4 count) and the risk of infection. Children with perinatally acquired HIV differ substantially from adults as immunisation and first exposure to vaccine antigens occurs after HIV infection, whereas for adults, most vaccines are inducing a secondary immune response.⁴⁰ HIV-infected individuals of any age who are well controlled on combination antiretroviral therapy (undetected or low viral load with good preservation of CD4 lymphocyte count) are likely to respond well to vaccines.

HIV-infected patients should be vaccinated as follows:

- Diphtheria-tetanus-pertussis (DTPa/dTpa), Hib and IPV vaccines – use the standard schedule.⁴¹
- MMR vaccine should be routinely administered to HIV-infected children at 12 months of age unless they have severely impaired immunity. Table 2.3.4 shows age-specific definitions of moderately and severely impaired immunity. Measles may cause severe disease in HIV-infected children and children with severely impaired immunity who are exposed to measles should, therefore, be given normal immunoglobulin (in a dose of 0.5 mL/kg), regardless of their vaccination status.⁴⁰
- While varicella vaccine is contraindicated in adults with HIV, its use may be considered for asymptomatic or mildly affected children ≥12 months and <13 years of age.⁴² The Advisory Committee on Immunization Practices (ACIP) recommends use of the vaccine, given in 2 doses, 3 months apart, in children with age-specific CD4 T-lymphocyte percentages greater than 25%.⁴³

Table 2.3.4: Immunological categories based on age-specific CD4 counts and percentage of total lymphocytes⁴⁴

Category	<12 months		1–5 years		≥6 years	
	CD4 per μL	%	CD4 per μL	%	CD4 per μL	%
No evidence of impaired immunity	≥1500	≥25	≥1000	≥25	≥500	≥25
Moderately impaired immunity	750–1499	15–24	500–999	15–24	200–499	15–24
Severely impaired immunity	<750	<15	<500	<15	<200	<15

- Pneumococcal disease, both respiratory and invasive, is a frequent cause of morbidity in HIV-infected children and adults. Infants and children <10 years of age should be vaccinated with the 7vPCV (see Table 3.15.1 *Summary table – pneumococcal vaccination schedule for children ≤9 years of age*) and older children and adults should be vaccinated with the 23vPPV (see also Chapter 3.15, *Pneumococcal disease*).^{45,46}
- Influenza vaccine is recommended even in symptomatic HIV-infected adults and children.⁴⁷⁻⁴⁹ Viral loads may increase after vaccination, but CD4 counts are unaffected and the benefits exceed the risk.⁵⁰⁻⁵³
- Hepatitis B vaccine is safe to use, but the immunological response may be poor. HIV-positive adults should receive 3 doses of the H-B-VAX II dialysis formulation and HIV-positive children should receive 3 doses of Engerix-B adult formulation. Antibody level should be measured at the completion of the vaccination schedule. Because many HIV-positive men who have sex with men may already have been exposed to the hepatitis B and hepatitis A viruses, their susceptibility should be determined in order to avoid unnecessary vaccination.
- Susceptible HIV-infected individuals should be vaccinated against hepatitis A.⁵⁴
- BCG must *not* be given to HIV-infected children or adults because of the risk of disseminated BCG infection.
- Yellow fever and oral live attenuated typhoid vaccines should not be given to HIV-infected individuals. Vi polysaccharide typhoid, Japanese encephalitis and rabies vaccines are safe and can be used for the usual indications (see Chapter 2.2, *Vaccination for international travel*).

2.3.3.5 Individuals with functional or anatomical asplenia^{55,56}

Individuals with an absent or dysfunctional spleen are at an increased risk of fulminant bacteraemia, most notably pneumococcal, for the rest of their lives.⁵⁷

• **Pneumococcal vaccination**

All individuals with functional or anatomical asplenia should be vaccinated against invasive pneumococcal disease. In elective splenectomy, the vaccination should be completed, if possible, 2 weeks before the operation; in unplanned splenectomy, the vaccination should commence when the patient has recovered from the surgery.⁵⁸

Children ≤5 years of age with functional or anatomical asplenia should be given the age-appropriate course of pneumococcal vaccines for medical-risk children (see Table 3.15.1 *Summary table – pneumococcal vaccination schedule for children ≤9 years of age* and Section 1.3.5, *Catch-up*).

Children who develop functional or anatomical asplenia between 6 and ≤9 years of age should be given 2 doses of 7vPCV 2 months apart, followed by a dose of 23vPPV 2 months later.

Individuals ≥ 10 years of age with functional or anatomical asplenia should be given:

- an initial dose of 23vPPV,
- revaccination with 23vPPV 5 years after the initial dose (of 23vPPV), and
- 1 further revaccination (third dose) should be given at either 5 years after the first revaccination or at 50 years (Indigenous adults) or 65 years (non-Indigenous adults) of age, whichever is later.

It should be noted that the above regimens cannot provide prolonged protection against all invasive pneumococcal disease. It is particularly important that individuals with functional or anatomical asplenia are informed of the altered immune status associated with asplenia and the increased life-long risk of severe bacterial infection, that they should seek urgent medical assessment for any febrile illness, and that they should always wear a medical alert bracelet or necklace.

NB. Children ≤ 5 years of age with splenic dysfunction, most frequently due to sickle cell disease, should also be treated with daily doses of penicillin V, commencing before the age of 4 months and continuing until 5 years of age (penicillin V 125 mg twice daily, increasing to 250 mg twice daily when they reach 4 years of age).

- **Meningococcal vaccination**

All individuals ≥ 1 year of age with functional or anatomical asplenia should be vaccinated with a single dose of MenCCV, although the vaccine can be given from 6 weeks of age (see also Chapter 3.12, *Meningococcal disease*). This should be followed by a dose of the 4vMenPV at ≥ 2 years of age (see also Chapter 3.12, *Meningococcal disease*). If MenCCV is given, a period of at least 2 weeks should elapse before 4vMenPV is administered. A single revaccination with 4vMenPV is recommended 3 to 5 years later.

- **Hib vaccination**

Children should be up-to-date with Hib vaccination. A single dose of Hib vaccine is recommended for splenectomised adults.

2.3.3.6 Individuals with autoimmune diseases

Adults with conditions such as systemic lupus erythematosus (SLE), rheumatoid arthritis (RA) and multiple sclerosis (MS) should be given influenza and pneumococcal polysaccharide vaccines, due to potential morbidity and mortality from infection, despite the potential for reduced immunogenicity in some patients (described below).⁵⁹⁻⁶¹

For conditions such as SLE and RA, theoretical concerns that vaccines may exacerbate or cause these diseases have not been substantiated, despite a number of sporadic case reports. There is potential for reduced immunogenicity of vaccines, due to both immunosuppressive therapies and the underlying disease.⁶²

Small controlled studies suggest that approximately one-third of patients with SLE or RA receiving immunosuppressive therapies may mount a lower antibody response to influenza and pneumococcal vaccines compared with healthy controls.^{60,62} A small proportion of patients may mount very little or no response to the pneumococcal vaccine.⁶⁰ Importantly, clinical and laboratory measures of disease activity, and the choice, duration and dose of immunosuppressive therapies, do not predict who these poor responders will be.^{60,62,63} In a study involving 149 patients with RA taking immunosuppressive agents, including tumour necrosis factor (TNF) blockers, and 47 healthy controls, patients on TNF blockers showed similar responses to pneumococcal vaccination to controls.⁶³ Patients treated with methotrexate (as monotherapy or with TNF blockers) had a reduced antibody response to vaccination.⁶³

There is clear evidence that multiple sclerosis is not exacerbated by influenza vaccination, and either insufficient or no evidence that other vaccines increase this risk.⁶⁴

2.3.4 Vaccination of recent recipients of normal human immunoglobulin

The immune response to live viral vaccines (with the exception of yellow fever vaccine) may be inhibited by normal human immunoglobulin. The interval recommended is dependent on the type of immunoglobulin given (see Table 2.3.5 *Recommended intervals between either immunoglobulins or blood products and MMR, MMRV or varicella vaccination*).

When hyperimmune globulin is used against a specific infection, such as varicella, vaccination against other live viruses need not be deferred. Specialist advice should be sought if high-dose or intravenous immunoglobulins have been used.

2.3.5 Vaccination of patients following receipt of other blood products including blood transfusions

People who have received a blood transfusion, including mass blood transfusions, do not require revaccination. However, following the receipt of any blood product, including plasma or platelets, an interval of 3 to 7 months should elapse, dependent on the blood product transfused, before vaccination with an MMR, MMRV or varicella vaccine (see Table 2.3.5 *Recommended intervals between either immunoglobulins or blood products and MMR, MMRV or varicella vaccination*).

An interval is suggested because there may be low levels of antibodies present in the blood product that may impair the immune response to the live vaccine.

Table 2.3.5: Recommended intervals between either immunoglobulins or blood products and MMR, MMRV or varicella vaccination⁶⁵

	Route	Dose		
		IU or mL	Estimated mg IgG/kg	Interval (months)
Blood transfusion: Washed RBCs	IV	10 mL/kg	Negligible	0
RBCs, adenine-saline added	IV	10 mL/kg	10	3
Packed RBCs	IV	10 mL/kg	20–60	5
Whole blood	IV	10 mL/kg	80–100	6
Cytomegalovirus immunoglobulin	IV	3 mL/kg	150	6
Hepatitis A prophylaxis (as NHIG)	IM	0.5 mL (<25 kg) 1.0 mL (25–50 kg) 2.0 mL (>50 kg)		3
Hepatitis B prophylaxis (as HBIG)	IM	100 IU 400 IU	10	3
ITP (as NHIG [Intravenous])	IV		400	8
ITP (as NHIG [Intravenous])	IV		1000	10
ITP or Kawasaki disease (as NHIG [Intravenous])	IV		1600–2000	11
Measles prophylaxis (as NHIG):		(max. dose 15 mL)		
Standard	IM	0.2 mL/kg		5
Immunocompromised	IM	0.5 mL/kg		6
Plasma or platelet products	IV	10 mL/kg	160	7
Rabies prophylaxis (as RIC)	IM	20 IU/kg	22	4
Replacement (or therapy) of immune deficiencies (as NHIG [Intravenous], various doses)	IV		300–400	9
Rh (D) IG (anti-D)	IM			0
Tetanus (as TIG for IM use)	IM	250 IU (given within 24 hrs of injury) 500 IU (>24 hrs after injury)	10 20	3
Varicella prophylaxis (as ZIG)	IM	200 IU (0–10 kg) 400 IU (11–30 kg) 600 IU (>30 kg)		5

2.3.6 Vaccination of patients with bleeding disorders

Intramuscular injection may lead to haematoma formation in patients with disorders of haemostasis, and to pressure necrosis, muscle contractures or nerve compression in patients with severe coagulopathies. Children with inherited coagulopathies should receive factor replacement before intramuscular injection. Unless warfarin doses are known to be stable, patients receiving this anticoagulant should have prothrombin times measured before intramuscular injections, which should be deferred if the INR (international normalised ratio) is greater than 3.0. Patients with platelet counts of less than $50 \times 10^9/L$ should not receive intramuscular injections.

The subcutaneous route could be considered as an alternative to the intramuscular route in patients with bleeding disorders; seek expert advice.¹⁹

2.3.7 Vaccination before or after anaesthesia/surgery

Recent or imminent surgery is not a contraindication to vaccinations and recent vaccination is not a contraindication to surgery (see Section 1.3.4, *Pre-vaccination screening*). There are no randomised controlled trials providing evidence of adverse outcomes with anaesthesia and surgery in recently vaccinated children. It is possible that the systemic effects from recent vaccination, such as fever and malaise, may cause confusion in the post-operative period. Elective surgery and anaesthesia may be postponed for 1 week after inactive vaccination and for 3 weeks after live attenuated viral vaccination in children, and routine vaccination may be deferred for 1 week after surgery.⁶⁶

A patient who receives any blood products during surgery will need to be informed of the need to delay any vaccinations (see Table 2.3.5 *Recommended intervals between either immunoglobulins or blood products and MMR, MMRV or varicella vaccination*).

2.3.8 Vaccination of those at occupational risk

Certain occupations, particularly those associated with healthcare, are associated with an increased risk of some vaccine-preventable diseases.^{67,68} Furthermore, some infected workers, particularly healthcare workers and childcare workers, may transmit infections such as influenza, rubella, measles, mumps, varicella and pertussis to susceptible contacts with the potential for serious health outcomes. Many infectious diseases, measles in particular, are highly infectious several days before symptoms become apparent.

Where workers are at significant occupational risk of acquiring a vaccine-preventable disease, the employer should implement a comprehensive occupational vaccination program which includes a vaccination policy, current staff vaccination records, provision of information about the relevant vaccine-preventable diseases, and the management of vaccine refusal (which should, for example, include reducing the risk of a healthcare worker (HCW) transmitting disease to a vulnerable

patient). Employers should take all reasonable steps to encourage non-immune workers to be vaccinated.

Current recommended vaccinations for people at risk of occupationally acquired vaccine-preventable diseases are listed in Table 2.3.6.

Standard precautions should be adopted where there is risk of occupational exposure to blood and body fluids. Preventive measures include the appropriate handling and disposal of sharps, and the donning of gloves, when handling body fluids, and goggles/face shields, when splashes are likely.

If a non-immune person is exposed to a vaccine-preventable disease, post-exposure prophylaxis should be administered where indicated.

Table 2.3.6: Recommended vaccinations for those at risk of occupationally acquired vaccine-preventable diseases*

OCCUPATION	DISEASE/VACCINE
HEALTHCARE WORKERS (HCW)	
All HCW: including all workers and students directly involved in patient care or the handling of human tissues	Hepatitis B Influenza Pertussis (dTpa, provided dTpa has not been given previously) MMR (if non-immune) [†] Varicella (if seronegative)
HCW who work with remote Indigenous communities in NT, QLD, SA and WA; medical, dental and nursing undergraduate students (in some jurisdictions)	Vaccines listed for 'All HCW', plus hepatitis A
HCW who may be at high risk of exposure to drug-resistant cases of tuberculosis	Vaccines listed for 'All HCW', plus BCG
THOSE WHO WORK WITH CHILDREN	
All those working with children including: Childcare and preschool staff (including childcare students) Correctional staff working where infants/ children cohabit with mothers School teachers (including student teachers) Outside school hours carers Child counselling services workers Youth services workers	Pertussis (dTpa, provided dTpa has not been given previously) MMR (if non-immune) [†] Varicella (if seronegative)
Childcare and preschool staff	Vaccines listed for 'All those working with children' plus hepatitis A vaccine

OCCUPATION	DISEASE/VACCINE
CARERS	
Carers of people with intellectual disabilities	Hepatitis A Hepatitis B
Staff of nursing homes and long-term care facilities	Influenza
Providers of home care to people at risk of high influenza morbidity	Influenza
EMERGENCY AND ESSENTIAL SERVICE WORKERS	
Police and Emergency Workers	Hepatitis B, influenza
Armed Forces personnel	Hepatitis B, influenza (and other vaccines relevant to deployment)
Staff of correctional facilities	Hepatitis B, influenza
LABORATORY PERSONNEL	
Laboratory personnel handling veterinary specimens or working with Q fever organism (<i>Coxiella burnetii</i>)	Q fever
Laboratory personnel handling either bat tissues or ABL or rabies virus	Australian bat lyssavirus (ABL) and rabies
Laboratory personnel routinely working with other infectious agents	Anthrax [†] Vaccinia poxviruses Poliomyelitis Typhoid Yellow fever Meningococcal disease Japanese encephalitis
WORKING WITH SPECIFIC COMMUNITIES	
Workers who live with or make frequent visits to remote Indigenous communities in NT, QLD, SA and WA	Hepatitis A
Workers assigned to the outer Torres Strait Islands for a month or more during the wet season	Japanese encephalitis

OCCUPATION	DISEASE/VACCINE
WORKING WITH ANIMALS	
Veterinarians, veterinary students, veterinary nurses	Q fever Australian bat lyssavirus (ABL) and rabies
Agricultural college staff and students exposed to high-risk animals	Q fever
Abattoir workers and contract workers in abattoirs (excluding pig abattoirs)	Q fever
Livestock transporters	
Sheep shearers and cattle, sheep and dairy farmers	
Those culling/processing kangaroos or camels	
Tanning and hide workers	
Goat farmers	
Livestock saleyard workers	
Those handling animal products of conception	
Those who come into regular contact with bats (both flying foxes and microbats), bat-handlers, bat scientists, wildlife officers, zoo curators	Australian bat lyssavirus (ABL) and rabies
Poultry workers, and others handling poultry, including those who may be involved in culling during an outbreak of avian influenza	Influenza
OTHERS EXPOSED TO HUMAN TISSUE, BLOOD, BODY FLUIDS OR SEWAGE	
Embalmers	Hepatitis B, BCG
Sex industry workers	Hepatitis A Hepatitis B
Workers who perform skin penetration procedures, eg. tattooists, body-piercers	Hepatitis B
Funeral workers and other workers who have regular contact with human tissue, blood or body fluids and/or used needles or syringes	Hepatitis B
Plumbers or other workers in regular contact with untreated sewage	Hepatitis A

* Work activities, rather than job title, should be considered on an individual basis to ensure an appropriate level of protection is afforded to each worker.

† All adults born during or since 1966 should have evidence of either receiving 2 doses of MMR vaccine or immunity. Adults born before 1966 are considered to be immune due to extensive measles circulating widely in the community during this period of time (see Chapter 3.11, *Measles*).

‡ People with a repeated risk of exposure or working with large quantities or concentrations of *Bacillus anthracis* cultures. For information regarding anthrax vaccination, please contact the Office of Health Protection in the Australian Government Department of Health and Ageing, Canberra.

2.3.9 Vaccination of immigrants to Australia⁶⁹

Vaccination status is not routinely assessed in children and adults entering Australia as refugees or immigrants. They may be incompletely vaccinated according to the Australian schedule or have incomplete records of vaccination. The World Health Organization website www.who.int/countries/en lists immunisation schedules for most countries and may provide some information regarding vaccine schedules.

- If an immigrant has no valid documentation of vaccination, the standard 'catch-up' schedule should be commenced. Serological testing to determine the need for specific vaccinations is not recommended in the absence of documented vaccination. If a child is ≥ 12 months of age, the first doses of DTPa, hepatitis B, IPV, MMR, MenCCV, 7vPCV and Hib vaccines can be given at the same visit. For details, see Section 1.3.5, *Catch-up*.
- If there is a valid record of vaccination, the history of previous doses should be taken into account when planning a catch-up vaccination schedule.
- Immigrant adults need to be targeted for vaccination, especially against rubella using MMR. This is particularly important for women of child-bearing age.
- All vaccines administered to children < 7 years of age should be documented on the ACIR, including those for children not enrolled with Medicare and vaccinations documented pre-arrival.
- ACIR History Statements can be issued after documentation of overseas vaccination(s) have been recorded on ACIR.
- The Australian Government Department of Immigration and Citizenship (DIAC) may in some circumstances be able to provide information regarding vaccine(s) administered to refugees before entering Australia.

2.3.10 Vaccination of inmates of correctional facilities

Inmates of correctional facilities are at risk of acquiring influenza, hepatitis A and hepatitis B, and should be vaccinated against these infections (see Chapter 3.5, *Hepatitis A*, Chapter 3.6, *Hepatitis B* and Chapter 3.9, *Influenza*).^{70,71}

2.3.11 Vaccination of men who have sex with men

Men who have sex with men are at risk of acquiring hepatitis A and hepatitis B, and should be vaccinated against these infections (see Chapter 3.5, *Hepatitis A* and Chapter 3.6, *Hepatitis B*).

2.3.12 Vaccination of injecting drug users

Injecting drug users are at risk of acquiring hepatitis A and hepatitis B, and should be vaccinated against these infections (see Chapter 3.5, *Hepatitis A* and Chapter 3.6, *Hepatitis B*).

References

Full reference list available on the electronic *Handbook* or website <http://immunise.health.gov.au>.