

Malaysian Society of Infectious Diseases and Chemotherapy



GUIDELINES FOR **ADULT** **IMMUNISATION**

4th Edition (2026)



Adult Immunisation Schedule

Vaccines	18-26 years	27-49 years	50-59 years	60-64 years	>65 years
Influenza	1 dose annually		1 dose annually		
Tetanus, diphtheria, pertussis (Td/Tdap)	1 dose Tdap, then Td booster every 10 years				
Chickenpox (Varicella)	2 doses (refer notes ^a)				
Human papillomavirus (HPV)	2 doses	3 doses (Until 45 years only)			
Shingles (Zoster)	2 doses		2 doses		
Measles, mumps, rubella (MMR)	1 or 2 doses (refer notes ^a)				
Pneumococcal	refer notes ^b			refer notes ^b	
Meningococcal ACWY	1-2 doses, booster every 5 years				
Hepatitis A	2 doses				
Hepatitis B	3 doses				
Haemophilus influenzae type B (Hib)	1 or 3 doses				
Respiratory syncytial virus (RSV)	1 dose (refer notes ^c)	1 dose	1 dose		
Dengue	2 doses				
COVID-19	1 or more doses				2 doses (refer notes ^d)



Notes

- a. Live attenuated vaccines that are contraindicated in some medical conditions
- b. Recommended pneumococcal vaccination dosing schedule:
 - Vaccine naïve individuals/unknown vaccination status: 1 dose of PCV20 (standalone)* OR 1 dose of PCV15/PCV13 followed by 1 dose of PPSV23 (at ≥ 1 year apart, unless immunocompromised group – at 8 weeks apart).
 - Previously received:
 - i. PCV13 only: 1 dose of PCV20 (at ≥ 1 year after the PCV13 dose) OR 1 dose of PPSV23 (at ≥ 1 year after the PCV13 dose).
 - ii. Only PPSV23: 1 dose of PCV20/PCV15/PCV13 (at ≥ 1 year after the last PPSV23 dose).
 - iii. PCV13 & 1 dose of PPSV23: 1 dose of PCV20 (at ≥ 5 years after the last PPSV23 dose).
 - iv. 1 dose of PCV20: no additional vaccine dose recommended.
 - Previously received both PCV13 & PPSV23, AND PPSV23 was received at age ≥ 65 years or older: Based on shared clinical decision-making, 1 dose of PCV20 (at ≥ 5 years after the last pneumococcal vaccine dose).
 - Previously received both PCV13 & PPSV23, both were received before the age of 65 years: 1 dose of PCV20 (at ≥ 5 years after last PPSV23 dose).
- c. Only bivalent recombinant RSVpreF vaccine is indicated for pregnant women.
- d. 2 doses of latest COVID-19 vaccine (at ≥ 6 months apart).

*preferred option

-  For all persons in this category who meet the age requirements and who lack documentation of vaccination (and evidence of immunity against certain infections such as varicella)
-  Recommended if some risk factor is present (eg, on the basis of medical, occupational, lifestyle, or other)
-  Recommended during pregnancy
-  No recommendation



ISBN 978-967-13054-4-7



First Edition Published December 2003

Second Edition Published April 2014, Revised October 2016



Third Edition Published October 2020, Revised November 2023

Fourth Edition Published July 2026

**Copyright © Malaysian Society of Infectious Diseases and
Chemotherapy (MSIDC) 2026**

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording and/or otherwise, without the prior written permission from the publisher. Applications for such permission should be addressed to Malaysian Society of Infectious Diseases and Chemotherapy.

Published by:

Malaysian Society of Infectious Diseases and Chemotherapy
c/o Department of Medical Microbiology & Immunology
Faculty of Medicine, 16th Floor, Pre-Clinical Building
Jalan Yaacob Latif, Bandar Tun Razak
Cheras 56000, Kuala Lumpur, MALAYSIA

Printed by:

Ultra Works Sdn Bhd

23-5, Block B, The Suites, Jaya One,
72A, Jln Profesor Diraja Ungku Aziz,
46200 Petaling Jaya,
Selangor.



GUIDELINES FOR **ADULT** **IMMUNISATION**

4th Edition (2026)

Editorial Panel



EDITOR-IN-CHIEF

Prof Dr Yasmin A. Malik

Visiting Senior Clinical Consultant,
Department of Medical Microbiology
University Malaya Medical Centre

AUTHORS

Professor Dr Zamberi Sekawi

Professor of Medical Microbiology
Faculty of Medicine and
Health Sciences
Universiti Putra Malaysia

Associate Professor Datin Dr Zetti Zainol Rashid

Consultant Clinical Microbiologist
& Medical Lecturer
Department of Medical Microbiology
and Immunology
Faculty of Medicine
Universiti Kebangsaan Malaysia

Dr Ooi Mong How

Consultant Paediatrician
Department of Paediatrics
Sarawak General Hospital

Dr Azureen Azmel

Consultant Infectious Diseases
Physician
Hospital Tengku Ampuan Rahimah

Professor Dr S Fadilah Abdul S Wahid

Consultant Hematologist
Pusat Terapi Sel
Hospital Canselor Tuanku Muhriz
Universiti Kebangsaan Malaysia

Professor Dr Zakuan Zainy Deris

Professor of Medical Microbiology
School of Medical Sciences
Universiti Sains Malaysia

Dato' Dr Chow Ting Soo

Consultant Infectious Diseases
Physician
Hospital Pulau Pinang

Professor Dr Nurul Azmawati Mohamed

Professor of Medical Microbiology
Faculty of Medicine & Health
Sciences
Universiti Sains Islam Malaysia

Professor Dr Tan Maw Pin

Professor of Geriatric Medicine
Faculty of Medicine
University of Malaya



EXTERNAL REVIEWERS

Associate Professor Dr Petrick Periyasamy

Consultant Infectious Disease
Physician
Department of Medicine
Faculty of Medicine
Universiti Kebangsaan Malaysia

Professor Dr Gerard Flaherty

Professor of Travel Medicine and
International Health
University of Galway, Ireland and
Adjunct Professor of Travel Medicine
and International Health
IMU University, Malaysia

Dr Lim Bee Yee

Senior Principal Assistant Director
Biologics Section
Centre of Product and Cosmetic
Evaluation
National Pharmaceutical Regulatory
Agency Ministry of Health, Malaysia

Puan Nur Ayuni binti Ahmad

Senior Principal Assistant Director
Pharmacovigilance Section
Centre of Compliance and Quality
Control
National Pharmaceutical Regulatory
Agency Ministry of Health, Malaysia

Dr Radziah binti Mohamad

Public Health Consultant
Deputy Director of Family Health
Family Health Development Division
Ministry of Health Malaysia

Dr Noor Rizawati binti Mahpot

Public Health Physician
Head, Vaccine-Preventable Disease
(VPD) Sector
Disease Control Division (DCD)
Ministry of Health Malaysia

Table of Content



Introduction

General Advice on Immunisation

Immunosenescence

Cholera

COVID-19

Dengue

Diphtheria, Tetanus and Pertussis (Tdap)

Haemophilus influenzae Type B infections

Hepatitis A

Hepatitis B

Human Papillomavirus (HPV) infections

Influenza

Japanese Encephalitis (JE)

Measles, Mumps, Rubella (MMR)

Meningococcal Disease

Mpox

Pneumococcal Disease

Poliomyelitis

Rabies

Respiratory Syncytial Virus (RSV)

Typhoid

Chickenpox (Varicella)

Yellow Fever

Shingles (Zoster)

Passive Immunisation



FUTURE VACCINES

Avian Influenza

Chikungunya

Clostridioides difficile

Ebola

Human Immunodeficiency Virus (HIV)

Malaria

Zika

SPECIAL GROUPS

Adults Who Missed Childhood Immunisation

Elderly and Patients with Chronic Diseases
(Including Autoimmune Diseases)

Healthcare Workers

Human Immunodeficiency Virus (HIV)

Immunocompromised Patients

Miscellaneous Groups

Travelers

Vets & Animal Handlers

ABBREVIATIONS



Most vaccination programmes continue to focus on reducing mortality and morbidity in children, even though the major burden of vaccine-preventable diseases is in adults. The changing demographics have raised concerns on the impact of aging populations on healthcare provision and healthcare budgets. Vaccination can help deliver significant decreases in healthcare utilisation, and improved quality of life.

However, there still remains a lack of awareness of the benefits of immunisation for adults. Adults need vaccination for various reasons:

1. Vaccination helps adults to stay healthy. Other than influenza, shingles (herpes zoster) and respiratory syncytial virus (RSV) infection cause significant morbidity and mortality by increasing the risk for other conditions, particularly cardiovascular and cerebrovascular diseases.
2. Immunity derived from vaccination during childhood wanes over time, and as we age the progressive decline of immune responsiveness also contributes to reduced immunogenicity and faster waning, resulting in increased risk for some infectious diseases.
3. Vaccination helps to protect family members and the community from infectious diseases. This is seen with increased pertussis in adults (due to waning immunity) correlating with increased risk of infection, illness and death from pertussis in infants. Thus, a lifetime risk may be addressed by life course vaccination.
4. Some adults can face greater risks to certain infections because of their work or underlying co-morbidities. Social factors such as exposure through travel for older persons or through clustering, from long-term care facilities or community living, may further exacerbate risks.

The primary objective for developing these clinical practice guidelines on adult immunisation is to assist doctors and the public in making decisions on the appropriate use of vaccines in the adult population from aged 18 years and above. These recommendations on adult immunisation are evidence-based, appropriate to the Malaysian context and reflect current best practices. As the global population, including Malaysia, is aging rapidly, this edition has also included a brief explanation on immunosenescence,



that refers to the gradual decline in immune function with increasing age. It is hoped that the judicious use of vaccines will provide a cost-effective way of reducing the burden of morbidity and mortality due to vaccine-preventable infections among adults in Malaysia.

This is the fourth edition of the Guidelines For Adult Immunisation and we hope that it will continue to provide a useful resource for all doctors in Malaysia.

Yasmin A Malik

Editor-in-Chief

April 2026



Contraindications and Special Considerations

All vaccines are contraindicated in those who have had a confirmed anaphylactic reaction to:

- a previous dose of a vaccine containing the same antigens, or
- another component contained in the relevant vaccine, e.g. neomycin, streptomycin or polymyxin B (which may be present in trace amounts in some vaccines).

Live vaccines may be temporarily contraindicated in individuals who are:

- immunosuppressed
- pregnant

Some vaccines are contraindicated in specific groups:

- **Egg allergy:** As of 2017, it has been recommended that egg-allergic individuals may be safely vaccinated with the measles, mumps, rubella (MMR), the measles, mumps, rubella, varicella (MMR-V) vaccine (which contains no egg protein) and the influenza vaccine (which may contain minute traces of egg protein).

Special precautions such as split dosing, prior allergy testing with the vaccines, allergy specialist review before vaccination or prolonged waiting times after administration are not required.

The yellow fever and Q fever vaccines potentially contain higher amounts of egg protein, and an allergy specialist evaluation is recommended before vaccination.

- **Severe latex allergy:** While it is theoretically possible that latex protein in the tip cap and/or rubber plunger or vial stoppers may cause allergic reactions, there is little evidence that such a risk exists, and any such risk would be extremely small (around 1 per 1 million vaccine doses). Even



so, as a precaution, vaccines supplied in vials or syringes that contain latex should not be administered unless the benefit of vaccination outweighs the risk of an allergic reaction to the vaccine.

For latex allergies other than anaphylactic allergies (e.g. a history of contact allergy to latex gloves), vaccines supplied in vials or syringes that contain latex can be administered.

- **Pregnancy:** There is no evidence that any live vaccine (including rubella and MMR) causes direct foetal injury or birth defects. However, since the theoretical possibility of foetal infection still exists, live vaccines should generally be delayed until after delivery. Women should avoid conception for 4 weeks after vaccination with live vaccines. Termination of pregnancy following inadvertent immunisation is not recommended.

Even though inactivated vaccines cannot replicate and cause infection in either the mother or the foetus, they should be administered to pregnant women only if protection is required without delay.

- **Immunosuppression:** Live vaccines can, in some situations, cause severe or fatal infections in immunosuppressed individuals (including the HIV-infected) due to extensive replication of the vaccine strain. For this reason, severely immunosuppressed individuals should not be given live vaccines (see section on Immunocompromised Patients on page 203).

Killed or recombinant vaccines and toxoids may be administered to immunosuppressed individuals since the organisms cannot replicate. Since they may elicit a lower immune response than in immunocompetent individuals, a double dose may be required.



Other Considerations:

- Adults on stable long term low dose corticosteroid therapy (up to 20mg prednisolone per day for >14 days) either alone, or in combination with other low dose immunosuppressive drugs or low dose non-biological oral immune modulating drugs (e.g. methotrexate, azathioprine, 6-mercaptopurine), are not considered sufficiently immunosuppressed. These patients can therefore receive live vaccines.
- Non-systemic corticosteroids, such as aerosols or topical or intra-articular preparations, do not cause systemic immunosuppression. Neither does replacement schedule of corticosteroids for people with adrenal insufficiency. Therefore, administration of live vaccines is not contraindicated.

Live vaccines should not be given to the following:

- Patients receiving immunosuppressive treatment including radiotherapy or systemic high-dose steroids.
- Patients with evidence of primary or secondary immunodeficiency.

Contact with an individual with immunodeficiency, on current/recent immunosuppressive therapy:

- For most of the current live vaccines in use, transmission through contacts does not occur or can be minimised by simple precautions (e.g. MMR, chickenpox. See vaccine specific advice).
- In addition, vaccination of close contacts of vulnerable people has a major benefit by reducing the risk of exposure to wild-type infection. Thus, some vaccines should be actively encouraged in family and household contacts of those at risk.
- Organ transplant candidates should complete the recommended full vaccination schedule as early as possible because of the problem of reduced immune response to vaccines following transplantation, as a result of immunosuppressive treatment.



The following are **NOT** contraindications to routine vaccinations (in some of these situations, additional precautions may be required – refer to the relevant chapters for further information):

- Minor self-limiting illness with fever $<38^{\circ}\text{C}$
- Asthma, eczema, hay fever, or food allergy
- Non-anaphylactic egg allergy
- Recent contact with an infectious disease
- History of jaundice
- Family history of any adverse events following immunisation
- History of vaccine-preventable disease
- Someone in the household being pregnant
- Stable neurological conditions
- Personal or family history of convulsions
- Prematurity or low birth weight
- Being a sibling or close contact of an immunosuppressed individual
- Recent or imminent elective surgery
- Imminent general anaesthesia
- Unknown or inadequately documented immunisation history
- Treatment with antibiotics or locally-acting (e.g. topical or inhaled) steroids
- Treatment with interferons & other non-immunosuppressing immunomodulators



Temporary deferral of immunisation

The following are situations where temporary deferral of immunisation is required:

- Individuals with immunosuppression from malignant disease on chemotherapy should not receive live attenuated vaccines until at least 3 months after chemotherapy has finished.
- Patients who received a hematopoietic stem cell transplant may be given inactivated vaccine or toxoid from 6 to 12 months after completing all immunosuppressive treatment, or longer if the patients developed graft versus-host disease.
- For those on high dose systemic corticosteroids (for adults; daily doses in excess of 20mg for >2 weeks or 60mg of prednisolone), live attenuated vaccines should be postponed until at least 3 months after treatment has stopped.
- Live virus vaccines, with the exception of yellow fever vaccine, generally should not be given during the 3 months following injection of immunoglobulin because the immune response may be inhibited. For MMRV vaccine, refer to Table 15.2, page 89.

Interrupted immunisation course:

- If an immunisation course is interrupted, it should be resumed as soon as possible. It is not necessary to repeat the course, regardless of the interval from the previous incomplete course except cholera vaccine. The course should be completed with the same brand of vaccine if possible.



Route and Site of Administration

By mouth:

- Cholera and specific typhoid vaccines may also be given orally. Food and drink should be avoided for 1 hour before and 1 hour after vaccination. Oral administration of other medicinal products should be avoided within 1 hour before and after administration of the vaccine.

Intranasal:

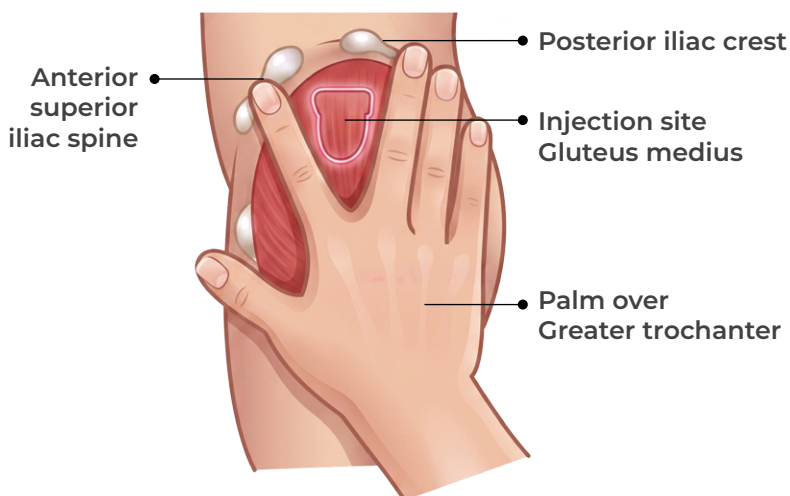
- The live attenuated influenza vaccine (LAIV) is administered by the intranasal route (**FluMist**) and is supplied in an applicator that allows a divided dose to be administered in each nostril (total dose of 0.2ml, 0.1ml in each nostril). The device allows intranasal administration to be performed without the need for additional training.
- Administration of either dose does not need to be repeated if the patients sneeze or blow their nose following administration. As heavy nasal congestion might impede delivery of the vaccine to the nasopharyngeal mucosa, defer administration of the vaccine until resolution of the nasal congestion has occurred. Alternatively, an appropriate intramuscularly administered influenza vaccine should be considered.

Subcutaneous (SC) and intramuscular (IM) injections:

- Most vaccines are given by IM injections, rather than deep SC, as the former are less likely to cause local reactions. However, for individuals with a bleeding disorder, vaccines normally given by an IM route should be given by deep subcutaneous injection to reduce the risk of bleeding. Vaccines should never be given intravenously.
- The preferred site for IM and SC immunisation is the deltoid area of the upper arm. The upper outer quadrant of the buttock (ventrogluteal) area is an alternative injection site (as shown in figure 1.0). The anterolateral thigh is another alternative injection site since the immune response is not reliable for gluteal vaccine injections because of the difficulty in reaching the muscle.



Figure 1.0 Ventrogluteal Site



- IM injections should be given with the needle at a 90-degree angle to the skin and the skin should be stretched, not bunched. Deep SC injections should be given with the needle at a 45-degree angle to the skin and the skin should be bunched, not stretched. It is not necessary to aspirate the syringe after the needle is introduced into the muscle. (refer to Figure 1.1a & b on page 19).
- Immunisations should not be given into the buttock, due to the risk of sciatic nerve damage and the possibility of injecting the vaccine into fat rather than muscle. Injection into fatty tissue of the buttock has been shown to reduce the immunogenicity of hepatitis B and rabies vaccines.
- Inadvertent SC injection of IM vaccines:
 - » If a vaccine that is registered for IM administration is inadvertently given subcutaneously, check the vaccine product information and the relevant disease-specific chapters for more details.
 - » This can increase the risk of significant local adverse events, particularly with aluminium-adsorbed vaccines (e.g. HBV, DTPa, DTPa combination or DT vaccines).



- » Hepatitis B vaccines should usually be repeated if they are inadvertently given subcutaneously.
- » Some IM vaccines may still be immunogenic when given by the SC route. These vaccine doses do not need to be repeated.

Intradermal injections:

- Whilst the IM route is preferred for rabies pre-exposure prophylaxis, suitably qualified and experienced healthcare professionals may give the vaccine via the intradermal route. The preferred site of administration is behind the posterior border of distal portion of deltoid muscle.
- During an intradermal injection, considerable resistance is felt and a raised, blanched bleb showing the tips of the hair follicles is a sign that the injection has been correctly administered. A bleb of 7mm in diameter is approximately equivalent to 0.1ml and is a useful indication of the volume that has been injected. If no resistance is felt, the needle should be removed and reinserted before more vaccine is given (refer to Figure 1.1c).

Figure 1.1 Techniques of Administration

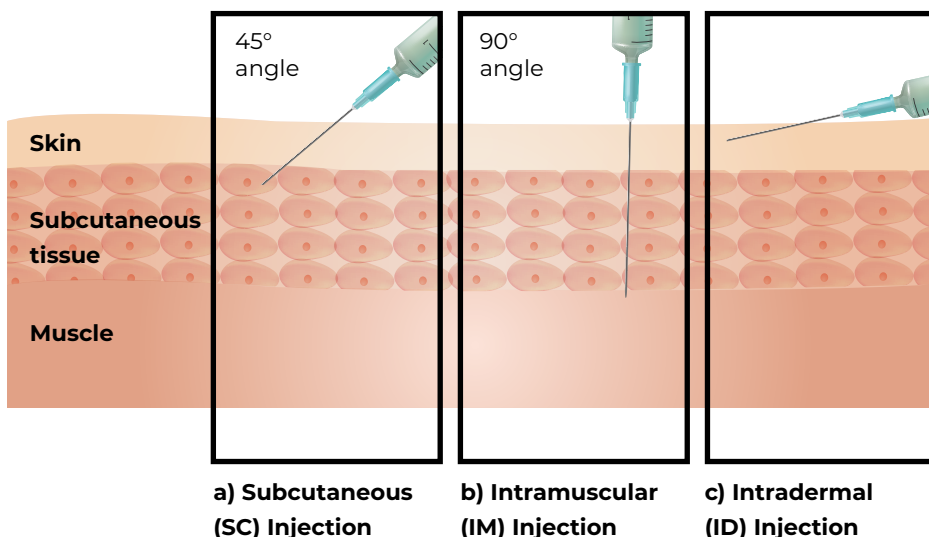




Table 1.1 Injection Routes for Common Vaccines

Vaccines	Dose	Route
Chickenpox (Varicella)	0.5mL	SC/IM
Diphtheria, tetanus, pertussis (DTaP, DT, Tdap, Td)	0.5mL (under combo)	IM
<i>Haemophilus influenzae</i> type b (Hib)	0.5mL	IM
Hepatitis A (Hep A)	1.0mL	IM
Hepatitis B (Hep B)	1.0mL	IM
Human papillomavirus (HPV)	0.5mL	IM
Influenza, inactivated (IIV)	0.5mL	IM
Measles, mumps, rubella (MMR)	0.5mL (under combo)	SC/IM
Meningococcal conjugate (MCV)	0.5mL	IM
Pneumococcal conjugate (PCV)	0.5mL	IM
Pneumococcal polysaccharide (PPSV)	0.5mL	IM or SC
Shingles (Zoster) - recombinant	0.5mL	IM
Combination Vaccines	Dose	Route
Hep A + Hep B	1.0mL	IM

Note: Always refer to the package insert included with each biologic for complete vaccine administration information.



Table 1.2 Injection Sites and Needle Sizes Appropriate for Each Age Group

Subcutaneous (SC) injection: Use a 23-25-gauge needle.		
Age	Needle Length	Injection Site
Adults	5/8 in	Fatty tissue over anterolateral thigh muscle or fatty tissue over triceps
Intramuscular (IM) injection: Use a 22-25-gauge needle. Choose injection site & needle length appropriate to age & body mass.		
Age	Needle Length	Injection Site
Adults (19 yrs or older)		
Male or female <59kg	5/8 - 1 in*	Deltoid muscle of arm
Female 59-92kg	1 – 1.5 in	Deltoid muscle of arm
Male 59-118kg		
Female >92kg	1.5 in	Deltoid muscle of arm
Male >118kg		

** A 5/8 in needle may be used only if the skin is stretched tight, subcutaneous tissue is not bunched, and injection is made at a 90-degree angle.*



Suitable sites for immunoglobulin administration:

- This should be administered deep into a large muscle mass. If the volume is more than 5ml when given to older children and adults, the immunoglobulin should be divided into smaller amounts and given into different sites. The preferred site of injection is the upper outer quadrant (that is, ventrogluteal site) of the buttock.
- Rabies immunoglobulin should be infiltrated into the site of the wound.

Interrupted during vaccination process:

- If the process of administering a vaccine intramuscularly or subcutaneously is interrupted (such as by syringe–needle disconnection) and **most** of the dose has not been given, repeat the whole dose as soon as practicable.

Post Vaccination

- Recipients of vaccine should remain onsite for at least 15 minutes until they have been seen to recover from the procedure. The area should be close enough so that the vaccinated person can be observed and medical treatment can be provided rapidly if needed.
- Paracetamol is not routinely used before, or at the time of, vaccination, but may be recommended as required for fever or pain occurring following immunisation.
- In adults, the most common immediate adverse event is Immunisation Stress-Related Responses (ISRR) that commonly include vasovagal episodes, dizziness, hyperventilation, and acute anxiety. Anyone who complains of giddiness or light-headedness before or after vaccination should be advised to lie down until free of symptoms.
- The most serious immediate adverse events following immunisation is anaphylaxis.



Anaphylaxis



Symptoms of anaphylaxis include:



- Upper airway obstruction: hoarseness and stridor as a result of angioedema.
- Lower airway obstruction: subjective feelings of retrosternal tightness and dyspnoea with audible expiratory wheeze from bronchospasm.
- Cardiovascular: sinus tachycardia, profound hypotension in association with tachycardia; severe bradycardia.
- Skin: rapid development of urticarial lesions – circumscribed, intensely itchy wheals with erythematous raised edges and pale blanched centres.

Management of anaphylaxis:

- Lie the patient in a left lateral position. If unconscious, insert airway.
- Give 1:1000 (1-in-1,000) adrenaline by deep intramuscular injection unless there is a strong central pulse and the patient's condition is good.
- Adrenaline is not required for generalised non-anaphylactic reactions (such as skin rash or angioedema). If in doubt, IM adrenaline should be given. No serious or permanent harm is likely to occur from mistakenly administering adrenaline to an individual who is not experiencing anaphylaxis.
- For adults, the dosage is 0.5-1.0-mL repeated as necessary up to a maximum of 3 doses. An initial dose of 0.5 mL is recommended. The lower dose should be used for the elderly or those of slight build.
- If oxygen is available, give it by face mask.
- Never leave the patient alone.
- If appropriate, begin cardio-pulmonary resuscitation (CPR).
- Chlorpheniramine maleate 10mg may be given intravenously. Hydrocortisone 100mg may also be given intravenously to prevent further deterioration in severely affected cases.



- If there is no improvement in the patient's condition in 5 minutes, repeat the dose of adrenaline every 5 minutes up to a maximum of 3 doses or until improvement occurs.
- All cases should be admitted to hospital for further observation and treatment.

Vaccine Storage and Disposal of Vaccines

- Household-grade refrigerators can be an acceptable alternative to pharmaceutical-grade vaccine storage units. However, the freezer compartment of this type of unit is not recommended to store vaccines.
- On receipt, vaccines are immediately placed under the required storage conditions. Vaccines should be stored in the original packaging, retaining batch numbers and expiry dates. Place vaccines and diluents with the earliest expiration dates in front of those with later expiration dates. Whenever possible, store diluent with the corresponding vaccine. Never store diluent in a freezer. Label the shelves and containers to clearly identify each type of vaccine and diluent is stored.
- Vaccines should be stored according to the manufacturer's document as aligned to NPRA Drug Registration Guidance Document (DRGD) – usually at 2 - 8 deg C and protected from light, so that the potency of the some of the vaccines is not reduced.
- Generally, vaccines should not be kept frozen but there are some exceptions, e.g. chickenpox (Varivax), RSV (MResvia), MMR II vaccines. If the facility provides frozen vaccine, a separate freezer unit (-50 deg C and -15 deg C) is necessary.
- A door that is left open unnecessarily not only affects the temperature in a unit, it also exposes vaccines to light, which can reduce potency of some vaccines. Consider using safeguards to ensure the doors of the unit remain closed—e.g., self-closing door hinges, door alarms, or door locks.
- A digital data logger (DDL) provides the most accurate storage unit temperature information, including details on how long a unit has been operating outside the recommended temperature range. Unlike

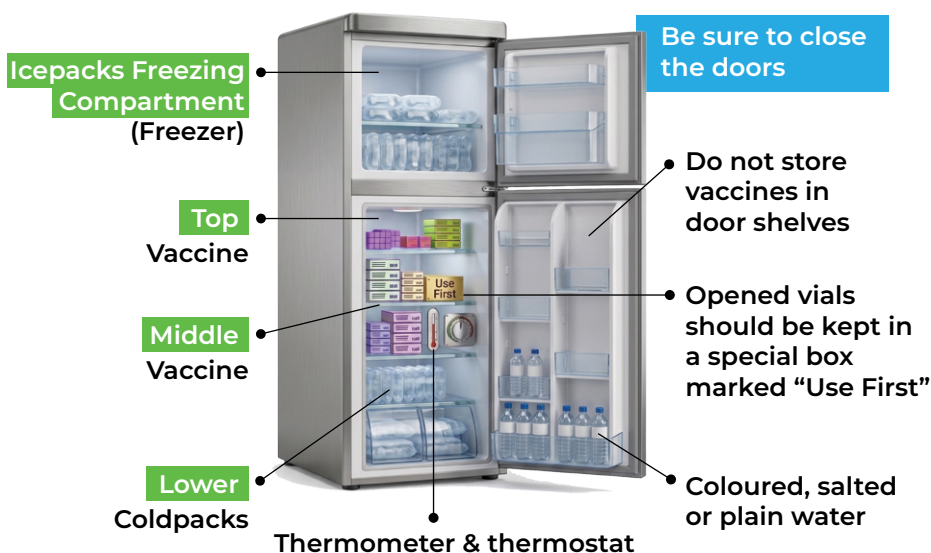


a simple minimum/maximum thermometer, which only shows the coldest and warmest temperatures reached in a unit, a DDL provides detailed information on all temperatures recorded at preset intervals. Temperature data from a DDL can either be downloaded to a computer using special software or retrieved from a website.

- The temperature of the fridge should be recorded at least twice a day even during the weekend or a public holiday. Meanwhile, the door and drawers of fridges should be filled with bottles of water to help maintain steady temperatures.
- Within the refrigerator, sufficient space around the vaccine packages should be left for air to circulate. Arrange vaccines and diluents in rows and allow space between them. Position vaccines and diluents 5 to 8 cm (2 to 3 inches) from the unit walls, ceiling, floor, and door. Avoid storing vaccines and diluents directly under cooling vents; in fruit, or vegetable drawers; or on refrigerator door shelves. The instability of temperatures and air flow in these areas may expose vaccines to inappropriate storage temperatures. (refer to Figure 1.2 showing appropriate vaccine storage in a designated refrigerator).
- Special care should be taken when bringing the vaccine to room temperature to ensure that the temperature of the vaccine does not exceed the specified range. An insulated container with an appropriate number of ice packs should be used to keep the temperature between 2 to 8 deg C.



Figure 1.2 Appropriate Vaccine Refrigeration and Storage



Note: Place containers of water (coloured, salted or plain), labelled "**Do NOT Drink**" in the shelves situated on the door. Extra ice packs or cold packs can also be stored in the freezer and lower compartment. Do not store food and drinks inside the refrigerator. A top-loading fridge is preferred to domestic refrigerator as it can preserve temperature for at least 72 hours.

- Reconstituted vaccine must be used within the recommended period, varying from 1-4 hours, according to the manufacturer's instructions. Single-dose containers are preferable. Once opened, multi-dose vials must not be kept after the end of the session and any unopened vaccine left unused must be discarded unless the temperature is at 2 to 8 °C at all times. The reason is that opened vaccines, especially live vaccines, may have reduced potency and there is also the risk of possible contamination. Thus, it is recommended that multi-dose vials be used for mass vaccination campaigns.
- Immunoglobulins should be stored in the original packaging at 2 to 8 °C and protected from light. Although these products have a tolerance of ambient temperatures (up to 25 °C) for up to one week, they should be refrigerated immediately on receipt.



- Unused vaccine, spent or partly spent vials, should be disposed of safely, preferably by heat inactivation or incineration. Contaminated waste and spillage should be dealt with appropriately with heat sterilisation, incineration or chemical disinfection.

Vaccine Combinations

This is becoming more common since it will reduce the number of injections and thus increase compliance. Examples of licensed combination vaccines are highlighted in the separate sections on the individual vaccines.

Problems of combination:

- Undesirable effects may be more frequent and worse.
- Reduced antibody response due to interference.

Multiple Vaccinations

Simultaneous administration on same day:

- No contraindications to simultaneous administration of live attenuated vaccines with inactivated or toxoid vaccines.
- The vaccines should never be mixed in the same syringe unless approved for mixing by the manufacturer.
- Separate sites should be used for different vaccines. If more than 1 vaccine must be administered in the same limb, the injection sites should be separated by 2.5-5.0cm so that any local reactions can be differentiated.
- The location of each injection should be documented in the patient's health record.

Interval between vaccines not administered simultaneously:

- There is no minimum interval between administration of inactivated or toxoid vaccines, or between inactivated and live attenuated vaccines.



- However, 2 or more live vaccines should either be given concurrently or separated by a minimum interval of 4 weeks.

Vaccines and Immunoglobulin preparations:

- If a vaccine and an immunoglobulin preparation are administered simultaneously, a separate anatomic site should be used for each injection.
- If the vaccine and the immunoglobulin preparation are not administered simultaneously, the vaccine and the immunoglobulin should be separated by a minimum interval (refer to Table 1.3 on page 28)

Table 1.3 Intervals Between Vaccines and Immunoglobulin Preparations Not Administered Simultaneously

Vaccine Products	Interval
Between live vaccine and immunoglobulin	2 weeks
Between immunoglobulin and live vaccine	3 months
Between inactivated vaccine and immunoglobulin	6 weeks

With the recent availability of 2 live vaccines not given by a parenteral route (live attenuated nasal influenza vaccine and oral rotavirus vaccine), the guidance to either administer the vaccines on the same day or at 4-week interval period should not be generalised to all live vaccines. Intervals between vaccines should be based only upon specific evidence for any interference of those vaccines.



Table 1.4 Intervals between live and non-live vaccines

Antigen Combinations	Recommended Interval between doses
Yellow Fever and MMR	Should not be administered on same day. They should be given ≥ 4 weeks part. If protection is required rapidly the vaccines may be given on the same day and an additional dose of MMR given at least 4 weeks later.
MMR, and chickenpox vaccine	Can be given on same day or ≥ 4 weeks apart
Non live vaccines	Can be given on same day or at any interval between doses.
Non live and live vaccines	Can be given on same day or at any interval between doses.

Spacing of Multiple Doses of the Same Antigen:

- Administration of doses of a multidose vaccine using intervals that are shorter than recommended might be necessary in certain circumstances, such as
 - » impending international travel,
 - » when a person is behind schedule on vaccinations but needs rapid protection.
- Administering a dose a few days earlier than the minimum interval is unlikely to have a substantially negative effect on the immune response.
- Vaccine doses administered ≤ 4 days (grace period) before the minimum interval are considered valid. Because of the unique schedule for rabies vaccine, the 4-day guideline does not apply to this vaccine.



- Doses of any vaccine administered ≥ 5 days earlier than the minimum interval should not be counted as valid doses and should be repeated. The repeat dose should be spaced after the invalid dose by the recommended minimum interval. Example: Hepatitis A vaccine
 - » If the first and second doses of hepatitis A vaccine were administered less than 6 months apart, the second dose is invalid and should be repeated 6 months after the invalid second dose.
 - » However, if this repeat dose (the third dose) is administered anytime 6 months or more after the first dose, the series can be considered complete.
- Regarding **lapsed vaccination schedule**, intervals between doses that are longer than recommended typically do not reduce final antibody concentrations, although protection might not be attained until the recommended number of doses has been administered. With some exceptions (e.g. oral typhoid vaccine) an interruption in the vaccination schedule does not require restarting the entire series of a vaccine or toxoid or addition of extra doses.

Interchangeability of Formulations:

- A combination vaccine may be used interchangeably with monovalent formulations and other combination products with similar component antigens produced by the same manufacturer to continue the vaccination series.
- For example, DTaP, DTaP-IPV/Hib, and DTaP-HepB-IPV vaccines that contain similar acellular pertussis (aP) antigens from the same manufacturer may be used interchangeably.

Interchangeability of Combination Vaccines from different manufacturers:

- It is preferable that doses of vaccine in a series come from the same manufacturer.
- If this is not possible or if the manufacturer of doses given previously is unknown, providers should administer the vaccine that they have available.



Adverse Event Following Immunisation (AEFI)

- An adverse event following immunisation (AEFI) is any untoward medical occurrence which follows immunisation, and which does not necessarily have a causal relationship with the usage of the vaccine. The adverse event may be any unfavourable or unintended sign, abnormal laboratory finding, symptoms or disease.
- Reported adverse events can either be true adverse events, ie, really a result of the vaccine or immunisation process, or coincidental events that are not due to the vaccine or immunisation process but are temporally associated with immunisation.
- A serious event is defined by the World Health Organization (WHO) as resulting in death, requires hospitalisation or prolongation of existing hospitalisation, persistent or significant disability, life-threatening or causing congenital abnormalities.
- Malaysia has an established AEFI reporting system managed by the National Pharmaceutical Regulatory Agency (NPRA), Ministry of Health, which is responsible for monitoring the safety of registered vaccines. Reporting AEFI allows NPRA to continuously monitor the safety profile of vaccines and ensure that the benefits of vaccination outweigh the potential risks.



Methods Of Reporting



Kindly report AEFI through only ONE channel:



- PhIS version 1.7 & above* (for government facilities under Ministry of Health only), **OR**
- manual submission by mail/fax/e-mail by downloading the form via

this link:

<https://www.npra.gov.my/index.php/en/health-professionals/reporting-adr.html>



All manual forms to be submitted via the following mode:

a. through mail to:

NATIONAL CENTRE FOR ADVERSE DRUG REACTIONS MONITORING
National Pharmaceutical Regulatory Agency Lot 36, Jalan Prof Diraja
Ungku Aziz, 46200 Petaling Jaya, Selangor, Malaysia **OR**

b. by email: fv@npra.gov.my

Repeated submission using multiple channels is NOT necessary.

**Note: If your facility is equipped with PhIS version 1.7 & above, your PhIS ADR report will be automatically pushed to NPRA. For any enquiries related to PhIS reporting, please contact PhIS Helpdesk.*

The National Pharmaceutical Regulatory Agency has developed an Adverse Drug Reaction (ADR) / Adverse Event Following Immunisation (AEFI) Reporting Manual for Healthcare Providers, which is available on the official NPRA website for further reference.



References

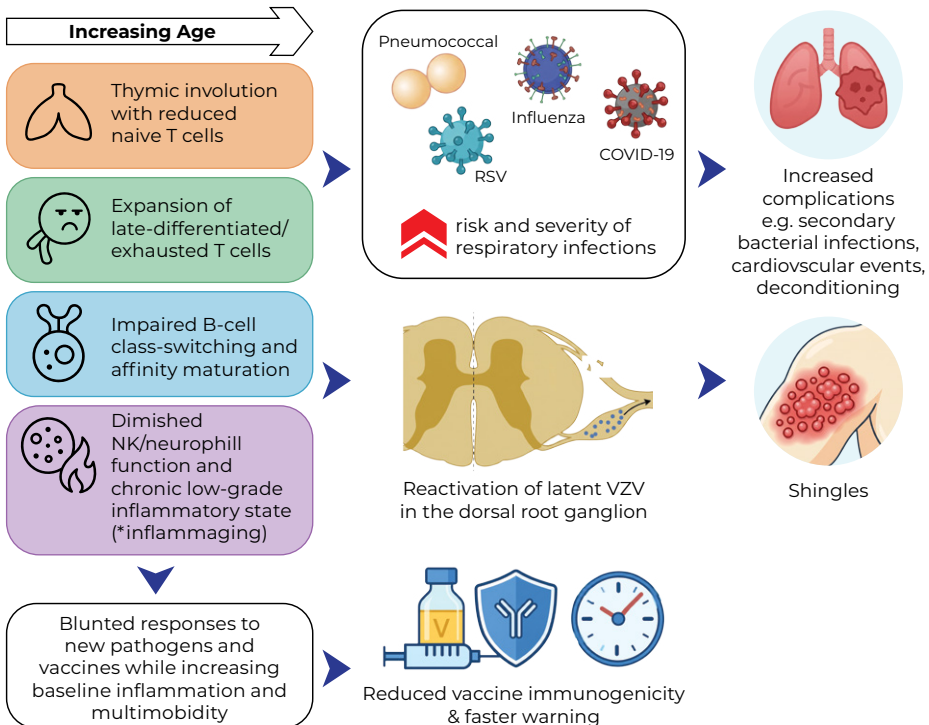
1. Advisory Committee on Immunization Practices. (2025) *Recommended Adult Immunization Schedule for Ages 19 Years or Older*. U.S. Centre for Disease Control (revised Oct 07, 2025). <https://www.cdc.gov/vaccines/hcp/imz-schedules/downloads/adult/adult-combined-schedule.pdf>
2. Australian Society of Clinical Immunology and Allergy (Updated July 18, 2025) Guidelines on Vaccination of the *egg-allergic individual*. Retrieved 23 November 2025 from www.allergy.org.au
3. Dreskin, S.C., Halsey, N.A., Kelso, J.M., et al. (2016). International Consensus (ICON): allergic reactions to vaccines. *World Allergy Organization Journal*, 9(1):32. DOI: 10.1186/s40413-016-0120-5
4. Epidemiology and Prevention of Vaccine-Preventable Diseases (14th ed) 2021 Retrieved 23 November 2025, from https://www.cdc.gov/pinkbook/hcp/table-of-contents/?CDC_AAref_Val=https://www.cdc.gov/vaccines/pubs/pinkbook/
5. Kroger, A., Bahta, L., Long, S., Sanchez, P. (2017). *General Best Practice Guidelines for Immunization. Best Practices Guidance of the Advisory Committee on Immunization Practices (ACIP)* <https://www.cdc.gov/vaccines/hcp/acip-recs/general-recs/downloads/general-recs.pdf>
6. Center for Disease Control (March 2024). Vaccine Storage and Handling Toolkit. Section Three: Vaccine Storage and Temperature Monitoring Equipment. <https://www.cdc.gov/vaccines/hcp/downloads/storage-handling-toolkit.pdf>
7. Mary Ramsay (Ed). Immunisation against Infectious Diseases (2021). *Chapter 2 General Immunisation Procedures*. Updated August 2022. Public Health England. <https://assets.publishing.service.gov.uk/media/6196386dd3bf7f054f43e02d/Greenbook-cover-Nov21.pdf>
8. WHO (Oct 2019). Immunization stress-related response: a manual for program managers and health professionals to prevent, identify and respond to stress-related responses following immunization. <https://www.who.int/publications/item/9789241515948>



Definition and Biological Mechanisms

Immunosenescence refers to a gradual decline in immune function with increasing age. The biological mechanisms associated with this include thymic involution with reduced naïve T cells, expansion of late-differentiated or exhausted T cells, impaired B-cell class switching and affinity maturation, diminished NK or neutrophil function, and a chronic low-grade inflammatory state (“inflammaging”). Together, these changes blunt responses to new pathogens and vaccines while increasing baseline inflammation and multimorbidity.

Immunosenescence





Clinical Consequences



Immunosenescence increases the risk and severity of respiratory infections (e.g., influenza, pneumococcus, RSV, COVID-19), reactivation of latent infections (e.g., herpes zoster), and certain complications (e.g., secondary bacterial pneumonia, cardiovascular events following respiratory infections). It also contributes to reduced vaccine immunogenicity and faster waning.



Malaysia and the Region: Why This Is Urgent

Malaysia is ageing. The proportion of people ≥ 65 years rose from 4.0% (2000) to 7.2% (2022) and is projected to keep rising through 2030–2040; several states already have $\geq 7\%$ of their population aged ≥ 65 years. This demographic shift will expand the proportion of individuals biologically susceptible to immunosenescence and its consequences.

Vaccine Responsiveness in the Context of Immunosenescence

Because of impaired innate sensing, T-helper cell and B-cell function, conventional vaccines can elicit lower peak titres and shorter durability in older adults. Strategies that partly overcome this include:

1. Higher antigen dose (e.g., high-dose inactivated influenza vaccine).
2. Adjuvanted formulations that recruit innate pathways (e.g., MF59-adjuvanted influenza vaccines; AS01B-adjuvanted RZV).
3. Conjugate technology for polysaccharides (e.g., PCV15/PCV20), which drives T-cell-dependent memory.

Randomised and real-world studies show that high-dose/adjuvanted influenza vaccines reduce influenza-related outcomes in older adults compared with standard-dose vaccines, and that modern pneumococcal conjugate vaccines are immunogenic and effective in older adults.



Implications for the Malaysian Adult Immunisation Guidelines

1. Prioritise older adults (≥ 60 –65 years) and those with multimorbidity, frailty, or immunocompromising conditions, who experience the most pronounced effects of immunosenescence.
2. **Influenza:** recommend annual vaccination, with preference for enhanced formulations (high-dose or adjuvanted) where available and affordable, given their superior protection in older adults and Malaysia's demonstrated burden.
3. **Pneumococcal:** adopt conjugate-based schedules for adults age ≥ 65 and for younger adults with risk conditions, with consideration of sequential strategies depending on product availability and evolving evidence. Malaysian mortality data in seniors argue for proactive uptake.
4. **Herpes zoster:** recommend RZV (2 doses) for adults age ≥ 50 (including immunocompromised where allowed), given sustained efficacy and regional burden projections that include Malaysia.
5. **Additional doses:** continue COVID-19 vaccination programmes, Td/Tdap every 10 years, and hepatitis B catch-up for non-immune risk groups.
6. **Implementation levers:** increase access and uptake (through public funding for priority groups, integration into chronic disease clinics, pharmacy vaccination, and seasonal campaigns) to counter historically low adult vaccine coverage in the region.



References

1. Aw, D., Silva, A. B., & Palmer, D. B. (2007). Immunosenescence: emerging challenges for an ageing population. *Immunology*, 120(4), 435–446. <https://doi.org/10.1111/j.1365-2567.2007.02555.x>
2. Montgomery, R. R., & Shaw, A. C. (2015). Paradoxical changes in innate immunity in aging: recent progress and new directions. *Journal of Leukocyte Biology*, 98(6), 937–943. <https://doi.org/10.1189/jlb.5MR0315-104R>
3. Mad Tahir, N. S., Ismail, A., Aljunid, S. M., Abdul Aziz, A. F., Azzeri, A., & Alkhodary, A. A. (2023). Estimating the economic burden of influenza on the older population in Malaysia. *PloS one*, 18(11), e0294260. <https://doi.org/10.1371/journal.pone.0294260>
4. Sundaramurthy, S. S. R., Allen, K. E., Fletcher, M. A., Liew, K. F., Borhanuddin, B., Ali, M., Morales, G., Gessner, B., Naidoo, J., & Southern, J. (2024). Retrospective database analysis for clinical diagnoses commonly associated with pneumococcal diseases in the Malaysian healthcare system over a 3-year period (2013-2015). *BMC infectious diseases*, 24(1), 79. <https://doi.org/10.1186/s12879-023-08611-3>
5. Han, R., San Martin, P., Ahmed, N., Guzman-Holst, A., Mohy, A., Pinto, T., de Veras, B., Gomez, J. A., Bibera, G. L., & van Oorschot, D. A. M. (2024). Modelling the Public Health Burden of Herpes Zoster and the Impact of Adjuvanted Recombinant Zoster Vaccine in Five Selected Countries in Southeast Asia. *Infectious Diseases and Therapy*, 13(4), 761–778. <https://doi.org/10.1007/s40121-024-00945-y>
6. Doherty, T. M., Connolly, M. P., Del Giudice, G., Flamaing, J., Goronzy, J. J., Grubeck-Loebenstien, B., Lambert, P. H., Maggi, S., McElhaney, J. E., Nagai, H., Schaffner, W., Schmidt-Ott, R., Walsh, E., & Di Pasquale, A. (2018). Vaccination programs for older adults in an era of demographic change. *European Geriatric Medicine*, 9(3), 289–300. <https://doi.org/10.1007/s41999-018-0040-8>



Introduction

Cholera is a rapidly dehydrating diarrhoeal disease, caused by the toxigenic serogroups O1 and O139 of *Vibrio cholerae*, that is a gram-negative, curve-shaped rod, mainly waterborne bacterium. The primary mode of transmission is through the ingestion of contaminated food and water.

After an incubation period of a few hours to 5 days, up to 25% may develop symptoms. Approximately 10-20% of those who develop symptoms experience severe disease, characterized by acute, profuse watery diarrhoea (“rice water stools”), usually with vomiting, leading to rapid dehydration. Untreated cholera can lead to severe dehydration, hypovolemic shock, and death within hours.

Between January 1 and November 24, 2024, a total of 733,956 cholera cases and 5,162 fatalities were reported across 33 countries spanning five WHO regions. The incidence of cholera cases and related mortality in November 2024 exhibited 37% and 27% increases, respectively, compared to the same period in 2023.

In Malaysia, cholera remains endemic, with an incidence rate ranging from 0.02 to 0.35 per 100,000 population over the past five years (2020–2024). No recent cholera-related fatalities have been reported, with the last recorded outbreak occurring in Sabah in 2020.

Table 3.1 Vaccines Registered in Malaysia

No.	Name	PRH/ Manufacturer	Type
1.	Euvichol-Plus®	Averroes Pharmaceuticals Sdn. Bhd. / EuBiologics Co., Ltd., South Korea	Oral cholera vaccine (OCV) containing: killed modified whole cell bivalent (O1 and O139) vaccines without the B subunit (WC)



Table 3.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Travellers to cholera-affected areas	<u>Euvichol-Plus</u> • Two oral doses, using single dose vials, 2 weeks apart. • Protection begins 7–10 days after completing primary series. • No current recommendation on routine booster doses.
2.	During cholera outbreaks	
3.	During humanitarian crises with high risk of cholera	
NOTE: Cholera vaccination is a complementary cholera prevention and control measure, which can be implemented in the short-to-medium term.		

Implication for Healthcare Workers (HCWs)

The vaccine is not routinely recommended for HCWs in non-endemic settings.

Evidence of Safety and Efficacy

OCV has shown a good safety profile. Common side effects are mild, including headache, fever, diarrhea, and vomiting.

The vaccine effectiveness of two doses of the modified bivalent killed whole-cell only vaccines (WC) against medically attended cholera was 79% for those aged ≥ 5 years



References

1. Malaysian National Centre of Adverse Drug Reactions database (n.d). <https://npra.gov.my/>
2. Ministry of Health of Malaysia (MOH) (2023). Health facts: *Incidence rate and mortality rate of communicable diseases*. https://www.moh.gov.my/moh/resources/Penerbitan/Penerbitan%20Utama/4_Health_Facts_2023-compressed_.pdf
3. World Health Organization. (December 8, 2024). *Multi-country outbreak of cholera: External situation report no. 21*. <https://www.who.int/publications/m/item/multi-country-outbreak-of-cholera--external-situation-report--21---18-december-2024>
4. Centers for Disease Control and Prevention. (April 23, 2025). Cholera. In CDC Yellow Book 2026: Health information for international travel. <https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/cholera.html>
5. World Health Organization. (n.d.). *Prequalification of medical products: Euvichol-R (Effective as of 2024)*. <https://extranet.who.int/prequal/vaccines/p/euvichol-r-s>
6. Khanam, F., Islam, M.T., Ahmmed, F., et al. (2025). Evaluation of oral cholera vaccine (Euvichol-Plus) effectiveness against *Vibrio cholerae* in Bangladesh: an interim analysis. *BMJ Global Health*, 10(2), e016571. <https://doi.org/10.1136/bmjgh-2024-016571>



Introduction



COVID-19 is caused by SARS-CoV-2 virus, a single-stranded RNA virus from the genus *Betacoronavirus* of the *Coronaviridae* family. SARS-CoV-2 is primarily spread through respiratory droplets and aerosols and from direct person-person contact. The virus can persist in respiratory secretions for 7-12 days after symptom onset, and viral loads are highest soon after symptom onset.

Common symptoms include headache, fatigue, cough, and muscle aches. Severe cases of the disease can lead to pneumonia, acute respiratory distress syndrome (ARDS), and multi-organ failure. A long-term complication, known as Long COVID, involves symptoms persisting 12 to 16 weeks after the initial infection.

In Malaysia, more than 5 million cases were reported with 37,000 deaths in June 2025.

Table 4.1 Vaccines Registered in Malaysia

No.	Name	PRH/ Manufacturer	Type
1.	Comirnaty®	Pfizer (Malaysia Sdn. Bhd. / BioNTech Manufacturing GmbH (Germany)	mRNA vaccine containing Omicron KP.2 (LP.8.1) COVID-19 strain.

In Malaysia, following the transition to endemicity of COVID-19 since January 2023, MySejahtera app has been utilised for healthcare information, infectious diseases tracking, health screening and appointments. The COVID-19 vaccination programme is now available in public health clinics.


Table 4.2 High-Risk Groups in Malaysia

No.	Vaccination status	Target group	Recommendation
1.	Never received COVID-19 vaccine	All adults	One IM dose
		Pregnant	One dose at any stage of pregnancy
		Immunocompromised	2-3 doses (4-8 weeks apart) Consult with healthcare practitioner on timing of vaccination when least immune compromised.
2.	Previously received at least one dose of COVID-19 vaccine	Adults >75 or 80 years old	Revaccinate 6-12 months after the most recent dose
		Adults >50 or 60 years old with co-morbidities	
		Immunocompromised	
		Adults >50 or 60 years old	Revaccinate 12 months after the most recent dose
		Adults with co-morbidities	
		Pregnant	Single dose in each pregnancy
		Healthy adults	Revaccination NOT routinely recommended.

Note:

Any individuals aged 6 months and above who has not been vaccinated before, and who wish to be vaccinated, can receive the up-to-date vaccine.

For COVID-19 vaccine additional dose, any individuals age 18 years and above and who wish to be vaccinated, may receive boosters at intervals of 12 months using the up-to-date vaccine.



Implication for Healthcare Workers (HCWs)



Never received COVID-19 vaccine



One dose of the COVID-19 vaccine is to be given for healthcare workers with direct contact with patients.

Previously received at least one dose of COVID-19 vaccine

An updated booster dose is recommended every 12 months for healthcare workers with direct contact with patients.

Evidence of Safety and Effectiveness

Recent evidence suggests that LP.8.1-adapted COVID-19 vaccines demonstrate improved immunogenicity and clinically meaningful effectiveness against currently circulating SARS-CoV-2 variants, particularly those within the JN.1 lineage.

Clinical data indicate that LP.8.1-adapted mRNA vaccines are associated with increased protection against severe COVID-19 outcomes caused by currently circulating variants. Early effectiveness estimates from the 2025–2026 vaccine formulation report approximately 54–57% protection against hospital visits due to COVID-19 shortly after vaccination, supporting moderate real-world effectiveness in the context of ongoing viral evolution. However, neutralizing antibody titres against heterologous variants may be modestly reduced compared with the homologous strain, highlighting the continued need for periodic vaccine updates.

COVID-19 vaccines are generally safe and well-tolerated. Adverse events associated with vaccines have been generally rare, and the benefits of vaccination have far outweighed the risks.

With regards to myocarditis occurring one week after the second dose of mRNA vaccine, the overall incidence is very low - typically 0.3-1.9 cases per 100,000 doses in young adults, especially among males under 30 years old. Most of the cases are mild with symptoms of chest discomfort, followed by full recovery.



References

1. Link-Gelles, R., Chickery, S., Webber, A., et al. Interim Estimates of 2024–2025 COVID-19 Vaccine Effectiveness Among Adults Aged ≥18 Years — VISION and IVY Networks, September 2024–January 2025. (2025). *MMWR Morb Mortal Wkly Rep*, 74:73–82. <http://dx.doi.org/10.15585/mmwr.mm7406a1>
2. World Health Organization. (19 July 2023). *Interim recommendations for the use of mRNA COVID-19 vaccines*. <https://www.who.int/publications/i/item/WHO-2019-nCoV-vaccines-SAGE-recommendation-mRNA-2023.1>
3. Witberg, G., Barda, N., Hoss, S., et al. (2021). Myocarditis after Covid-19 Vaccination in a Large Health Care Organization. *The New England Journal of Medicine*, 385(23), 2132–2139. <https://doi.org/10.1056/NEJMoa2110737>
4. Guo, B. Q., Li, H. B., & Yang, L. Q. (2023). Incidence of myopericarditis after mRNA COVID-19 vaccination: A meta-analysis with focus on adolescents aged 12-17 years. *Vaccine*, 41(28), 4067–4080. <https://doi.org/10.1016/j.vaccine.2023.05.049>
5. World Health Organization. (October 8, 2024). *WHO advice for the public on COVID-19 vaccines*. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines/advice>
6. Centers for Disease Control and Prevention. (November 4, 2025). *Routine COVID-19 vaccination guidance*. <https://www.cdc.gov/covid/hcp/vaccine-considerations/routine-guidance.html>
7. Centers for Disease Control and Prevention. (November 4, 2025). *COVID-19 Vaccination Guidance for People Who Are Immunocompromised*. <https://www.cdc.gov/covid/vaccines/immunocompromised-people.html>
8. Appaneal, H. J. (2026). Early effectiveness of the BNT162b2 LP.8.1 vaccine against COVID-19 emergency department, urgent care, and outpatient visits in the US Veterans Affairs. medRxiv. <https://doi.org/10.64898/2026.01.22.26344618>



Introduction

The dengue virus (DENV) belongs to the genus *Flavivirus* within the family *Flaviviridae*. Flaviviruses are lipid-enveloped, single-stranded RNA viruses. Dengue is a vector-borne disease transmitted primarily by *Aedes aegypti* and *Aedes albopictus* mosquitoes and caused by the four dengue virus serotypes (DENV 1-4).

Since 2009, WHO classifies dengue illness as: i) dengue without warning signs for progression towards severe dengue; ii) dengue with warning signs for progression towards severe dengue; and iii) severe dengue. Warning signs of severe dengue include abdominal pain or tenderness, persistent vomiting, clinical fluid accumulation, mucosal bleeding, lethargy or restlessness, liver enlargement of >2 cm, or an increase in haematocrit concurrent with a rapid decrease in platelet count. Criteria for severe dengue include any sign of severe plasma leakage leading to shock or fluid accumulation with respiratory distress, severe bleeding, or severe organ impairment.

DENV is endemic in South and Central America, Southeast Asia, and Sub-Saharan Africa. Approximately half of the world is at risk of dengue, which is estimated to cause 400 million infections and 20,000 deaths globally each year. The majority of people living in high endemic areas have been infected by at least one strain of dengue virus by the time they reach adolescence. About 75% of dengue infections could be asymptomatic. In Malaysia in 2024, the cumulative number of 122,423 dengue cases with 117 deaths was reported. The outbreak of dengue occurred in a 4-to-5-year cyclical pattern, following the shift in circulating dengue virus serotypes.

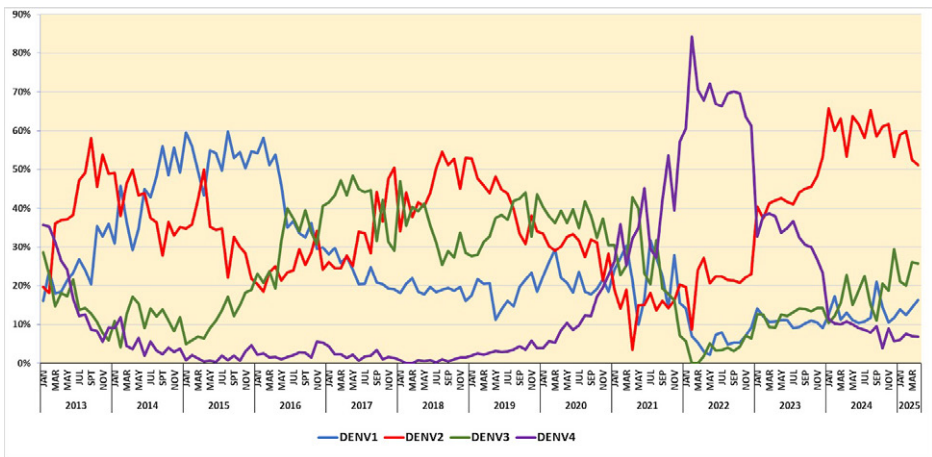
The prevalence of individual serotypes varies across different regions, countries, seasons and over time. Dengue outbreaks are associated with serotype shifts. Dengue cases and serotypes in Malaysia (2013–2024) are shown in Figure 2. A shift in dominance of DENV1 occurred in 2014–2015, followed by DENV2 dominance in 2017–2018. In year 2021, there was a shift in dominance of DENV4 serotype in the country and DENV2 became dominant again in 2023–2025.



Recovery from infection by one serotype provides prolonged immunity against that serotype only, and subsequent infections by heterologous serotypes give rise to the potential immunopathology of severe dengue due to antibody-dependent enhancement. Patients with a second dengue infection with a different serotype are at increased risk of severe dengue. One of the challenges to the development of a dengue vaccine is that it must induce immunity to all 4 serotypes.

With the increasing disease burden and economic modelling supporting the introduction of dengue vaccination, one model suggests that routine vaccination starting at age 7 could reduce symptomatic cases by 34–42% and hospitalisations by 38–47%, resulting in savings of approximately RM 4 billion over 30 years from 2025.

Figure 5.1 Dengue cases and serotypes in Malaysia (2013–mid-2025)



Source: *Annual Dengue Serotype Surveillance Report (2013–2025)*. Ministry of Health Malaysia (KKM)



Table 5.1 Vaccines Registered in Malaysia

No.	Name	PRH/ Manufacturer	Type
1.	QDenga® (TAK-003)	Takeda Malaysia Sdn Bhd/ Takeda GmbH (Germany)	Live attenuated, tetravalent vaccine (based on DENV2 PDK53 with chimeric DENV1, DENV3, DENV4 on DENV2 backbone)

Table 5.2 High-Risk Groups in Malaysia

No.	Target group	Recommendation
1.	WHO recommends for countries with high dengue burden ($\geq 80\%$ seroprevalence by age 16 years). In Malaysia: • Age 4 years and above • Especially in high transmission settings regardless of prior dengue infection	0.5 mL dose in a 2-dose schedule (at 0 and 3 months) by subcutaneous administration, preferably in the upper arm (deltoid region).

Implication for Healthcare Workers (HCWs)

There are no specific recommendations for dengue vaccine for HCWs.



Evidence of Safety and Effectiveness



Evidence of Efficacy



- Vaccine efficacy (VE) data for the TAK-003 vaccine were derived from the Phase III Tetravalent Immunization against Dengue Efficacy Study (TIDES), conducted from 2016 and followed up until 2023. This double-blind, randomised, placebo-controlled trial involved 20,099 participants aged 4–16 years across 8 dengue-endemic countries.
- Overall efficacy against virologically confirmed dengue (VCD) was 80.2% (95% CI: 73.3–85.3%) during the first year after the second dose.
- Hospitalisation prevention: 90.4% efficacy at 18 months following the second dose.
- The vaccine maintained an efficacy of 61.2% against VCD 84.1% against VCD leading to hospitalisation for up to approximately 4.5 years after the second dose
- Vaccine efficacy varied by dengue serotype, with evidence suggesting lower efficacy against DENV-3 in seronegative individuals.
- The vaccine's efficacy in adults is supported by immunobridging studies, in which immune responses (antibody levels and T-cell responses) in adults were compared to those observed in the populations included in the pivotal trials.

Undesirable Effects and Safety

The most frequent TAK-003 vaccine-related unsolicited adverse events were injection site pruritus (0.7%), bruising (0.6%) and pyrexia (0.2%)

Due to insufficient safety data, the vaccine should be avoided in pregnant and lactating women and immunocompromised persons, including those with symptomatic HIV infection or asymptomatic infection associated with evidence of impaired immune function.

QDenga® vaccine was approved conditionally by the Drug Control Authority (DCA) in Malaysia on 9th February 2024. The conditional approval



means that the vaccine's safety and efficacy were evaluated. In the 416th PBKD meeting held on 8 January 2026, QDenga® was approved again for the conditional re-registration for a period of two (2) years, effective from 9 February 2026. QDenga® has been generally well tolerated, with no evidence of disease enhancement in vaccine recipients and no important safety risks have been identified, to date.

References

1. Ministry of Health Malaysia. (2024). *Media release on the current situation of dengue in 2024*. https://www.moh.gov.my/index.php/database_stores/store_view_page/17/2599
2. CodeBlue. (September 13, 2024). *National dengue vaccination programme may save Malaysia RM4 billion over three decades*, citing Dr. Azzeri's modeling data presented in Kuala Lumpur. <https://codeblue.galencentre.org/2024/09/national-dengue-vaccination-programme-may-save-malaysia-rm4-billion-over-three-decades/>
3. Percio, J., Kobayashi, C. D., Silva, R. M. A., et al (2024). Safety signal detected: Anaphylaxis after attenuated dengue vaccine (TAK-003) - Brazil, March 1, 2023-March 11, 2024. *Vaccine*, 42(26), 126407. <https://doi.org/10.1016/j.vaccine.2024.126407>
4. World Health Organization. (2025). *Update on safety of the dengue vaccine Qdenga*. Global Advisory Committee on Vaccine Safety. <https://www.who.int/groups/global-advisory-committee-on-vaccine-safety/topics/dengue-vaccines>
5. Biswal, S., Borja-Tabora, C., Martinez, E., et al (2020). Efficacy of a tetravalent dengue vaccine in healthy children aged 4–16 years: A randomized, placebo-controlled, phase 3 trial. *The Lancet*. Advance online publication. [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(20\)30414-1/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)30414-1/fulltext)
6. Biswal, S., Reynales, H., Saez-Llorens, X., et al., for the TIDES Study Group (2019). Efficacy of a Tetravalent Dengue Vaccine in Healthy Children and Adolescents. *The New England Journal of Medicine*, 381(21), 2009–2019. <https://doi.org/10.1056/NEJMoa1903869>
7. Tricou, V., Winkle, P. J., Tharenos, L. M., et al (2023). Consistency of immunogenicity in three consecutive lots of a tetravalent dengue vaccine candidate (TAK-003): A randomized placebo-controlled trial in US adults. *Vaccine*, 41(47), 6999–7006. <https://doi.org/10.1016/j.vaccine.2023.09.049>
8. Dengue Prevention Advocacy Malaysia (DPAM). (2025). *Position paper on dengue vaccine*. https://denguepreventionadvocacy.my/wp-content/uploads/2025/06/UPDATED-eBook_Position-Paper-on-Dengue-Vaccination.pdf
9. World Health Organization (May 3, 2024). WHO position paper on dengue vaccines (May 3, 2024). *Weekly Epidemiological Record*, 99(18):203-224.



Introduction



Diphtheria is an acute, respiratory infection caused by *Corynebacterium diphtheriae*, a gram-positive bacterium. The causative organism produces a potent exotoxin responsible for localised tissue destruction and formation of pseudomembrane in the upper respiratory tract. While the organism itself is rarely invasive, the exotoxin produced by toxigenic strains can exert both local and systemic effects. Haematogenous dissemination of the toxin may lead to serious complications, such as myocarditis and neuritis. Pharyngeal diphtheria, the most common manifestation, can result in acute and potentially life-threatening airway obstruction.

The disease is transmitted primarily through respiratory droplets and by direct contact with skin lesions or contaminated objects. Infection most often occurs following close contact with symptomatic patients or asymptomatic carriers. Notably, individuals with natural or vaccine-induced immunity may still harbour the organism and contribute to its spread.

In Malaysia, diphtheria incidence declined markedly after the introduction of routine childhood immunisation. Since 2016, diphtheria cases in Malaysia peaked and later declined, reaching their lowest during the COVID-19 pandemic. However, numbers began to rise again after 2022, showing a continuing upward trend.



Table 6.1 Vaccines Registered in Malaysia

No.	Name	PRH/ Manufacturer	Type
1.	Adacel	Sanofi Aventis (M) Sdn Bhd/ Sanofi Winthrop Industrie, France	Tdap; Tetanus-diphtheria-acellular pertussis
2.	Boostrix	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Tdap; Tetanus-diphtheria-acellular pertussis

Notes

- The pertussis vaccine is available in an acellular form, combined with diphtheria and tetanus vaccines.
- Tdap is recommended for adolescents and adults and contains lower doses of diphtheria and pertussis compared with the children's DTaP.
- Uppercase letters (T) indicate full-strength components; lowercase "d" and "p" indicate reduced doses. The "a" in Tdap stands for acellular, meaning it uses parts of the pertussis bacterium.

Table 6.2 High-Risk Groups in Malaysia

No.	Target group	Recommendation
1.	Adults without full primary vaccination	Complete the series with Tdap or Td
2.	Adults ≥10 years since last dose	Receive Tdap, then a Td booster every 10 years
3.	Recovered diphtheria patients	Individuals still need to complete the full immunisation schedule, as the disease does not provide immunity



No.	Target group	Recommendation
4.	Close contacts	• If <3 doses or vaccination status unknown → give an immediate dose and complete the primary series. • If ≥3 doses have been completed but >5 years have passed since last vaccination → administer a booster dose appropriate for age
5.	Pregnant women	Offer Tdap between 16 and 36 weeks* of each pregnancy (only acellular pertussis-containing vaccine is licensed for use)

**in accordance to Malaysian Maternal Immunisation Consensus Guidelines (2024)*

Implication for Health Care Workers (HCWs)

Regardless of age, all HCWs should receive a single dose of Tdap, as soon as feasible, if they have not previously received it. Tdap can be administered regardless of the interval since the last tetanus- or diphtheria-containing vaccine. Td boosters are advocated every 10 years thereafter.

Evidence of Safety & Effectiveness

Childhood immunisation provides protection against diphtheria, but immunity wanes with age. By middle age, about half of those not revaccinated since childhood have antibody levels too low (<0.1 IU/ml) to ensure protection. A single booster dose in adults can restore protective levels within six weeks, but these antibodies also decline over time; about 25% lose protection within 2–6 years, and levels often return to near baseline by 5–6 years. This highlights the importance of regular booster doses to maintain protection and herd immunity.



References

1. Centers for Disease Control and Prevention. (2020). Use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccines: Updated recommendations of the Advisory Committee on Immunization Practices — United States, 2019. *Morbidity and Mortality Weekly Report*, 69(3), 77–83. <https://www.cdc.gov/mmwr/volumes/69/wr/mm6903a5.htm>
2. Gao, H., Lau, E. H., & Cowling, B. J. (2022). Waning immunity after receipt of pertussis, diphtheria, tetanus, and polio-related vaccines: a systematic review and meta-analysis. *The Journal of Infectious Diseases*, 225(4), 557–566. <https://doi.org/10.1093/infdis/jiab480>
3. Havers, F. P., Moro, P. L., Hunter, P., Hariri, S., & Bernstein, H. (2020, January 24). Use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccines: Updated recommendations of the Advisory Committee on Immunization Practices — United States, 2019. *Morbidity and Mortality Weekly Report*, 69(3), 77–83. <https://doi.org/10.15585/mmwr.mm6903a5>
4. Obstetrical & Gynaecological Society of Malaysia. (2024). *Malaysian Maternal Immunisation Consensus Guidelines*. <https://ogsm.org.my/docs/Maternal-Immunisation-Guidelines.pdf>
5. National Pharmaceutical Regulatory Agency (NPRA) *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
6. World Health Organization. (2025). *Diphtheria reported cases and incidence*. <https://immunizationdata.who.int/global/wiise-detail-page/diphtheria-reported-cases-and-incidence?CODE=MYS&YEAR=>



Introduction

Tetanus is caused by *Clostridium tetani*, a spore-forming bacterium that produces two potent toxins: tetanospasmin (an alpha-neurotoxin responsible for muscle spasms and rigidity) and tetanolysin (an alpha-haemolysin that damages local tissues). Infection usually occurs when spores enter the body through wounds, lacerations, or penetrating injuries.

In Malaysia, tetanus has remained at a consistently low incidence, with only slight year-to-year variation. The case fatality rate is highest among infants and older adults, reaching up to 10–20% even with modern healthcare. Individuals over 60 years of age face greater risk of both infection and mortality, particularly if their immunisation is incomplete or immunity has waned. As tetanus can arise from even minor injuries, active immunisation is crucial for protection. A booster every 10 years is sufficient to maintain long-term immunity, and additional doses are unnecessary after each injury. For wound management, tetanus toxoid or tetanus immunoglobulin should be administered only if vaccination status is incomplete or uncertain, particularly in high-risk or contaminated wounds.

Table 7.1 Vaccines Registered in Malaysia

No.	Name	PRH/ Manufacturer	Type
1.	TT Vaccine®	PRH: Propharm (M) Sdn Bhd/ PT Bio Farma, Indonesia	Adsorbed tetanus vaccine
2.	SII Tetanus Toxoid Vaccine Adsorbed®	SM Pharmaceuticals Sdn Bhd/ Serum Institute of India, India	Adsorbed tetanus vaccine



No.	Name	PRH/ Manufacturer	Type
3.	Adacel®	Sanofi Aventis (M) Sdn Bhd/ Sanofi Pasteur, France	Tdap; Tetanus-diphtheria-acellular pertussis
4.	Boostrix	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Tdap; Tetanus-diphtheria-acellular pertussis

Table 7.2 High-Risk Groups in Malaysia

No.	Target group	Recommendation
1.	General population	- Adults who have never been vaccinated or whose status is unknown should receive the complete 3-dose primary series: » 1 dose of Tdap, followed by » 2 doses of Td at appropriate intervals - Adults who have not completed the primary diphtheria–tetanus series should finish the remaining dose, ensuring 1 dose is Tdap. - A Td or Tdap booster is recommended every 10 years - Individuals who have recovered from tetanus still require full vaccination, as natural infection does not confer lasting immunity.



No.	Target group	Recommendation
2.	Pregnant women	- Tdap is recommended during each pregnancy, ideally between 16 and 36* weeks gestation, regardless of previous Tdap history. - If tetanus vaccination status is incomplete or unknown: - Administer a 3-dose series, starting at quickening (second trimester). - Repeat Tdap 4 weeks after the first dose
3.	Wound Management	- For tetanus-prone wounds, such as: - Compound fractures - Animal or human bites - Wounds contaminated by soil, faeces, or saliva - Deep or puncture wounds - Wounds with extensive tissue damage or necrosis Post-exposure prophylaxis should be guided by immunisation history and wound type (refer to Table 7.3)

**in accordance to Malaysian Maternal Immunisation Consensus Guidelines (2024)*

Post-exposure Prophylaxis and Treatment

For wound management, the need for active immunisation, with or without passive immunisation, depends on the condition of the wound and the patient’s vaccination history (refer to Table 7.3).



Table 7.3 Guide to Tetanus Prophylaxis in Wound Management

History of Tetanus Vaccination	Time since the last dose	Type of Wound	Tdap or Td	Tetanus Immunoglobulin (TIG)*
>3 doses	<5yrs	Minor clean wound	No	No
		All other wounds†	No	No [#]
>3 doses	5-10 yrs	Minor clean wound	No	No
		All other wounds†	Yes	No [#]
>3 doses	>10 yrs	Minor clean wound	Yes	No
		All other wounds†	Yes	No [#]
<3 doses or uncertain [§]		Minor clean wound	Yes	No
		All other wounds†	Yes	Yes

Notes:

* The recommended dose for TIG is 250IU, given by IM injection, as soon as practicable after the injury. If more than 24 hours have elapsed, 500IU should be given. Because of its viscosity, TIG should be given to adults using a 21-gauge needle.

† All wounds other than minor clean wounds should be considered 'tetanus-prone'.

Individuals with humoral immune deficiency (including HIV-infected persons who have immunodeficiency) should be given TIG if they have received a tetanus-prone injury, regardless of the time since their last dose of tetanus-containing vaccine.

§ Individuals who have no documented history of a primary vaccination course (3 doses) with a tetanus toxoid-containing vaccine should receive all missing doses and must receive TIG.

In summary, for clean and minor wounds, administer Tdap or Td if more than 10 years have passed since the last dose of the tetanus-toxoid-containing vaccine; for all other wounds, administer Tdap or Td if more than 5 years have passed since the last dose of the tetanus-toxoid-containing vaccine. For pregnant women, Tdap is recommended. Tdap is also preferred for persons who have not previously received Tdap or whose Tdap history is unknown. For others who have already received Tdap before, either Td or Tdap can be given.

Implication for Healthcare Workers (HCWs)



A dose of Tdap is recommended to be administered as soon as feasible to all health care workers who have not received Tdap previously. Td or Tdap boosters are advocated every 10 years thereafter.



Evidence of Safety and Effectiveness

The tetanus vaccine contains a toxoid that stimulates the production of antitoxin antibodies, providing protection against the toxin produced by *Clostridium tetani*, though it does not prevent bacterial growth. Complete immunisation (3 primary doses and 2 booster doses) induces protective levels of antitoxin throughout childhood and into adulthood. By middle age, however, immunity may wane in about 50% of individuals. In such cases, a single booster dose reliably induces a rapid and robust anamnestic response.

References

1. Centers for Disease Control and Prevention. (2025). *Tetanus vaccine recommendations*. Retrieved July 31, 2025, from <https://www.cdc.gov/tetanus/hcp/vaccine-recommendations/index.html>
2. Centers for Disease Control and Prevention. (2023, April 25). Chapter 21: *Tetanus*. In *Epidemiology and Prevention of Vaccine-Preventable Diseases* (14th ed.). National Center for Immunization and Respiratory Diseases. Retrieved from <https://www.cdc.gov/pinkbook/hcp/table-of-contents/chapter-21-tetanus.html>
3. Havers, F. P., Moro, P. L., Hunter, P., Hariri, S., & Bernstein, H. (2020, January 24). Use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccines: Updated recommendations of the Advisory Committee on Immunization Practices — United States, 2019. *Morbidity and Mortality Weekly Report*, 69(3), 77–83. <https://doi.org/10.15585/mmwr.mm6903a5>
4. National Pharmaceutical Regulatory Agency (NPRA) Sistem Pendaftaran Produk & Perlesenan. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
5. Obstetrical & Gynaecological Society of Malaysia. (2024). *Malaysian Maternal Immunisation Consensus Guidelines* (1st ed.) [e-book]. Obstetrical & Gynaecological Society of Malaysia. <https://ogsm.org.my/docs/Maternal-Immunisation-Guidelines.pdf>



Introduction

Pertussis, also known as whooping cough, is an upper respiratory tract infection caused by *Bordetella pertussis*. Transmission occurs through direct contact with respiratory secretions or via aerosolised droplets from infected individuals. The classical presentation is characterised by paroxysmal coughing episodes followed by an inspiratory ‘whoop’. However, infected adolescents and adults experience a milder form of the illness due to varying degrees of immunity acquired from previous childhood vaccination or past infection. In adults, pertussis may present as a prolonged cough lasting for weeks or even months, often leading to misdiagnosis as bronchitis or other respiratory conditions.

Between 2019 and 2024, pertussis cases in Malaysia fluctuated markedly, with sharp declines during the COVID-19 pandemic followed by a resurgence in the post-pandemic period. Under the National Immunisation Programme, the final pertussis booster dose is administered at 18 months of age. As a result, immunity progressively wanes over time, particularly during adolescence, increasing susceptibility among adults who may subsequently act as reservoirs for transmission to vulnerable populations.

Table 8.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	Adacel®	Sanofi Aventis (M) Sdn Bhd/ Sanofi Pasteur, France	Tdap; Tetanus-diphtheria- acellular pertussis
2.	Boostrix	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Tdap; Tetanus-diphtheria- acellular pertussis

Notes

- The pertussis vaccine is available in an acellular form, combined with diphtheria and tetanus vaccines.
- Tdap is recommended for adolescents and adults and contains lower doses of diphtheria and pertussis compared with the children’s DTaP.



- Uppercase letters (T) indicate full-strength components; lowercase “d” and “p” indicate reduced doses. The “a” in Tdap stands for acellular, meaning it uses parts of the pertussis bacterium.

Table 8.2 High-Risk Groups in Malaysia

No.	Target group	Recommendation
1.	General population	• Adults aged ≥19 years who have not received Tdap, or whose vaccination status is unknown, should receive a single dose of Tdap • Tdap may be administered at any time, regardless of when the individual last received a Td dose (if any). • A total of 3 doses of the vaccine are required: » An interval of 4–6 weeks between the 1st and 2nd doses. » An interval of 6–12 months between the 2nd and 3rd doses
2.	Pregnant women	• All pregnant women should receive a dose of Tdap between 16 and 36 weeks* of gestation during each pregnancy
3.	Close contacts of infants	• Adolescents and adults who have or anticipate having close contact with an infant age <12 months should receive Tdap
4.	Staff working in early childhood settings	• Individuals working in early childhood education and care facilities should be vaccinated with Tdap

*in accordance to Malaysian Maternal Immunisation Consensus Guidelines (2024)



Implication for Healthcare Workers (HCWs)

- Primary Recommendation
 - » All healthcare workers should receive a dose of Tdap as soon as feasible if they have not previously been vaccinated, in line with recommendations for the general adult population.
- Revaccination Considerations
 - » Revaccination with Tdap may be considered in situations where there is documented or suspected healthcare-associated pertussis transmission.

Evidence of Safety and Effectiveness

A review of 17 clinical trials reported a vaccine protective rate of 88.89% for pertussis. A booster dose of Tdap, the adult formulation, can induce a strong anamnestic response. A randomised trial demonstrated 92% efficacy against confirmed pertussis within 2.5 years of vaccination with a 3-component monovalent pertussis vaccine.

References

1. Centers for Disease Control and Prevention. (October 2024). *Pertussis vaccination recommendations for healthcare providers*. CDC. Retrieved August 1, 2025, from <https://www.cdc.gov/pertussis/hcp/vaccine-recommendations/index.html>
2. Havers, F. P., Moro, P. L., Hunter, P., Hariri, S., & Bernstein, H. (2020, January 24). Use of tetanus toxoid, reduced diphtheria toxoid, and acellular pertussis vaccines: Updated recommendations of the Advisory Committee on Immunization Practices — United States, 2019. *Morbidity and Mortality Weekly Report*, 69(3), 77–83. <https://doi.org/10.15585/mmwr.mm6903a5>
3. National Pharmaceutical Regulatory Agency (NPRA) *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
4. Ward, J. I., Cherry, J. D., Chang, S. J., Partridge, S., Lee, H., Treanor, J., & Edwards, K. (2005). Efficacy of an acellular pertussis vaccine among adolescents and adults. *New England Journal of Medicine*, 353(15), 1555–1563. <https://doi.org/10.1056/NEJMoa050824>
5. World Health Organization. (2024). Pertussis reported cases and incidence: Malaysia [Data from WHO/UNICEF Joint Reporting Form]. WHO Immunization Data portal. Retrieved August 1, 2025, from <https://immunizationdata.who.int/global/wiise-detail-page/pertussis-reported-cases-and-incidence?CODE=MYS>
6. Xu, J., Liu, S., Liu, Q., Rong, R., Tang, W., Wang, Q., & Zhou, C. (2019). The effectiveness and safety of pertussis booster vaccination for adolescents and adults: A systematic review and meta-analysis. *Medicine*, 98(16), e15281. <https://doi.org/10.1097/MD.00000000000015281>



Introduction

Haemophilus influenzae is a Gram-negative coccobacillus that occurs in two major forms: encapsulated and non-encapsulated strains. Encapsulated strains are further classified into six serotypes (a–f) based on their polysaccharide capsule, with *Haemophilus influenzae* type b (Hib) being the most virulent and responsible for over 95% of invasive disease in children. Transmission occurs through respiratory droplets or contact with contaminated surfaces.

Malaysia incorporated Hib vaccination into the National Immunisation Programme in 2002. Since then, invasive Hib disease among Malaysian children has markedly declined, with only sporadic cases reported. Although primarily a paediatric pathogen, Hib remains clinically important in adults, particularly in older individuals, those with chronic illnesses (e.g., diabetes, COPD), and immunocompromised patients such as those with HIV infection, functional or anatomical asplenia, and transplant recipients. In adults, Hib can cause pneumonia, bacteraemia, and meningitis, all of which are associated with high morbidity and mortality. Hib vaccination is therefore recommended for at-risk adult groups, especially those with asplenia, haematopoietic stem cell transplant, or immunosuppressive therapy, to reduce the risk of invasive disease.

Table 9.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	Hiberix®	GlaxoSmithKline Pharmaceutical (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	<i>Haemophilus influenzae</i> type b



Table 9.2 High-Risk Groups in Malaysia

No.	Target group	Recommendation
1.	Anatomical or functional asplenia (including sickle cell disease)	• 1 dose if previously did not receive Hib vaccine. • Elective splenectomy: 1 dose, 2 weeks before elective splenectomy or as soon as possible after an emergency splenectomy.
2.	Hematopoietic stem cell transplant (HSCT)	• 3-dose series, 4 weeks apart starting 6–12 months after successful transplant, regardless of Hib vaccination history

** Hiberix® is licensed primarily for paediatric use and is not specifically approved for adults in Malaysia. The above recommendation is adapted from the CDC Adult Immunization Schedule Notes (2025).*

Evidence of Safety & Effectiveness

Adverse reactions to Hib conjugate vaccines are not common. Swelling, redness, or pain occur in 5%–30% of recipients and usually resolve within 12–24 hours. Systemic reactions such as fever and irritability are infrequent. The Hib conjugate vaccine has significantly reduced invasive diseases such as meningitis and epiglottitis worldwide, lowering incidence by 90–99% in countries with high coverage. However, where vaccine coverage lags (<90%) or schedules are altered (e.g., booster removal), resurgences have been reported. Evidence of efficacy in adults, however, remains limited.



References

1. Centers for Disease Control and Prevention. (2025, July 2). *Adult immunization schedule notes*. U.S. Department of Health & Human Services. Retrieved August 7, 2025, from <https://www.cdc.gov/vaccines/hcp/imz-schedules/adult-notes.html>
2. National Pharmaceutical Regulatory Agency (NPRA) *Sistem Pendaftaran Produk & Perlesenan*.<https://quest3plus.bpfk.gov.my/pmo2/index.php>
3. Slack, M. P. E., Cripps, A. W., Grimwood, K., Mackenzie, G. A., & Ulanova, M. (2021). Invasive Haemophilus influenzae infections after 3 decades of Hib protein conjugate vaccine use. *Clinical Microbiology Reviews*,34(3), 10-1128. <https://doi.org/10.1128/CMR.00028-21>
4. WHO. (2013, October 21). *Haemophilus influenzae type b (Hib) Vaccination WHO position paper: July 2013 Recommendations*. Retrieved from <https://www.sciencedirect.com/science/article/pii/S0264410X13014217?via=ihub>



Introduction



Hepatitis A is an acute liver infection caused by the hepatitis A virus (HAV), a member of the *Hepatovirus* genus with the *Picornaviridae* family. The virus has only one serotype with a single-stranded RNA genome.



The virus spreads primarily via the fecal–oral route, through ingestion of contaminated food and water, or direct contact with an infectious person. While most infections in young children are asymptomatic, older individuals commonly experience symptomatic disease that include jaundice and hepatitis. There is no chronic stage, but occasional fulminant cases may occur in 1-2% of those aged over 49 years. Ultimately, hepatitis A resolves completely in >99% of cases. However symptomatic relapse has been reported in 3-20% of clinical cases.

The disease occurs worldwide, with both minor and major outbreaks. Many cases go unreported due to the high proportion of subclinical infections. In Malaysia, hepatitis A has declined significantly with reported cases having dropped to 0.19/100,000 in 2022. This reduced population immunity increases the risk of outbreaks in a largely susceptible community, similar to trends seen in other high-income countries.

Table 10.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	Avaxim®	Sanofi Aventis (M) Sdn Bhd/ Sanofi Pasteur, France	Inactivated Hepatitis A vaccine, adjuvanted by adsorption to aluminium hydroxide.
2.	Havrix®	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	
Combination Vaccines			
3.	Twinrix®	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Combined inactivated Hepatitis A and recombinant Hepatitis B vaccine, adjuvanted by adsorption to aluminium hydroxide.



Table 10.2 High-Risk Groups in Malaysia

No.	Target group	Recommendation
1.	Travellers to countries where hepatitis A endemicity is high	Those without presumptive evidence of immunity should get 2 intramuscular doses of Hepatitis A vaccine, 6-12 months apart.
2.	Patients with chronic liver disease or living with HIV, haemophilics	
3.	Occupational exposure: health and home care workers, food handlers and laboratory personnel	Doses do not need to be repeated if the interdose interval exceeds that recommended.
4.	Men who have sex with men	
5.	Injection drug users	
6.	Individuals at risk during outbreaks	

Implications for Healthcare Workers

Outbreaks of hepatitis A among hospital staff occur occasionally, usually in association with an unsuspected index patient who is fecally incontinent. In most outbreaks, nurses accounted for most of the personnel infected.

Evidence for Safety and Effectiveness

Hepatitis A vaccines are highly effective in adults, with 94–100% developing protective antibodies within a month after the first dose and all achieving protection after the second dose. Clinical experience suggests that protection following vaccination may be present even if anti-HAV antibodies are not detectable. A positive (qualitative) test for total anti-HAV antibodies is considered to signify immunity against HAV infection.



In large prelicensure safety studies of 2 different inactivated hepatitis A vaccines in adult recipients, local reactions, including soreness or tenderness at injection site, were reported in 56% and 53% respectively for the 2 vaccines. Headache was reported in 14–16% of adults for both vaccines.

In adults, persistence of the vaccine-induced immune response following primary 2-dose vaccination with inactivated hepatitis A has been shown to persist for up to 15 years. Evidence has now been obtained to suggest that immunization against HAV with a killed vaccine also leads to a measurable cellular protective immune response, which is long-lasting for at least 6 years and may be boosted to revive the immune memory.

References

1. Malaysian National Centre of Adverse Drug Reactions Database. (2019). [Database]. Accessed 10 October 2019.
2. Ministry of Health Malaysia (2023, October) *Malaysia health facts 2022*. https://www.moh.gov.my/moh/resources/Penerbitan/Penerbitan%20Utama/4._Health_Facts_2023-compressed_.pdf
3. World Health Organization (October 7, 2022). *WHO position paper on hepatitis A vaccines Weekly epidemiological record*;40(97):493-512. <https://www.who.int/publications/i/item/who-wer9740-493-512>
4. National Pharmaceutical Regulatory Agency (NPRA). *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
5. World Health Organization. (Update 2019). *Immunological Basis for Immunization Series: Module 18 – Hepatitis A*. <https://www.who.int/publications/i/item/97892516327>
6. Centers for Disease Control and Prevention. (2021). *Epidemiology and prevention of vaccine-preventable diseases* (14th ed.; Hall, E., Wodi, A. P., Hamborsky, J., et al., Eds.). Public Health Foundation. <https://www.merle-arbeitsmedizin.de/wp-content/uploads/2022/02/CDC-Pink-Book-Version-14th-Edition.pdf>



Introduction



Hepatitis B is caused by Hepatitis B virus (HBV) from the genus *Orthohepadnavirus* and family *Hepadnaviridae*. HBV has a partially double-stranded enveloped DNA genome. HBV replicate primarily in hepatocytes. Humans are the only known reservoir for human HBV genotypes. The virus is relatively heat stable and highly infectious.

HBV is transmitted by exposure of mucosal membranes or non-intact skin to infected blood or other specific body fluids (saliva, semen and vaginal fluid). Transmission can occur perinatally from mother to child and from person to person.

Following an incubation period ranging from 2-6 months, the initial infection may be asymptomatic, or present as acute hepatitis with or without jaundice, or result in fulminant hepatitis. The virus persists in 5-10% of immunocompetent adults following acute infection. Fulminant hepatitis however, occurs in 0.5-1% of adult cases of acute hepatitis B, with a case-fatality rate of 20-33%. The rate of development of chronic HBV infection occur in <5% of otherwise healthy adults. Chronically infected persons are at high risk for development of liver cirrhosis and HCC.

As reported in WHO, 2024, globally, approximately 2 billion individuals have been infected with HBV at some point, with an estimated 254 million people living with chronic HBV infection. Chronic HBV infection results in approximately 1.3 million deaths annually, primarily due to complications such as cirrhosis and hepatocellular carcinoma. In Malaysia, HBV vaccination was included into the National Expanded Programme for Immunisation (EPI) in 1989. By 2022, the incidence rate was 16.02/100,000 with a mortality rate of 0.33/100,000 population.



Table 11.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
Hepatitis B Vaccine			
1	Euvax-B®	Pharmaniaga Marketing Sdn Bhd / LG Chem Ltd, South Korea	Recombinant Hepatitis B vaccine containing HBsAg, adjuvanted by adsorption to aluminum hydroxide.
2.	Engerix-B®	GSK Biologicals S.A., Belgium/ GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd	
3.	SII Hepatitis-B Vaccine®	Serum Institute of India Private Limited (India) SM Pharmaceuticals (M) Sdn Bhd	
Combination vaccines			
1.	Twinrix®	GSK Biologicals S.A., Belgium/ GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd	Combined inactivated Hepatitis A and recombinant Hepatitis B vaccine, adjuvanted by adsorption to aluminium hydroxide.
Hepatitis B Immunoglobulin (post-exposure prophylaxis or PEP)			
1.	Hepabig Injection®	GC Biopharma Corp. (Korea, South) Proparm (M) Sdn Bhd	Hepatitis B Immunoglobulin (HBIG) containing AntiHBs



Table 11.2 High-Risk Groups in Malaysia

No.	Target group	Recommendation
1.	Unvaccinated adults at increased risk	Those without presumptive evidence of immunity should get HBV vaccination. • Standard schedule (0, 1, 6 months). Doses do not need to be repeated if the interdose interval exceeds that recommended. • Accelerated schedule (0, 1, 2 months + booster at 12 months) • Rapid schedule for urgent travel (0, 7, 21 days + booster at 12 months)
2.	Partially vaccinated individuals	
3.	Patients with chronic renal disease	
4.	Haemophiliacs	
5.	Close family contact of a case or those chronically infected	
6.	Patients attending STD & HIV clinics	
7.	Those with multiple sex partners	
8.	Men who have sex with men	
9.	Injection drug users	
10.	Individuals at risk during outbreaks	

Implications for Healthcare Workers (HCWs)

- **Occupational risk:** HBV is a recognised risk for HCWs, especially from percutaneous exposures (e.g., needlestick injuries). Infection may also occur via mucosal or skin lesions.
- **Vaccination and immunity:** HBV vaccination and pre-employment immunity verification are strongly recommended.
- **Serology screening:** Routine pre-vaccination screening is not required, unless deemed cost-effective by the institution.



- **Post-vaccination testing:** Anti-HBs testing **1–2 months after completing** the 3-dose series is advised:
 - » **≥10 mIU/mL** = protective
 - » **<10 mIU/mL** = unprotected → repeat full 3-dose series + retest
 - » If still <10 → test for **HBsAg** to rule out chronic infection
- **Non-responders:** HBsAg-negative individuals with no seroconversion after two series are **primary non-responders** and must be informed of their vulnerability. If exposed, they should receive **HBIG**.
- **HBsAg-positive HCWs:** Should be counselled, educated on infection control, and followed-up medically.
- **Post-exposure prophylaxis:** See the section on **Passive immunisation**. (page 147).

Evidence of Safety and Effectiveness

The Global Advisory Committee on Vaccine Safety (GACVS) has confirmed the excellent safety profile of hepatitis B vaccine. In general, there are minimal adverse reactions, such as local pain, myalgia and transient fever, mostly within 24 hours. Numerous long-term studies have found no evidence of serious adverse events causally linked to hepatitis B vaccination.

Studies show that 90% of vaccinated individuals remain protected from HBV infection for **at least 30 years**, even if anti-HBs levels wane. Currently, the substantial body of evidence since 2022 does not provide a compelling basis for recommending a booster dose of hepatitis B vaccine after completion of the primary vaccination series for persons with normal immune status.



References

1. World Health Organization. (2024). *Global hepatitis report 2024*. World Health Organization. <https://www.who.int/publications/i/item/9789240091672>
2. Centers for Disease Control and Prevention. (2023). *Epidemiology and prevention of vaccine-preventable diseases* (14th ed., Hepatitis B. Chapter 10). Public Health Foundation. <https://www.cdc.gov/pinkbook/hcp/table-of-contents/chapter-10-hepatitis-b.html>
3. World Health Organization. (2017). Hepatitis B vaccines: WHO position paper – July 2017. *Weekly Epidemiological Record*, 92(27), 369–392. <https://www.who.int/publications/i/item/WER9227>
4. Hesham, R., Zamberi, S., Tajunisah, M. E., Ariza, A., & Ilina, I. (2005). Hepatitis B immunisation status among health care workers in two Kuala Lumpur hospitals. *Medical Journal of Malaysia*, 60(4), 407–410. https://www.e-mjm.org/2005/v60n4/Hepatitis_B_Immunisation.pdf
5. Ministry of Health Malaysia (2023, October) *Malaysia health facts 2022*. https://www.moh.gov.my/moh/resources/Penerbitan/Penerbitan%20Utama/4._Health_Facts_2023-compressed_.pdf
6. National Pharmaceutical Regulatory Agency (NPRA). *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>



Introduction



The Human papillomavirus (HPV) is a small, double-stranded DNA virus that belongs to the *Papillomaviridae* family. HPVs are highly tissue-specific and infect both cutaneous and mucosal epithelium. More than 200 HPV types have been identified and about 40 HPV types infect the anogenital tract. The virus is classified into: low-risk HPVs (LR-HPVs), which cause anogenital and cutaneous warts, and high-risk HPVs (HR-HPVs), which are responsible for oropharyngeal cancers and anogenital cancers. Individuals infected with one HPV type may be co-infected or subsequently infected with other types.

Worldwide, 1 in 10 women carries an HPV infection at any point in time. Globally, 610,000 incident cancers per annum are attributable to HPV infection. The cervix is the predominant HPV-associated cancer with 530,000 incident cases per annum. Genital warts are caused by HPV with an annual incidence of 0.1 to 0.2%.

HPV-16 and HPV-18 are the most frequent types worldwide, with HPV-16 being the most common in all regions. Globally, high-risk HPV types 16 and 18 cause about 70% of cervical cancer cases, 85% of HPV-related head and neck cancers, and 87% of anal cancers. HPV types 16, 18, 45, 31, 33, 52, and 58 together account for approximately 90% of squamous cell carcinomas that are positive for HPV DNA.

In Malaysia, 28 HPV genotypes were identified, with HPV16, HPV18, HPV58, HPV52, and HPV33 being the most prevalent high-risk HPV (HR-HPV) genotypes. Genotype distribution varied significantly across the Malaysian states and ethnic groups. HPV accounts for 99% of cervical cancer in Malaysia.



Table 12.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1	Cervarix®	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Adjuvanted, recombinant DNA vaccine using L1 structural proteins. Bivalent (2vHPV)-16,18
2.	Gardasil®	Merck Sharp & Dohme B.V. (Netherlands)	Adjuvanted, recombinant DNA vaccine using L1 structural proteins. Quadrivalent (4vHPV)-6, 11, 16, 18
3.	Gardasil 9®	MSD International GmbH (Singapore Branch) (Singapore)	Adjuvanted, recombinant DNA vaccine using L1 structural proteins. Nonavalent (9vHPV)-6, 11, 16, 18, 31, 33, 45, 52, 58

Table 12.2 High-Risk Groups in Malaysia

No.	Target group	Recommendation
1.	Females aged ≥ 18 years	IM injection 1 or 2 doses (0, 6-12 months)
2.	Males aged 9 - 45 years, especially for men who have sex with men (MSM)	IM injection 1 or 2 doses (0, 6-12 months)
3.	Immunocompromised	IM injection 3 doses (0, 1-2, months)



Implications for Healthcare Workers (HCWs)



There are no special recommendations for health care workers; they should follow the same vaccine recommendations as other adults, based on age or other individual risk factors.



Evidence of Safety and Effectiveness

Among males and females of all ages receiving HPV vaccine, injection site reactions included pain (35–88%), redness (5–40%) and swelling (4–35%). Severe pain (spontaneous pain or pain that prevented normal activity) was reported by around 6% of vaccinees.

While HPV vaccines are not recommended for use in pregnant women, giving to lactating women do not affect the safety of breastfeeding for mothers or infants.

Evidence for HPV vaccine Effectiveness

Bivalent HPV Vaccine (2vHPV – Cervarix®): Efficacy of 93–100% against CIN2+ caused by HPV 16/18 in HPV-naïve women of 15–26 years. Offers 30–50% cross-protection against HPV 31, 33, and 45. Protection lasts more than 10 years.

Quadrivalent HPV Vaccine (4vHPV – Gardasil®): Nearly 100% efficacy against HPV 16/18-related CIN2+, vaginal & vulvar lesions; 90% efficacy against male genital warts; 75% efficacy against male anal pre-cancers; and 95% efficacy against intra-anal HPV infection in men who have sex with men. Antibody levels last for at least 10 years.

Nanovalent HPV Vaccine (9vHPV – Gardasil 9®): 96.7% effectiveness against CIN2+ caused by HPV 31/33/45/52/58 in HPV-naïve women age 16–26 years; around 97% against any HPV-related high-grade lesion; and about 99% against genital warts. Protection so far lasts for at least 6–8 years.



Use of single dose of HPV vaccine

Data from immunogenicity trials, post-hoc analyses of efficacy trials, and post-licensure observational studies among females have demonstrated that a single dose of HPV vaccine is sufficient to elicit an immune response that provides similar protection as a multidose regimen against initial and persistent HPV infection. Systematic reviews have shown seropositivity among subjects who received one dose to be non-inferior to that after 2 or more doses. Key evidence supporting one dose HPV schedule for age 15-20 years:

- **KEN SHE Study (Kenya, 2022 – NEJM):** A single dose of 2vHPV or 9vHPV was 97.5% efficacious against persistent HPV-16/18 infection at 18 months, comparable to 2-dose and 3-dose schedules, indicating high efficacy and strong immunogenicity.
- **IARC-India Study (Lancet Oncol, 2023):** A 10-year follow-up study involving girls age 10–18 showed that a single dose of the HPV vaccine provides protection comparable to that of 2 doses, supporting a single-dose approach



References

1. de Sanjose, S., Quint, W. G., Alemany, L., et al and the Retrospective International Survey and HPV Time Trends Study Group (2010). Human papillomavirus genotype attribution in invasive cervical cancer: a retrospective cross-sectional worldwide study. *The Lancet. Oncology*,11(11), 1048–1056. [https://doi.org/10.1016/S1470-2045\(10\)70230-8](https://doi.org/10.1016/S1470-2045(10)70230-8)
2. Forman, D., de Martel, C., Lacey, C.J., et al. (November 20, 2012). Global Burden of Human Papillomavirus and Related Diseases. *Vaccine*, 30(5), F12–F23. <https://doi.org/10.1016/j.vaccine.2012.07.055>
3. Serrano, B., de Sanjosé, S., Tous, S., et al. (2015). Human papillomavirus genotype attribution for HPVs 6, 11, 16, 18, 31, 33, 45, 52, and 58 in female anogenital lesions. *European Journal of Cancer*, 51(13), 1732–1741. <https://doi.org/10.1016/j.ejca.2015.06.001>
4. Chee, S. M., Lim, K. H., Abdullah, N. H., & Wong, L. P. (2025). Human Papillomavirus (HPV) genotype distribution in Malaysia: A systematic review. *BMC Infectious Diseases*, 25(1010). <https://doi.org/10.1186/s12879-025-11441-0>
5. National Pharmaceutical Regulatory Agency (NPRA) Sistem Pendaftaran Produk & Perlesenan. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
6. World Health Organization. (December 16, 2022). WHO position paper on HPV vaccines – Weekly Epidemiological Record, No. 50, 97, 645–672. <https://www.who.int/publications/i/item/who-wer9750-645-672>
7. Whitworth, HS., Gallagher, K.E., Howard, N., et al. (2020). Efficacy and immunogenicity of a single dose of human papillomavirus vaccine compared to no vaccination or standard three and two-dose vaccination regimens: a systematic review of evidence from clinical trials. *Vaccine*, 38(6):1302-1314. DOI: 10.1016/j.vaccine.2019.12.017
8. Barnabas, R. V., Brown, E. R., Onono, M. A., Bukusi, E. A., Njoroge, B., Winer, R. L., Kiarie, J. (2022). Efficacy of single-dose human papillomavirus vaccination among young women. *The New England Journal of Medicine*, 386(24), 2302–2312. <https://doi.org/10.1056/evidoa2100056>
9. Bhatla, N., Nene, B. M., Joshi, S., Esmy, P. O., Poli, U. R. R., Jayant, K., Sankaranarayanan, R. (2023). Efficacy of a single dose of quadrivalent HPV vaccine in young women in India: Interim results of the randomised, controlled, non-inferiority IARC India HPV vaccine study. *The Lancet Oncology*, 24(5), 594–605. [https://doi.org/10.1016/S1470-2045\(23\)00120-3](https://doi.org/10.1016/S1470-2045(23)00120-3)



Introduction



Influenza is caused by the Influenza virus, a segmented RNA virus from the *Alphainfluenzavirus* Genus and *Orthomyxoviridae* family. Of the 4 influenza subtypes, Influenza A and B viruses cause all the human infection. The strains currently circulating globally are the Influenza A H1N1pdm09, Influenza A H3N2 and Influenza B. The influenza virus is normally transmitted via droplet inhalation, direct close contact as well as contaminated surfaces.

Following an incubation period of around 2 days, influenza typically begins suddenly with fever, sore throat, headache, muscle aches, chills, fatigue, and loss of appetite, followed by a runny nose and dry cough. While most otherwise healthy individuals recover within 3 to 7 days, fatigue can linger for weeks. Notably, individuals are contagious even before symptoms appear, starting one day prior to symptoms onset and can continue spreading the virus for up to 7 days after symptoms begin. In older adults, influenza may not present with typical symptoms like fever. Instead, it may manifest as confusion, loss of appetite, or general weakness, making diagnosis more challenging. Additionally, up to 75% of individuals may have asymptomatic infections, yet still transmit the virus to others.

Influenza affects around 5–15% of adults globally each year. The risk of severe influenza complications is highest in infants, the elderly, and individuals with chronic health conditions. Serious outcomes include worsening of underlying lung or heart diseases (such as COPD, asthma, or heart failure) and secondary bacterial pneumonia, most commonly caused by *Streptococcus pneumoniae*, *Staphylococcus aureus*, or *Haemophilus influenzae*.



Table 13.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
Egg-based Influenza Vaccine			
1.	Influvac® (Suspension for Injection)	Abbott Laboratories (M) Sdn Bhd / Abbott Biologicals B.V., Netherlands	Inactivated surface antigen vaccine containing HA and NA antigens from three influenza virus strains (Trivalent) cultivated in eggs.
2.	Vaxigrip® Influenza Vaccine (0.5ml Syringe)	Sanofi Aventis (M) Sdn Bhd / Sanofi Pasteur Inc., France	Inactivated split-virion vaccine containing antigens from three influenza virus strains (Trivalent) cultivated in eggs.
Indicated for use in adults and children aged 6 months and older.			
Cell-based Influenza Vaccine			
1.	SKYCellflu® Trivalent Solution for Injection (0.5ML Prefilled Syringe)	Pharmaniaga Marketing Sdn Bhd / SK Bioscience Co., (Korea, South)	Inactivated split/ subunit vaccine containing HA and NA antigens from three influenza virus strains (Trivalent) cultivated in cell culture.



- Indicated for use in adults and children aged 6 months and older.
- Offers an alternative for those with egg allergies.

Live Attenuated Influenza Vaccine (Intranasal)

1.	FluMist® (Nasal Spray)	AstraZeneca Sdn. Bhd. / AstraZeneca Pharmaceuticals LP	Live attenuated influenza vaccine (LAIV) containing three weakened influenza virus strains (Trivalent). Administered intranasally.
----	-------------------------------	--	--

- Indicated for individuals aged 2 to 49 years.

Table 13.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Adults aged 50 years and older	- Intramuscular - Intranasal - Single dose given annually
2.	Adults aged 18–49 years with underlying medical conditions	
3.	Healthy adults aged 18-49 years	
4.	Persons living in long-term care facilities or congregate living settings	
5.	Household contacts and caregivers of high-risk individuals	
6.	Pregnant women	



No.	Target group	Recommended Dosing Schedule
7.	Obesity	• Intramuscular • Intranasal • Single dose given annually
8.	Religious pilgrims	

Implications for Healthcare Workers (HCWs)

All healthcare workers should receive annual influenza vaccination to protect themselves and prevent transmission to vulnerable patients, as it is a critical measure for patient safety and infection control in healthcare settings.

Evidence for Safety and Effectiveness

Inactivated influenza vaccines (IIVs) have an excellent safety profile and are well tolerated by recipients of all ages, including individuals with underlying conditions and pregnant women. Mild adverse reactions are frequent but self-limiting, lasting no more than 1 to 2 days. In adults and older children, mild pain at the injection site is common (60–80% of recipients); systemic symptoms include low-grade fever (2–10%), malaise, headache, myalgia and fatigue.

A meta-analysis of 31 studies found trivalent inactivated influenza vaccines (TIV) to be 59% effective in healthy adults aged 18–65. However, data on adults over 65 are limited, with lower effectiveness observed, though studies suggest it still helps reduce illness severity, complications, and mortality.

High-dose, recombinant and adjuvanted vaccines have demonstrated a higher vaccine efficacy or effectiveness against symptomatic disease, with a slightly increased reactogenicity than standard inactivated vaccines in older adults.



References

1. Hayward, A. C., Fragaszy, E. B., Bermingham, A., et al and Flu Watch Group. (2014). Comparative community burden and severity of seasonal and pandemic influenza: Results of the Flu Watch cohort study. *The Lancet Respiratory Medicine*, 2(6), 445–454. [https://doi.org/10.1016/S2213-2600\(14\)70034-7](https://doi.org/10.1016/S2213-2600(14)70034-7)
2. Centers for Disease Control and Prevention. (2022). *How influenza (flu) vaccines are made*. U.S. Department of Health & Human Services. <https://www.cdc.gov/flu/vaccine-process/index.html>
3. Erbeling, E. J., Post, D. J., Stemmy, E. J., et al. (2018). A universal influenza vaccine: The strategic plan for the National Institute of Allergy and Infectious Diseases. *Journal of Infectious Diseases*, 218(3), 347–354. <https://doi.org/10.1093/infdis/jiy103>
4. Centers for Disease Control and Prevention. (2024). *Influenza (flu) vaccination and egg allergy*. <https://www.cdc.gov/flu/prevent/egg-allergies.htm>
5. Centers for Disease Control and Prevention. (2024). *Prevention and control of seasonal influenza with vaccines: Recommendations of the Advisory Committee on Immunization Practices (ACIP)*. <https://www.cdc.gov/mmwr/volumes/73/rr/r7305a1.htm>
6. Isahak, I., Mahayiddin, A. A., & Ismail, R. (2007). Effectiveness of influenza vaccination in prevention of influenza-like illness among inhabitants of old folk homes. *The Southeast Asian Journal of Tropical Medicine and Public Health*, 38(5), 841–848. <https://pubmed.ncbi.nlm.nih.gov/18041300/>
7. Mustafa, A. N., Gessner, B. D., Ismail, R., Yusoff, A. F., Abdullah, N., Ishak, I., Abdullah, N., & Merican, M. I. (2003). A case-control study of influenza vaccine effectiveness among Malaysian pilgrims attending the Haj in Saudi Arabia. *International Journal of Infectious Diseases* : IJID : official publication of the International Society for Infectious Diseases, 7(3), 210–214. [https://doi.org/10.1016/s1201-9712\(03\)90054-3](https://doi.org/10.1016/s1201-9712(03)90054-3)
8. Osterholm, M. T., Kelley, N. S., Sommer, A., & Belongia, E. A. (2012). Efficacy and effectiveness of influenza vaccines: a systematic review and meta-analysis. *The Lancet. Infectious diseases*, 12(1), 36–44. [https://doi.org/10.1016/S1473-3099\(11\)70295-X](https://doi.org/10.1016/S1473-3099(11)70295-X)
9. World Health Organisation (May 13, 2022). Vaccines against influenza: *WHO Position paper-May 2022*. Weekly epidemiological record; 97(19):185-208. <https://www.who.int/publications/i/item/who-wer9719>
10. World Health Organisation (February 28, 2025). *Recommended composition of influenza virus vaccines for use in the 2025-2026 northern hemisphere influenza season*. <https://www.who.int/teams/global-influenza-programme/vaccines/who-recommendations>



Introduction



Japanese encephalitis (JE) is an arbovirus central nervous system infection. Numerically, it is the most important cause of viral encephalitis across Asia. It has been estimated that 100,000 clinical cases of JE, with 25,000 deaths, occur around the world each year. The causative agent, Japanese encephalitis virus or JEV (family *Flaviviridae*, genus *Flavivirus*), is transmitted primarily among birds, pigs, and other vertebrate hosts by *Culex* species mosquitoes that breed in flooded rice fields and stagnant water and bite largely at dusk and night. While pigs and water birds serve as the primary amplifying hosts, humans are incidental dead-end hosts who become infected when they encroach on the enzootic cycle. The virus is found in Southeast Asia, India, Nepal, Pakistan, Sri Lanka, China, the Korean peninsula, Japan, Timor Leste, Pacific Rim islands and Australia. In Malaysia, JEV exhibits an endemic transmission characterized by sporadic human cases throughout the year with seasonal peaks that coincide with high rainfall during the monsoon season.

In parts of Asia where JE is endemic, it is primarily a disease of children living in rural areas. Whilst most people living in endemic areas are infected by the age of 15 years, JE virus can infect all age groups, particularly when it is newly introduced into geographical areas where the general population has no pre-existing immunity. In addition, travelers from non-JE endemic regions are also at risk. In countries with longstanding childhood JE vaccination programs, such as Japan, South Korea, and Taiwan, the age distribution of cases has shifted toward adults, particularly to elderly people. Waning vaccine-induced immunity, immunosenescence in the elderly, and reduced natural boosting in urban populations may have contributed to increased incidence of JE among older individuals in endemic regions.

Only 1 in 300 infections result in symptomatic illness. These may range from a non-specific flu-like illness, febrile seizures, aseptic meningitis, encephalitis and poliomyelitis-like acute flaccid paralysis. There is no specific antiviral treatment for severe JE apart from supportive care. The acute case fatality rate of encephalitis is approximately 30%. Up to 50% of the survivors develop severe neurological sequelae such as seizures, limb weakness, hearing, visual and speech-language impairments, learning



and psychobehavioural disabilities and Parkinsonian syndrome. Although the clinical condition of many JE survivors improves during the first 3–6 months after hospital discharge, less than 50% make a full recovery, and about 20% experienced subsequent deterioration on long-term follow-up.

In Malaysia, the great majority of laboratory-confirmed JE cases are found in Sarawak. There is a paucity of data on JE in other parts of Malaysia although two historical outbreaks have been documented in Pulau Langkawi in 1974 and Penang in 1988 and sporadic cases have been recorded in peninsular Malaysia and Sabah since 2000.

Table 14.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	IMOJEV®	Zuellig Pharma Sdn Bhd/ Global Biotech Products Co., Ltd, Thailand	Live attenuated recombinant chimeric JE vaccine, prM and E protein are derived from SA-14-14-2 vaccine strain
2.	CD.JEVAX®	Farmaco Healthcare Sdn Bhd / Chengdu Institute of Biological Products, China	Live attenuated JE vaccine, SA-14-14-2 vaccine strain



Table 14.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Children aged ≥9 months living in Sarawak	IMOJEV® - Children aged ≥9 months: a single injection - A booster dose should be given preferably 1–2 year after the first vaccination for those aged <18 years. Adults (aged ≥18 years): A single injection. No booster dose is required for up to 5 years following first dose. (Children in Sarawak receive this JE vaccine (IMOJEV®) at aged 9 and 21 months under the Expanded Programme of Immunisation)
2.	Workers, travellers and other individuals on an extended stay in Sarawak	
3.	Research laboratory personnel, pig farmers and abattoir workers	CD.JEVAX® - Children aged ≥9 months: a single subcutaneous injection (0.5mL). - Booster dose can be given between 3 months to 1 year after primary dose.

Implication for Healthcare Workers (HCWs)

There are no specific recommendations for JE vaccine for HCWs since they are generally not at special risk of contracting JE.

Evidence of Safety & Effectiveness

Undesirable effects and Safety

The safety profile of the live recombinant vaccine was comparable with that of other licensed vaccines (live attenuated JE, MMR, and hepatitis A). Among adults, a significantly lower frequency of local adverse reactions was reported for live recombinant vaccine than mouse brain-derived



vaccine. Otherwise, there was comparable tolerability and reactogenicity, with the majority of adverse events being mild to moderate and resolving within a few days. The most commonly reported adverse effects were headache (19%), myalgia (13%) fatigue (10%), influenza-like illness (9%), and nausea(5%).

Evidence of Effectiveness

Studies have shown the use of inactivated mouse brain derived and live attenuated vaccines have reduced considerably the incidence of JE in Sarawak. The average annual incidence of JE in Sarawak prior to the introduction of inactivated mouse brain-derived vaccine into the Expanded Programme of Immunisation (EPI) in 2001 was 9.8/100,000 aged 12 years and below. By the end of 2006, the average annual incidence had dropped to 4.3/100,000 aged 12 years and below. Malaysia has since switched to the use of the live-attenuated recombinant chimeric JE vaccine. At the end of 2022, a reduction of incidence rate to 0.07/100,000 with mortality rate of 0.01/100,000 was reported.

Since vaccination has no impact on the zoonotic transmission of the virus, hence susceptible individuals will continue to be at risk of disease even when few cases are observed. Thus, any vaccination programme would have to target all susceptible individuals without expecting herd immunity to contribute to a reduction in incidence.

References

1. Quan TM, Thao TTN, Duy NM, Nhat TM, Clapham H. (May 26, 2020). Estimates of the global burden of Japanese encephalitis and the impact of vaccination from 2000-2015. *Elife*, 9:e51027. doi: 10.7554/eLife.51027.
2. Ministry of Health Malaysia (2023) *Malaysia Health Facts 2022*. Disease Control Division. https://www.moh.gov.my/moh/resources/Penerbitan/Penerbitan%20Utama/4_Health_Facts_2023-compressed_.pdf
3. Halstead, SB, Hills, SL, Marfin, AA, Solomon, T (2024). *Japanese Encephalitis vaccine*. In: Orenstein, W. A., Offit, P. A., EDWARDS, K., Plotkin, S. A. (Editors), Plotkin's vaccines (8th ed.). Philadelphia, PA: Elsevier.
4. Bista, M. B., Banerjee, M. K., Shin, S. H., Tandan, J. B., Kim, M. H., Sohn, Y. M., Ohrr, H. C., Tang, J. L., & Halstead, S. B. (2001). Efficacy of single-dose SA 14-14-2 vaccine against Japanese encephalitis: a case control study. *Lancet* (London, England), 358(9284), 791–795. [https://doi.org/10.1016/s0140-6736\(01\)05967-0](https://doi.org/10.1016/s0140-6736(01)05967-0)



5. Hennessy, S., Liu, Z., Tsai, T. F., Strom, B. L., Wan, C. M., Liu, H. L., Wu, T. X., Yu, H. J., Liu, Q. M., Karabatsos, N., Bilker, W. B., & Halstead, S. B. (1996). Effectiveness of live-attenuated Japanese encephalitis vaccine (SA14-14-2): a case-control study. *Lancet* (London, England), 347(9015), 1583–1586. [https://doi.org/10.1016/s0140-6736\(96\)91075-2](https://doi.org/10.1016/s0140-6736(96)91075-2)
6. Xin, Y. Y., Ming, Z. G., Peng, G. Y., Jian, A., & Min, L. H. (1988). Safety of a live-attenuated Japanese encephalitis virus vaccine (SA14-14-2) for children. *The American journal of tropical medicine and hygiene*, 39(2), 214–217. <https://doi.org/10.4269/ajtmh.1988.39.214>
7. Ohrr, H., Tandan, J. B., Sohn, Y. M., Shin, S. H., Pradhan, D. P., & Halstead, S. B. (2005). Effect of single dose of SA 14-14-2 vaccine 1 year after immunisation in Nepalese children with Japanese encephalitis: a case-control study. *Lancet* (London, England), 366(9494), 1375–1378. [https://doi.org/10.1016/S0140-6736\(05\)67567-8](https://doi.org/10.1016/S0140-6736(05)67567-8)
8. Ooi, M. H., Lewthwaite, P., Lai, B. F., Mohan, A., Clear, D., Lim, L., Krishnan, S., Preston, T., Chieng, C. H., Tio, P. H., Wong, S. C., Cardoso, J., & Solomon, T. (2008). The epidemiology, clinical features, and long-term prognosis of Japanese encephalitis in central Sarawak, Malaysia, 1997-2005. *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America*, 47(4), 458–468. <https://doi.org/10.1086/590008>
9. World Health Organisation (2015). *Japanese Encephalitis Vaccines: WHO position paper – February 2015*. *Weekly Epidemiological Record*. 90(9):69-87.] <https://www.who.int/publications/i/item/japanese-encephalitis-vaccines-who-position-paper>
10. Monath, T. P., Guirakhoo, F., Nichols, R., Yoksan, S., Schrader, R., Murphy, C., Blum, P., Woodward, S., McCarthy, K., Mathis, D., Johnson, C., & Bedford, P. (2003). Chimeric live, attenuated vaccine against Japanese encephalitis (ChimeriVax-JE): phase 2 clinical trials for safety and immunogenicity, effect of vaccine dose and schedule, and memory response to challenge with inactivated Japanese encephalitis antigen. *The Journal of infectious diseases*, 188(8), 1213–1230. <https://doi.org/10.1086/378356>
11. Torresi J, McCarthy K, Feroldi E, Méric C (November 23, 2010). Immunogenicity, safety and tolerability in adults of a new single-dose, live-attenuated vaccine against Japanese encephalitis: Randomised controlled phase 3 trials. *Vaccine*, 28(50):7993-8000. doi: 10.1016/j.vaccine.2010.09.035.
12. Wong, S. C., Ooi, M. H., Abdullah, A. R., Wong, S. Y., Krishnan, S., Tio, P. H., Pek, P. C., Lai, B. F., Mohan, A., Muhi, J., Kiyu, A., Arif, M. T., & Cardoso, M. J. (2008). A decade of Japanese encephalitis surveillance in Sarawak, Malaysia: 1997-2006. *Tropical medicine & international health : TM & IH*, 13(1), 52–55. <https://doi.org/10.1111/j.1365-3156.2007.01967.x>
13. Nasveld, P. E., Ebringer, A., Elmes, N., Bennett, S., Yoksan, S., Aaskov, J., McCarthy, K., Kanesa-athan, N., Meric, C., & Reid, M. (2010). Long term immunity to live attenuated Japanese encephalitis chimeric virus vaccine: randomized, double-blind, 5-year phase II study in healthy adults. *Human vaccines*, 6(12), 1038–1046. <https://doi.org/10.4161/hv.6.12.13057>



Introduction



Measles is due to a highly contagious single-stranded RNA measles virus from the *Paramyxoviridae* family. The infection is a highly contagious viral disease transmitted through airborne droplets, with an incubation period of 10–14 days and infectivity from four days before to four days after rash onset. Humans are the only natural host, and the disease is entirely vaccine preventable. In the absence of vaccination, up to 95% of the population would acquire measles by age 15; with widespread childhood immunisation, susceptibility has shifted to unvaccinated adolescents and young adults. Maintaining high vaccination coverage is therefore critical to prevent outbreaks and protect vulnerable populations.

The severity, risk of complications, and clinical outcomes vary by age, nutritional status, and comorbidities. Common complications include otitis media, pneumonia, croup, diarrhoea, post-infectious encephalitis, and subacute sclerosing panencephalitis (SSPE). Young children are prone to life-threatening pneumonia, while adults over 20 years are at higher risk of encephalitis. Immunocompromised individuals, including those with HIV, may present atypically without rash and experience severe or fatal disease. In pregnancy, measles increases the risk of hospitalisation, pneumonia, foetal loss, preterm labour, and maternal death, although it is not teratogenic. Travellers face a higher risk of exposure in measles-endemic regions, while college and university students are vulnerable due to close-contact living and learning environments that facilitate transmission.



Table 15.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	MMR® II	Merck Sharp & Dohme (Malaysia) Sdn Bhd / Merck Sharp & Dohme B.V. Netherlands	Live attenuated measles, mumps and rubella vaccine
2.	Priorix®	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd / GlaxoSmithKline Biologicals S.A., Belgium	Live attenuated measles, mumps and rubella vaccine
3.	SII Measles and Rubella virus Vaccine®	SM Pharmaceuticals Sdn Bhd/ Serum Institute of India Private Limited, India	Live attenuated measles, mumps and rubella vaccine, single or 10 doses

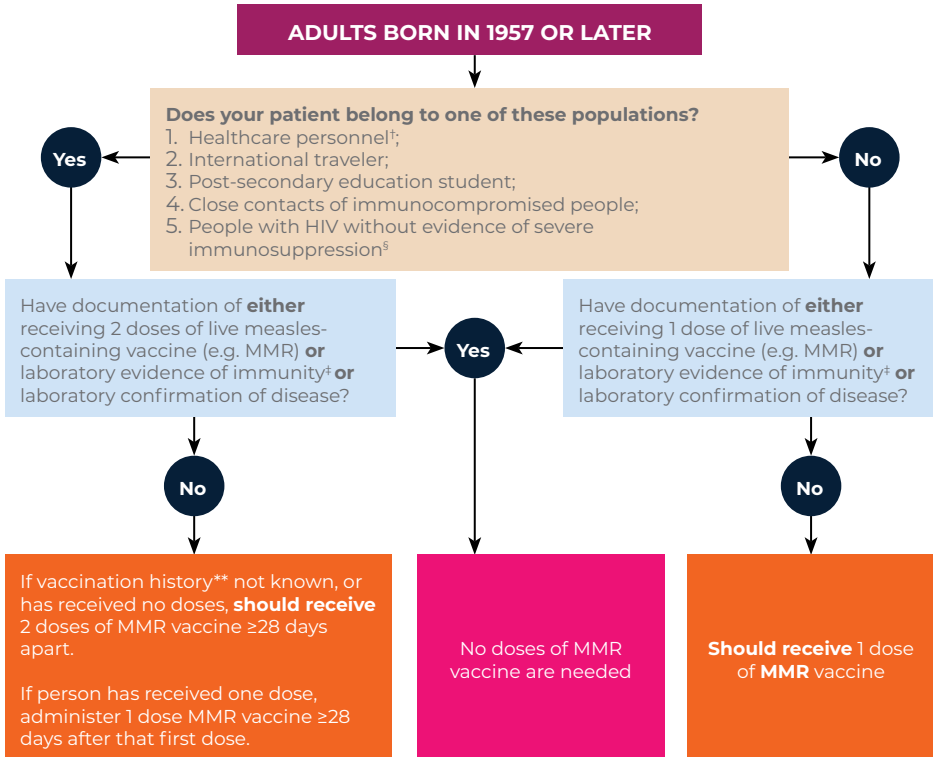
Table 15.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Those travelling to measles-endemic areas	Those without evidence of immunity should receive 2 doses of MMR vaccine, at least 28 days apart.
2.	College and university students	
3.	Asymptomatic HIV-infected individuals	
4.	Close contacts of immunocompromised people	
5.	General adult population	Those without evidence of immunity should receive 1 dose of MMR vaccine



Measles vaccine recommendations for non-pregnant adults* aged ≥19 years by birth year—United States

This infographic for healthcare providers summarizes ACIP and CDC recommendation



* MMR vaccine should NOT be administered during pregnancy. Refer to Adult Immunization Schedule by Age | Vaccines & Immunizations | CDC (www.cdc.gov/vaccines/hcp/immunz-schedules/adult-age.html) for more contraindications and precautions, and other details.

† Healthcare personnel include all paid and unpaid persons working in healthcare settings who have the potential for exposure to patients and/or to infectious materials, including body substances, contaminated medical supplies and equipment, contaminated environmental surfaces, or contaminated air.

‡ Acceptable laboratory evidence of immunity includes: measles IgG in serum (equivocal results should be considered negative).

§ Refer to Prevention of Measles, Rubella, Congenital Rubella Syndrome, and Mumps, 2013 (www.cdc.gov/mmwr/preview/mmwrhtml/rr6204a1.htm) for details about absence of severe immunosuppression. In addition to the adults belonging to one of these population groups, health departments may

consider a second dose for adults (including visitors) who have received one dose who are living in or traveling to domestic areas with sustained, community-wide measles transmission affecting adults where there is ongoing risk of exposure.

Refer to VPD surveillance manual (www.cdc.gov/surv-manual/php/table-of-contents/chapter-7-measles.html).

** A small number (<5%) of adults vaccinated between 1963–1967 received an inactivated (killed) measles vaccine. Check documentation to ensure that the adult did not receive inactivated vaccine. Adults who received killed vaccine, or do not know what type of vaccine they received between 1963–1967, should receive 1 or 2 doses of current MMR vaccine (i.e. those killed or unknown doses do not count).

Adapted from:

<https://www.cdc.gov/measles/hcp/vaccine-considerations/index.html>





Implication for Healthcare Workers (HCWs)



All healthcare workers (HCWs) should have documented immunity to measles, as transmission in healthcare settings poses serious risks to infants and immunocompromised patients. HCWs without evidence of immunity should receive two doses of a measles-containing vaccine, given at least four weeks apart.



Notes

Post-exposure Prophylaxis

- Measles vaccine may be used to protect susceptible individuals against measles if the vaccine is administered within 72 hours of the initial virus exposure. Timely administration of the vaccine is effective in preventing, shortening the duration, or reducing the severity of the disease.
- In the event that measles vaccination is contraindicated (e.g., pregnant women and immunocompromised individuals) or was not given within 72 hours of initial exposure, human immunoglobulin may be given within 6 days of the exposure to prevent measles or reduce the severity or duration of illness.

Evidence of Safety & Effectiveness

In adults, a single dose of measles-containing vaccine (MCV1) confers partial protection but is insufficient for reliable long-term immunity, leaving individuals vulnerable during outbreaks. Administration of two doses (MCV2) provides robust and durable protection, with vaccine effectiveness exceeding 98–99% in children and young adults, remaining around 98% through the mid-20s and persisting above 91% in adults aged 26–31 years.



References

1. Centers for Disease Control and Prevention. (2024, September 20). *Measles vaccine recommendations*. U.S. Department of Health & Human Services. <https://www.cdc.gov/measles/hcp/vaccine-considerations/index.html>
2. Centers for Disease Control and Prevention. (2025). *Adult immunization schedule notes* [Web page]. U.S. Department of Health & Human Services. Retrieved September 30, 2025, from <https://www.cdc.gov/vaccines/hcp/imz-schedules/adult-notes.html#note-mmr>
3. Centers for Disease Control and Prevention. (2025). *Measles vaccine recommendations for non-pregnant adults aged ≥ 19 years by birth year — United States [PDF]*. U.S. Department of Health & Human Services. <https://www.cdc.gov/measles/downloads/adult-mmr-algorithm-508.pdf>
4. Franconeri, L., Antona, D., Cauchemez, S., Lévy-Bruhl, D., & Paireau, J. (2023). Two-dose measles vaccine effectiveness remains high over time: A French observational study, 2017–2019. *Vaccine*, 41(37), 5797–5804. <https://doi.org/10.1016/j.vaccine.2023.08.018>
5. National Pharmaceutical Regulatory Agency (NPRA) *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
6. PRIORIX: Recommendations of the Advisory Committee on Immunization Practices — United States, 2022. *Morbidity and Mortality Weekly Report Weekly* / November 18, 2022 / 71(46);1465–1470 <https://www.cdc.gov/mmwr/volumes/71/wr/mm7146a1.htm>
7. World Health Organization. (2017, April 28). Measles vaccines: *WHO position paper*, WER No. 17, 92, 205–227. *Weekly Epidemiological Record*, 92(17), 205–227. <https://iris.who.int/server/api/core/bitstreams/3eb838f7-724d-41d4-9a66-47ed008deb48/content>



Introduction

Mumps is a mild childhood infection most commonly affecting children aged 5 to 9 years. It is caused by the mumps virus and is transmitted from person to person through direct contact or respiratory droplets. Individuals with mumps are contagious from 2 days before to 9 days after the onset of parotid swelling. The illness typically begins with fever, malaise, headache, and the characteristic parotid gland swelling.

While mumps is often uncomplicated in children, adults are at higher risk of complications including meningitis, orchitis, and hearing loss. Orchitis occurs in approximately 20% of post-pubertal males with mumps, and both testes are affected in about 20% of these cases; however, mumps orchitis rarely results in permanent infertility. Acquisition of mumps during the first 12 weeks of pregnancy is associated with a 25% risk of spontaneous abortions, but fetal malformations following maternal mumps infection have not been reported.

Table 16.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	MMR® II	Merck Sharp & Dohme (Malaysia) Sdn Bhd/Merck Sharp & Dohme B.V. Netherlands	Live attenuated measles, mumps and rubella vaccine
2.	Priorix®	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd / GlaxoSmithKline Biologicals S.A., Belgium	Live attenuated measles, mumps and rubella vaccine



Table 16.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Adults living or working in congregate settings	Those without presumptive evidence of immunity should get 2 doses of mumps-containing vaccine, separated by at least 28 days
2.	International travellers	
3.	University and college students	
4.	Women of childbearing age, before pregnancy	
5.	Groups at increased risk during mumps outbreak	• During mumps outbreaks, adults previously vaccinated with 2 doses of a mumps-containing vaccine may be advised to receive a third dose, if identified by public health authorities as being at increased risk. • Individuals should not seek an additional dose unless officially notified.

Implication for Healthcare Workers (HCWs)

All healthcare workers (HCWs) and staff with regular patient contact should be immune to mumps, as transmission in healthcare settings endangers both HCWs and patients. Those without a history of mumps infection or prior vaccination should receive two doses of a mumps-containing vaccine, administered at least four weeks apart.



Evidence of Safety & Effectiveness

The mumps component of the MMR vaccine is moderately effective in preventing mumps infection. Two doses provide about 86% effectiveness, with a reported range of 32% to 95%, while one dose offers approximately 72% effectiveness, ranging from 49% to 91%. Despite this variability, receiving two doses remains the most effective strategy for reducing the risk of mumps and its complications. Serological studies of vaccinated children demonstrated that mumps virus-neutralizing antibody titres persist for at least a decade post-vaccination.

References

1. Centers for Disease Control and Prevention. (2024, September 20). *Mumps vaccine recommendations*. U.S. Department of Health & Human Services. <https://www.cdc.gov/mumps/hcp/vaccine-considerations/index.html>
2. Centers for Disease Control and Prevention. (n.d.). *Adult immunization schedule notes* [Web page]. U.S. Department of Health & Human Services. Retrieved September 30, 2025, from <https://www.cdc.gov/vaccines/hcp/imz-schedules/adult-notes.html#note-mmr>
3. Marin, M., Marlow, M., Moore, K. L., & Patel, M. (2018, January 5). Recommendation of the Advisory Committee on Immunization Practices for use of a third dose of mumps virus-containing vaccine in persons at increased risk for mumps during an outbreak. *Morbidity and Mortality Weekly Report*, 67(1), 33–38. <https://doi.org/10.15585/mmwr.mm6701a7>
4. National Pharmaceutical Regulatory Agency (NPRA) *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
5. World Health Organization. (2024, March 15). *Mumps virus vaccines: WHO position paper, WER No. 11, 99, 115–133. Weekly Epidemiological Record*. World Health Organization. <https://iris.who.int/bitstream/handle/10665/376287/WER9911-115-133.pdf?sequence=1>



Introduction

Rubella, or German measles, is a mild viral illness transmitted by respiratory droplets, most often affecting children and young adults. It is caused by rubella virus, a single-stranded RNA from the *Rubivirus* genus, and *Matonaviridae* family. The incubation period is about 2–3 weeks, and infected individuals are contagious from one week before to two weeks after rash onset. Symptoms are usually mild, such as fever, rash, lymphadenopathy, and arthralgia, particularly in adult women.

In Malaysia, rubella has shown a stable low incidence in recent years, reflecting strong vaccination coverage and steady progress toward elimination. The main concern is infection in pregnancy, which can result in miscarriage or congenital rubella syndrome (CRS) with complications such as deafness, eye and heart abnormalities, and developmental delays. Although severe malformations are less likely after the first trimester, hearing loss may still occur, and infants with CRS can shed the virus for long periods.

Vaccination remains essential, particularly for adults in close-contact environments and for college or university students, as these settings facilitate rapid spread once a single case is introduced. It is also a priority for international travelers and women of childbearing age before pregnancy, to prevent infection and protect future pregnancies.

Table 17.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	SII Rubella®	SM Pharmaceuticals Sdn Bhd/Serum Institute of India Private Limited, India	Live attenuated rubella vaccine
2.	MMR® II	Merck Sharp & Dohme (Malaysia) Sdn Bhd/Merck Sharp & Dohme B.V. Netherlands	Live attenuated measles, mumps and rubella vaccine



No.	Name	PRH/Manufacturer	Type
3.	Priorix®	GlaxoSmithKline Pharmaceutical Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Live attenuated measles, mumps and rubella vaccine
4.	SII Measles and Rubella Virus Vaccine®	SM Pharmaceuticals Sdn Bhd/Serum Institute of India Private Limited, India	Live attenuated measles and rubella vaccine, single or 10 doses

Table 17.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Adults living or working in congregate settings	Those without presumptive evidence of immunity should get 2 doses of MMR vaccine, separated by at least 28 days
2.	International travellers - independent of destination of travel (endemic or non-endemic country)	
3.	University and college students	
4.	Women of childbearing age, before pregnancy	1 dose of rubella vaccine for all non-pregnant women of reproductive age who are not already vaccinated or who are seronegative for rubella

Implication for Healthcare Workers (HCWs)

All healthcare workers (HCWs) and staff with regular patient contact should be immune to rubella. Those without a history of rubella infection or prior vaccination are advised to receive a single dose of the rubella vaccine.



Evidence of Safety & Effectiveness

Rubella vaccines, either single or in combinations, have proven highly efficacious in the prevention of rubella and congenital rubella syndrome worldwide. The effectiveness of 1 dose of rubella-containing vaccine (RCV) is $\geq 95\%$, even at the age of 9 months of age. Therefore, if high coverage is achieved, only 1 dose of RCV is required to achieve rubella elimination. In outbreak situations the effectiveness of different rubella vaccines has been found to be 90–100% effective. The vaccine provides life-long immunity against rubella virus.

There is no evidence that the rubella vaccine harms the fetus; however, women are advised to avoid pregnancy for 4 weeks (28 days) after receiving the MMR vaccine as a precaution.

References

1. Centers for Disease Control and Prevention. (2025, January 17). *Rubella vaccine recommendations*. Centers for Disease Control and Prevention. <https://www.cdc.gov/rubella/hcp/vaccine-considerations/index.html>
2. Centers for Disease Control and Prevention. (n.d.). *Adult immunization schedule notes* [Web page]. U.S. Department of Health & Human Services. Retrieved September 30, 2025, from <https://www.cdc.gov/vaccines/hcp/imz-schedules/adult-notes.html#note-mmr>
3. Krow-Lucal, E., Marin, M., Shepersky, L., Bahta, L., Loehr, J., & Dooling, K. (2022). *Measles, mumps, rubella vaccine (PRIORIX): Recommendations of the Advisory Committee on Immunization Practices — United States, 2022*. Morbidity and Mortality Weekly Report, 71(46), 1465–1470. <https://doi.org/10.15585/mmwr.mm7146a1>
4. National Pharmaceutical Regulatory Agency (NPRA) *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
5. World Health Organization. Summary of the WHO position on Rubella Vaccine—July 2020. https://www.who.int/docs/default-source/immunization/position_paper_documents/rubella/summary-of-the-who-position-on-rubella-vaccine-2020.pdf?ua=1
6. World Health Organization. Rubella reported cases and incidence: Malaysia [Data from WHO/UNICEF Joint Reporting Form]. WHO Immunization Data portal. Retrieved August 1, 2025, from <https://immunizationdata.who.int/global/wiise-detail-page/rubella-reported-cases-and-incidence?CODE=MYS>



Introduction



Meningococcal disease is most commonly manifested as meningitis or sepsis but can also present as septic arthritis or carditis. It is caused by *Neisseria meningitidis*, which is classified into 12 serogroups of which serogroups A, B, C, W135, X, or Y capsular polysaccharides have been associated with invasive disease.

Neisseria species, which usually reside asymptotically in the human nasopharynx, are easily transmitted to close contacts by respiratory droplets. Nasopharyngeal carriage of potentially pathogenic *N. meningitidis* has been reported in 4%–35% of healthy adults. In particular, high carriage rates have been found in relatively confined populations such as college students and army recruits. Studies in the UK and US have revealed that students, in their first year of college and who are living in dormitories are at a higher risk of meningococcal disease, compared to other college students and age-matched general population. Outbreaks following the Hajj pilgrimage to Mecca illustrate how high levels of transmission of *N. meningitidis* can occur under crowded conditions.

The case-fatality is typically 10–15% and can be higher in meningococemia, even with treatment.

In the African meningitis belt, which is considered to have the highest annual incidence in the world, serogroups A, C and W135 are the main causes of epidemic meningococcal meningitis. Serogroup B is generally associated with sporadic disease but may cause some upsurges or outbreaks. Serogroup W135 has caused international outbreaks in 2000 and 2001 among Hajj pilgrims and household contacts of returning pilgrims.



Vaccines

- Currently, tetravalent vaccines protecting against A, C, Y and W135 are available. These vaccines are derived from the capsular polysaccharide and can be either conjugated to diphtheria/tetanus toxoid or CRM197 (a non-toxic protein of *Corynebacterium diphtheriae*). These vaccines offer no protection against serogroup B organisms.
- A vaccine against serogroup B meningococcal disease is used in some countries but it is not currently available in Malaysia. It is a multicomponent vaccine made from three *N. meningitidis* proteins and capsular group B outer membrane vesicles. Fortunately, Men B vaccination is not included in current immunisation strategies in Kingdom of Saudi Arabia (KSA), or for individuals entering the country for the Hajj and Umrah pilgrimages
- A pentavalent meningococcal ACWYX conjugate vaccine (Men5CV), the first to include NmX, was prequalified by WHO in July 2023, with an indication for use in individuals aged ≥1 year. Countries (especially in the African meningitis belt) with >10 districts crossing the epidemic threshold, or >300 outbreak cases since 2011,27 are considered high risk and should be prioritized for Men5CV introduction.

Table 18.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	Menactra®	Sanofi Aventis (M) Sdn Bhd/ Sanofi Pasteur, France	Quadrivalent (ACWY) conjugate vaccine containing serogroups A, C, W135 and Y polysaccharides conjugated with diphtheria toxoid protein
2.	Menveo®	GlaxoSmithKline Pharmaceutical Sdn Bhd/ GlaxoSmithKline Vaccines S.r.l, Italy	Quadrivalent (ACWY) conjugate vaccine containing serogroups A, C, W135 and Y polysaccharides conjugated with non-toxic <i>C. diphtheriae</i> CRM197 protein.



No.	Name	PRH/Manufacturer	Type
3.	MenQuadfi®	Sanofi Aventis (M) Sdn Bhd/ Sanofi Pasteur Inc (United States)	Quadrivalent (ACWY) conjugate vaccine containing serogroups A, C, W135 and Y polysaccharides conjugated with tetanus toxoid protein.
4.	Nimenrix®	Pfizer (M) Sdn Bhd/ Pfizer Manufacturing Belgium NV, Belgium	Quadrivalent (ACWY) conjugate vaccine containing serogroups A, C, W135 and Y polysaccharides conjugated with tetanus toxoid carrier protein.

Table 18.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Pilgrims attending the Hajj or Umrah in Saudi Arabia	KSA requires MenACWY vaccination for Hajj/Umrah pilgrims: conjugate vaccine within the last 5 years (or polysaccharide within the last 3 years), administered ≥10 days before arrival.
2.	Travelers who intend to visit countries where epidemics of group A, W135 or Y disease are frequent (i.e. African meningitis belt)	- Current list of those countries is available at https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/meningococcal-disease.html  - Single dose of quadrivalent conjugate vaccine every 5 years if they are still at risk of meningococcal exposure



No.	Target group	Recommended Dosing Schedule
3.	*High risk adults	• 2-dose primary schedule, 8 weeks apart. • Booster doses every 5 years.

** functional or anatomical asplenia or complement component disorders (C5-C9, properdin, factor D or factor H), persons receiving treatment with eculizumab (a monoclonal antibody directed against complement component C5), or those post haematopoietic stem cell transplantation.*

NOTE:

- The different conjugate vaccine products can be used interchangeably for the booster doses.
- If Menactra® is used, it should be administered at least four weeks after completion of all pneumococcal conjugate vaccine doses.

Implication for Health Care Workers (HCWs)

Recommended for laboratory staff who frequently handle *N. meningitidis* isolates.

Evidence of Safety & Effectiveness

Contraindications and Undesirable Effects

For the conjugate vaccines, adverse reactions are generally mild with pain and redness at the injection site, fever, headache, anorexia and nausea. While there were initial concerns regarding Guillain-Barré syndrome (GBS) with Menactra®, recent safety studies found no increased risk in the general population or in those with a history of GBS. Meningococcal vaccines are not routinely recommended for pregnant or breastfeeding women but can be given if clinically indicated.

To date, the most frequently reported adverse events for meningococcal vaccines received by the National Pharmaceutical Regulatory Agency (NPRA) include local site reactions such as injection site swelling and pain, fever, muscle pain and rash.



Evidence of Effectiveness

The meningococcal conjugate vaccines elicit a T cell-dependent memory response that results in an improved primary response to vaccination and a strong anamnestic response at re-exposure when compared with polysaccharide vaccines. Effectiveness of the quadrivalent vaccine within 3-4 years after vaccination is 80-85%. However, the effectiveness seems to wane with time. Five years post vaccination, the proportion with protective antibody levels drops to 56-72% among adolescents.

References

1. Andersen B. M. (1978). Mortality in meningococcal infections. *Scandinavian Journal of Infectious Diseases*, 10(4), 277-282. <https://doi.org/10.3109/inf.1978.10.issue-4.04>
2. Bruce, M. G., Rosenstein, N. E., Capparella, J. M., Shutt, K. A., Perkins, B. A., & Collins, M. (2001). Risk factors for meningococcal disease in college students. *JAMA*, 286(6), 688-693. <https://doi.org/10.1001/jama.286.6.688>
3. Centers for Disease Control and Prevention (CDC) (2013). *Prevention and control of meningococcal disease: recommendations of the Advisory Committee on Immunization Practices (ACIP)*. MMWR. Recommendations and reports: Morbidity and mortality weekly report. Recommendations and reports, 62(RR-2), 1-28. <https://www.cdc.gov/mmwr/pdf/rr/r6202.pdf>
4. Keyserling, H., Papa, T., Koranyi, K., et al. (2005). Safety, immunogenicity, and immune memory of a novel meningococcal (groups A, C, Y, and W-135) polysaccharide diphtheria toxoid conjugate vaccine (MCV-4) in healthy adolescents. *Archives of Pediatrics & Adolescent Medicine*, 159(10), 907-913. <https://doi.org/10.1001/archpedi.159.10.907>
5. Macneil, J. R., Cohn, A. C., Zell, E. R., Schmink, S., Miller, E., Clark, T., Messonnier, N. E., & Active Bacterial Core surveillance (ABCs) Team and MeningNet Surveillance Partners (2011). Early estimate of the effectiveness of quadrivalent meningococcal conjugate vaccine. *The Pediatric Infectious Disease Journal*, 30(6), 451-455. <https://doi.org/10.1097/INF.0b013e31820a8b3c>
6. The Malaysian National Centre of Adverse Drug Reactions Database. [Accessed: 10 October 2019]
7. Nelson, S. J., Charlett, A., Orr, H. J., et al. (2001). Risk factors for meningococcal disease in university halls of residence. *Epidemiology and Infection*, 126(2), 211-217. <https://doi.org/10.1017/s0950268801005301>
8. National Advisory Committee on Immunization, Canada. (January, 2013). *Update on the Use of Quadrivalent Meningococcal Vaccines: Canadian Communicable Disease Report (CCDR)*. An Advisory Committee Statement (ACS), 39(ACS-1), 1-40. <https://doi.org/10.14745/ccdr.v39i00a01>
9. Wilder-Smith, A., Barkham, T. M., Ravindran, S., Earnest, A., & Paton, N. I. (2003). Persistence of W135 *Neisseria meningitidis* carriage in returning Hajj pilgrims: risk for early and late transmission to household contacts. *Emerging Infectious Diseases*, 9(1), 123-126. <https://doi.org/10.3201/eid0901.020131>



10. World Health Organization. (November 18, 2011). Meningococcal vaccines: WHO position paper, Weekly epidemiological record, 47:521-539. <https://iris.who.int/server/api/core/bitstreams/fa4b8b3c-3b14-4f1d-85ce-a7ae0f31f2e3/content>
11. World Health Organization. (January 12, 2024). Meningococcal vaccines: WHO position paper on the use of multivalent meningococcal conjugate vaccines in countries of the African meningitis belt. Weekly epidemiological record, 99(1/2):1-10.
12. Badur, S., Mona, A., Dabbagh, Al, et al. (2021). The Epidemiology of Invasive Meningococcal Disease in the Kingdom of Saudi Arabia: A Narrative Review with Updated Analysis. Infect Dis Ther,10:2035-2049. <https://doi.org/10.1007/s40121-021-00467-x>
13. Health requirements and recommendations for travelers to Saudi Arabia for Hajj and Umrah [Internet]. Riyadh: Ministry of Health (Saudi Arabia); 2025 May 24. <https://www.moh.gov.sa>
14. Centers for Disease Control and Prevention (CDC). Use of meningococcal vaccines in persons with increased risk for invasive meningococcal disease: Recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep*. 2020;69(RR-9):1–41.
15. Centers for Disease Control and Prevention. Meningococcal disease: *Clinical overview and vaccine recommendations*. In: Pink Book — Epidemiology and Prevention of Vaccine-Preventable Diseases. 14th ed. Atlanta: CDC; 2024.
16. National Pharmaceutical Regulatory Agency (NPRA). *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>



Introduction

Mpox is caused by the monkeypox virus (MPXV), an enveloped double-stranded DNA virus. It is a member of the *Orthopoxvirus* genus in the family *Poxviridae*. There are two distinct clades of the virus: clade I (Central African/ Congo Basin) (subclades Ia and Ib) and clade II (West African) (subclades IIa and IIb). Clade I infections are generally more severe and more transmissible, with higher mortality rates, while Clade II infections are typically milder and were responsible for the 2022–2023 global outbreak and continues to circulate internationally.

Mpox can be transmitted through close contact with an individual who has mpox, with contaminated materials, or with infected animals. The virus can spread between people through skin-to-skin contact with sores, scabs, respiratory droplets or oral fluids, usually through close, intimate situations. Most of the recent spike in cases has been through sexual transmission. Infection is also transmitted through contact with animals, such as via infected rodents through broken skin (bites or scratches), or direct contact with an infected animal's blood, bodily fluids or pox lesions (sores).

Incubation period is 5–13 days, although it can take up to 21 days. Early symptoms include fever, headache, muscle ache, backache, swollen lymph nodes, chills and exhaustion, followed by a rash on the face, hands and feet, that can spread to the inside of the mouth, the genitals and the cornea. The rash can last 2–4 weeks. With no specific antiviral treatment available, treatment of Mpox is mainly symptomatic.

Mpox was first discovered in 1958 when outbreaks of a disease that caused pox-like symptoms were discovered in monkeys held in captivity for research. It was first seen in humans in 1970 in the Democratic Republic of the Congo (DRC) and it is now endemic in Central and West Africa. The geographic range of mpox is mostly West and Central Africa.

In 2017, Nigeria saw a re-emergence of cases after nearly four decades of zero cases; and the disease was spreading in an unusual way. Most patients were young men who had lesions or skin rashes and ulcers around the genital area, which suggested that mpox might also be spread through



sexual contact. By this point, DRC had also seen cases steadily rising. A global outbreak of clade IIb began in 2022 and continues to this day, including in some African countries. There are also growing outbreaks of clades Ia and Ib affecting the DRC and other countries in Africa. As of 2024, clade Ib has also been detected beyond Africa.

In May 2022, a case of mpox was detected in the UK, and soon several more, apparently unconnected cases, were found, spreading across borders in Europe and to the US. It soon emerged that most of the cases across Europe and the US were in men who have sex with men, especially those who had closely connected sexual networks, allowing the virus to spread in a different way than in the general population. By July 2022, WHO declared the global outbreak a Public Health Emergency of International Concern (PHEIC). The 2022–2023 global outbreak was caused by the clade IIb mpox strain.

Just over a year later, on 14 August 2024, WHO declared once more that mpox was a PHEIC. This declaration was prompted by a surge of mpox cases in countries like DRC, and also in neighbouring countries that had never seen mpox before, such as Burundi, Kenya, Rwanda and Uganda. This was caused by the more deadly clade I strain.

In 2025, it was reported to WHO that between January–May 2025, 24,672 confirmed cases and 82 deaths were reported across 75 countries. Most cases were in Africa, especially Central and East Africa. Outside Africa, smaller clusters continue in Europe, North America, Asia, and Latin America, mostly linked to Clade II.

Vaccines

Vaccines are available for mpox and should be considered along with other public health interventions. The smallpox vaccine, which uses the vaccinia virus, is closely related to the mpox virus and provides partial cross-protection against mpox infection, although this immunity wanes over time. This connection has driven the development of vaccines specifically for mpox. The smallpox vaccine that can prevent about 85% of mpox cases have been deployed in recent emergencies to curb transmission. Available evidence shows mpox vaccines are safe and well tolerated in most people.



Table 19.1 Mpox Vaccines

No.	Vaccine	Develop	Type / Schedule
1.	MVA-BN (Jynneos®) / Imvamune® (in Canada)/ Imvanex® (in Europe)	Bavarian Nordic, Denmark	• Live-attenuated vaccine, non-replicating. • SC/intradermal, two doses, 4 weeks apart.
		• Provides protection against both mpox and smallpox. • For adults ≥ 18 years old at high risk; pregnant and breastfeeding women; immunocompromised patients.	
2.	LC16m8 (LC16-KMB®)	KM Biologics Co., Ltd. Japan	• Live-attenuated, minimally replicating smallpox vaccine • ID/SC, single dose using bifurcated (two-tipped) needle
		• For children from 1 year of age • Causes skin reaction at the site of the injection within two weeks of vaccination and leaves a small scar. • Contraindicated in pregnant and immunocompromised individuals, except those with well-controlled HIV	
3.	ACAM2000	Emergent Biosolutions, Canada	• Live-unattenuated vaccine, replicating, derived from Dryvax smallpox vaccine • Single dose using bifurcated (two-tipped) needle
		• Older smallpox vaccine that can also protect against mpox. • Important in certain high-risk settings but is typically not recommended for widespread use. • Limited use due to significant safety concerns. • Contraindicated in the immunocompromised, pregnant, and those with heart/skin conditions	



In Malaysia, mpox vaccines are not part of a general public health programme. Malaysia received 2,220 doses of the JYNNEOS (MVA BN) vaccine in February 2025 through the ASEAN Covid 19 Response Fund. The coverage is sufficient for about 1,100 individuals, since JYNNEOS requires two doses. The Ministry of Health is prioritizing frontline healthcare workers and close contacts of confirmed cases, using limited supplies of the JYNNEOS vaccine and reinforcing the ring vaccination approach. Vaccination is administered only after medical expert evaluation. Malaysia's rollout mirrors a global strategy of limited doses, targeted use, and outbreak containment as opposed to broad public immunization.

Meanwhile, BioNTech, in partnership with CEPI (Coalition for Epidemic Preparedness Innovations) started a Phase 1/2 clinical trial of the mRNA-based mpox vaccine candidate, BNT166.

Implication for Healthcare Workers (HCWs)

Targeted approach and priority groups for vaccination currently as above.

Evidence of Safety and Effectiveness

JYNNEOS has demonstrated strong safety and efficacy in clinical trials, with mild adverse effect such as injection site pain, fever, and fatigue. It has been shown to provide effective protection in populations at risk of infection. ACAM2000, while effective, has more serious adverse effects, including myocarditis, pericarditis, and severe skin reactions, which make it less ideal for immunocompromised individuals. Both vaccines appear to be highly effective in preventing severe disease, reducing viral transmission, and shortening the duration of illness when used in PEP or PrEP settings.

A 2015 clinical study evaluated a two-dose series of JYNNEOS given intradermally compared to subcutaneously in individuals ≥ 18 years old. Individuals who received the vaccine intradermally received a



lower volume (one fifth) than individuals who received the vaccine subcutaneously. The results of this study demonstrated that intradermal administration produced a similar immune response to subcutaneous administration. Administration by the intradermal route resulted in more redness, firmness, itchiness and swelling at the injection site, but less pain.

References

1. Bavarian Nordic. (March 2025). JYNNEOS vaccine. Prescribing Information. <https://bavariannordic.io/uploads/jynneos-pi.pdf>
2. Esteban Ortiz-Prado, E., Kyriakidis, N. C., López-Cortés, A., et al. (2025). Current and emerging mpox vaccine strategies: A comprehensive review. *Vaccine*, 62, 127598. <https://doi.org/10.1016/j.vaccine.2025.127598>
3. Grabenstein, J. D., & Hacker, A. (2024). Vaccines against mpox: MVA-BN and LC16m8. *Expert Review of Vaccines*, 386, e078243. <https://doi.org/10.1080/14760584.2024.2397006>
4. Hraib, M., Jouni, S., Albitar, M.M., Alaidi, S., and Aishehabi, Z. (June 2022). The outbreak of monkeypox 2022: An overview. *Ann Med Surg (Lond)*,79:104069. DOI: 10.1016/j.amsu.2022.104069
5. Kennedy, J.S., Gurwith, M., Dekker, C.L., et al. (2011). Safety and immunogenicity of LC16m8: An attenuated smallpox vaccine in vaccinia-naïve adults. *Journal of Infectious Diseases*, 204, 1395–1402. <https://doi.org/10.1093/infdis/jir527>
6. Lauren, P., Martini, B.A., Yu, N., et al. (2024). Vaccine effectiveness of 3rd generation mpox vaccines against mpox and disease severity: A systematic review and meta-analysis. *Vaccine*, 42(25), 126053. <https://doi.org/10.1016/j.vaccine.2024.06.021>
7. Ministry of Health Malaysia. (2025). *Reten pemantauan dan pemberian vaksin Mpox (MVA-BN) di fasiliti*. Bahagian Kawalan Penyakit, KKM.
8. Nalca, A., & Zumbun, E. E. (2010). ACAM2000: The new smallpox vaccine for the United States Strategic National Stockpile. *Drug Design, Development and Therapy*, 4, 71–79. <https://doi.org/10.2147/dddt.s3687>
9. Navarro, C., Lau, C., Buchan, S. A., et al. (2024). Effectiveness of modified vaccinia Ankara-Bavarian Nordic vaccine against mpox infection: Emulation of a target trial. *BMJ*, 386. <https://doi.org/10.1136/bmj-2023-078243>
10. Pittman, P. R., Hahn, M., Lee, H. S., et al. (2019). Phase 3 efficacy trial of modified vaccinia Ankara as a vaccine against smallpox. *New England Journal of Medicine*, 381, 1897–1908. DOI: 10.1056/NEJMoal817307
11. Rao, A.K., Peterson, B.W., Whitehill, F., et al. (2022). Use of JYNNEOS (Smallpox and Monkeypox Vaccine, Live, Nonreplicating) for Preexposure Vaccination of Persons at Risk for Occupational Exposure to Orthopoxviruses: Recommendations of the Advisory Committee on Immunization Practices — United States, 2022. *MMWR*,71(22):734–742. <https://www.cdc.gov/mmwr/volumes/71/wr/pdfs/mm7122e1-H.pdf>
12. Shafaati, M., Forghani, S., Shahsavand Davoudi, A., et al. (2025). Current advances and challenges in mpox vaccine development: A global landscape. *Therapeutic Advances in Vaccines and Immunotherapy*, 13, 25151355251314339. <https://doi.org/10.1177/25151355251314339>



13. Wang, X., Gu, Z., Sheng, S., Song, R., & Jin, R. (2024). The current state and progress of mpox vaccine research. *China CDC Weekly*, 6(7), 118–125. <https://doi.org/10.46234/ccdcw2024.025>
14. World Health Organization. (August 2024). *Mpox: Fact sheet*. <https://www.who.int/news-room/fact-sheets/detail/monkeypox>
15. World Health Organization. (April 22, 2025). *LC16m8 (live-attenuated freeze-dried vaccinia) smallpox and mpox vaccine: Interim guidance*. <https://iris.who.int/server/api/core/bitstreams/9b10eb01-fbfd-4f9f-81b7-9c29ddbccc560/content>
16. Zhai, Y. Q., Han, Y. Z., Wang, W. L., & Tan, W. J. (2025). Advancements in mpox vaccine development: A comprehensive review of global progress and recent data. *Biomedical and Environmental Sciences*, 38(2), 248–254. <https://doi.org/10.3967/bes2024.121>



Introduction



The pneumococcal disease is caused by *Streptococcus pneumoniae*, a gram-positive, encapsulated diplococcus with over 100 identified serotypes, based on the capsular polysaccharide. The polysaccharide capsule is its most important virulence factor and 15 of the serotypes are responsible for the majority of the invasive pneumococcal diseases (IPD). Type-specific antibody to this capsular polysaccharide is protective.

Based on data from the Institute for Medical Research (IMR) collected from 2019-2022, the predominant serotypes identified in Malaysian adults were 3, 6A, 19A, 19F, 23A and 23F.

The pneumococci commonly colonize the nasopharynx, often without causing symptoms. The nasopharynx acts as the main reservoir for transmission. Asymptomatic carriage is estimated to be 20-60% in children and 5-10% in adults. Pneumococcal infection can affect multiple organ systems leading to pneumonia, bacteremia, meningitis, otitis media and sinusitis.

The risk of pneumococcal disease decreases after early childhood but increases again in older age. This suggests acquisition of natural immunity in early life and its waning in older adults due to immunosenescence and increased vulnerability from comorbid conditions.



Table 20.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	Prevenar 13	Pfizer (M) Sdn Bhd/ Pfizer Manufacturing Belgium NV (Belgium)	Intramuscular (IM) PCV13 contains 13 pneumococcal serotypes & conjugated with CRM197
2.	Vaxneuvance	Merck Sharp & Dohme B.V. (Netherlands)	Intramuscular (IM) PCV15 contains 15 pneumococcal serotypes & conjugated with CRM197
3.	Prevenar 20	Pfizer (M) Sdn Bhd/ Pfizer Manufacturing Belgium NV (Belgium)	Intramuscular (IM) PCV20 contains 20 pneumococcal serotypes & conjugated with CRM197
4.	Pneumovax 23	Merck Sharp & Dohme B.V. (Netherlands)	Intramuscular (IM)/ Subcutaneous (SC) PPSV23 contains 23 pneumococcal polysaccharide serotypes

Note

- In vaccine naïve individuals, PCV should be given first as it improves the antibody response to subsequent PPSV23 vaccination.
- Sequential vaccination with PCV13 or PCV15 followed by PPSV23 provides enhanced protection against invasive pneumococcal disease (IPD) and pneumonia compared to individual vaccines alone.
- However, a single dose of PCV20 offers comparable broad serotype coverage, eliminating the need for sequential dosing, thereby simplifying the pneumococcal vaccination schedule.
- The 21-valent pneumococcal conjugate vaccine (PCV21), which expands coverage to include additional serotypes associated with adult invasive pneumococcal disease in settings with serotype replacement, is recommended in some countries but is not yet available in Malaysia.

Current Pneumococcal Vaccines																																	
Serotype	4	6B	9V	14	18C	19F	23A	23B	23F	24F	1	5	7F	3	6A	19A	22F	31	35B	33F	8	10A	11A	12F	15A	15B	16F	2	9N	17F	20	20A	
Pneumococcal Conjugate Vaccines																																	
PCV13 ¹																																	
PCV15 ¹																																	
PCV20 ²																																	
PCV21 ¹																																	
Pneumococcal Polysaccharide Vaccine																																	
PPSV 23 ³																																	

1. Pevnar 13 Prescribing Information. 3 November 2021.; 2. Kobayashi M, et al. MMRW. 2022;71(4):109-117.; 3. Capvaxive Prescribing Information. July 2025 4. Pneumovax 23 Prescribing information. April 2021.

*PCV21 is not yet available in Malaysia



Table 20.2 High Risk Groups in Malaysia

No.	Target group	Prior Vaccine	Recommendation
1.	Adults ≥50 years old	None	- Option 1: Single dose of PCV20 - Option 2: PCV13 or PCV15 followed by PPSV23 after ≥1 year
		Either PCV20 alone or PCV13/PCV15+ PPSV23 sequential series is acceptable.	
		PPSV23 only	- Option 1: PCV20 after ≥1 year - Option 2: PCV13 or PCV15 after ≥1 year
		PCV13 only	- Option 1: PCV20 after ≥1 year - Option 2: PPSV23 after ≥1 year
		For option 2, PPSV23 provides added protection against serotypes not covered by PCV13	
		PCV13+PPSV23 (both given before 65 yrs old)	PCV20 ≥5 years after last PPSV23
		Complete series: PCV13 at any age & PPSV23 at ≥65 years	PCV20 after ≥5 years (shared clinical decision making)
		Vaccine providers may choose to give PCV20 to adults ≥65 years	

If PCV20 is not available, a maximum of three lifetime doses of PPSV23 may be administered, with a minimum interval of 5 years between doses in individuals with ongoing indications for revaccination.



No.	Target group	Prior Vaccine	Recommendation
2.	19-49 years old with chronic health conditions*	None	- Option 1: Single dose of PCV20 - Option 2: PCV13 or PCV15 followed by PPSV23 after ≥ 1 year
		Either PCV20 alone or PCV13/PCV15+ PPSV23 sequential series is acceptable	
		PPSV23 only	- Option 1: PCV20 after ≥ 1 year - Option 2: PCV13 or PCV15 after ≥ 1 year
		PCV13 only	- Option 1: PCV20 after ≥ 1 year - Option 2: PPSV23 after ≥ 1 year
		For option 2, PPSV23 provides added protection against serotypes not covered by PCV13	
		PCV13+PPSV23	No further vaccine needed.
		To review pneumococcal vaccine recommendations again when the patient turns 50 years old	

*Chronic health conditions include:

- Alcoholism
- Chronic heart disease including congestive heart failure and cardiomyopathies
- Chronic liver disease
- Chronic lung disease including chronic obstructive pulmonary disease, emphysema, and asthma
- Cigarette smoking
- Diabetes mellitus



No.	Target group	Prior Vaccine	Recommendation
3.	19-49 years old with immunocompromising conditions*, cochlear implant and CSF leak	None	• Option 1: Single dose of PCV20 • Option 2: PCV13 or PCV15 followed by PPSV23 after ≥ 8 weeks
		PPSV23 only	• Option 1: PCV20 after 1 year • Option 2: PCV13 or PCV15 after ≥ 1 year
		PCV13 only	• Option 1: PCV20 after ≥ 1 year • Option 2: PPSV23 after ≥ 1 year
		PCV13+ PPSV23	• Option 1: PCV20 after 5 years • Option 2: 2nd dose of PPSV23 after 5 years (Refer to the comments in option 2)
		<u>Comments</u> Option 1: • Considered a complete vaccination schedule. Option 2: • A second dose of PPSV23 should be administered at least 5 years after the previous PPSV23 dose. • A maximum of three lifetime doses of PPSV23 may be administered if PCV 20 is not available, in individuals with ongoing indications for revaccination	

*Immunocompromising conditions

- Solid organ transplant recipients on immunosuppressants
- Blood cancer or some red blood cell disorders—thalassemia, sickle cell disease
- Primary or acquired (HIV) immunodeficiency
- Chronic renal failure
- Chemotherapy or whole-body radiotherapy in the past 3 months



- High dose corticosteroids or pulse corticosteroid therapy in the past 3 months
- Immunosuppressive treatments in the past 3 months
- Monoclonal antibody treatment in the past 12 months

Evidence of Effectiveness

Protection from anti-capsular antibodies is generally serotype-specific; however, cross-protection against serotypes within a serogroup can occur – e.g. between 6A and 6C. The use of PPSV requires a booster dose every 5 years if indicated (maximum 3 lifetime doses: more than this is associated with hyporesponsiveness). Currently, using PCV only needs a single dose and additional booster doses are not routinely recommended.

Pneumococcal conjugate vaccine (PCV) reduces nasopharyngeal colonisation, thereby decreasing the spread of infection. In countries with childhood vaccination coverage exceeding 50%, the rate of invasive pneumococcal disease (IPD) in adults decreased by 28% and rates of IPD due to strains covered by PCV13 decreased by 40%. However, this has been accompanied by a 20% increase in IPD due to non-PCV13 strains in the elderly.



References

1. Bonten, M. J., Huijts, S. M., Bolkenbaas, M., et al. (2015). Polysaccharide Conjugate Vaccine against Pneumococcal Pneumonia in Adults. *New England Journal of Medicine*, 372(12), 1114–1125. <https://doi.org/10.1056/nejmoa1408544>
2. Vadlamudi, N. K., Chen, A., & Marra, F. (2019). Impact of the 13-Valent Pneumococcal Conjugate Vaccine Among Adults: A Systematic Review and Meta-analysis. *Clinical infectious diseases : an official publication of the Infectious Diseases Society of America*, 69(1), 34–49. <https://doi.org/10.1093/cid/ciy872>
3. Bonnaville, C., Mertens, D., Peetermans, W., Cobbaert, K., Ghesquiere, B., Deschodt, M., & Flamaing, J. (2019). Adult vaccination for pneumococcal disease: a comparison of the national guidelines in Europe. *European journal of clinical microbiology & infectious diseases: official publication of the European Society of Clinical Microbiology*, 38(4), 785–791. <https://doi.org/10.1007/s10096-019-03485-3>
4. Greenberg, G.M., Koshy, P.A., Hanson, M.J.S. (Nov 2022) Adult Vaccination, *Am Fam Physician*, 106(5):534-542. <https://www.aafp.org/pubs/afp/issues/2022/1100/adult-vaccination.pdf>
5. Shah AA. Simplifying pneumococcal immunizations for adults. *Am Fam Physician*. 2022;105(6):580-581. <https://www.aafp.org/pubs/afp/issues/2022/0600/p580.html>
6. Fletcher, M. A., Vojcic, J., Daigle, D., et al. (2024). National recommendations for adult pneumococcal vaccination in countries of the WHO regions of Americas, Africa, Eastern Mediterranean, South-East Asia, and Western Pacific. *Vaccine*, 42(26), 126390. <https://doi.org/10.1016/j.vaccine.2024.126390>
7. Kobayashi, M., Leidner, A. J., Gierke, R., et al. (2025). Expanded Recommendations for Use of Pneumococcal Conjugate Vaccines Among Adults Aged ≥50 Years: Recommendations of the Advisory Committee on Immunization Practices - United States, 2024. *MMWR. Morbidity and mortality weekly report*, 74(1), 1–8. <https://doi.org/10.15585/mmwr.mm7401a1>
8. Kobayashi, M., Pilishvili, T., Farrar, J. L., et al. (2023). Pneumococcal Vaccine for Adults Aged ≥19 Years: Recommendations of the Advisory Committee on Immunization Practices, United States, 2023. *MMWR. Recommendations and reports: Morbidity and mortality weekly report. Recommendations and reports*, 72(3), 1–39. <https://doi.org/10.15585/mmwr.rr7203a1>
9. Kobayashi, M., Farrar, J. L., Gierke, R., et al. (2022). Use of 15-Valent Pneumococcal Conjugate Vaccine and 20-Valent Pneumococcal Conjugate Vaccine Among U.S. Adults: Updated Recommendations of the Advisory Committee on Immunization Practices - United States, 2022. *MMWR. Morbidity and mortality weekly report*, 71(4), 109–117. <https://doi.org/10.15585/mmwr.mm7104a1>



Introduction



Poliomyelitis is an acute communicable disease caused by one of the three poliovirus serotypes (poliovirus type 1, 2 or 3) and is spread mainly by the faecal-oral route. The last cases of wild poliovirus type 2 (WPV2) were reported in October 1999 (India) and global eradication of WPV2 was certified in 2015. The last case of wild poliovirus type 3 (WPV3) was reported in November 2012 (Nigeria) and global eradication of WPV3 was certified in 2019. In 2021, WPV type 1 (WPV1) cases were reported in Afghanistan and Pakistan. These two countries continue to report cases of wild poliovirus type 1 (polio-endemic countries). Besides these two countries, circulating vaccine-derived poliovirus (cVDPV) has been reported in 35 other countries in 2023.

(for an updated list, visit www.polioeradication.org)



In 2000, WHO certified Malaysia as polio-free. However, in December 2019, the Ministry of Health of Malaysia announced the country's first case of polio since 1992. Testing had confirmed that the vaccine-derived polioviruses (cVDPV1 and cVDPV2) were genetically linked to the virus circulating in the Philippines. However, after extensive public health measures, Malaysia was declared polio-free again since 11 Sept 2021.

On average, about 1 in 75 adults who are infected, will develop paralytic poliomyelitis. The case fatality rate among paralytic cases is higher in adults (15–30%) compared to children (5–10%) predominantly due to bulbar involvement. Outbreaks of vaccine associated paralytic poliomyelitis (VAPP) occur in regions with low immunisation rates and poor sanitation. The low immunisation rates result in long-term circulation of the vaccine-derived poliovirus in the population and thus allowing the virus to mutate and reacquire biologic properties similar to naturally occurring wild-type poliovirus. This results in VAPP among the unvaccinated.



Vaccines

Two types of poliovirus vaccines are currently available: oral poliovirus vaccine (OPV) and inactivated poliovirus vaccine (IPV). Until 2015, over 90% of vaccine-derived poliomyelitis were due to the type 2 component of OPV. In 2016, trivalent OPV was switched to bivalent OPV (bOPV) in the routine immunisation programme in countries with high risk of transmission. Type 2 poliovirus was removed from the vaccine because it was eradicated in 1999 and ongoing burden of VAPP due to circulating vaccine-derived poliovirus type 2. In November 2020, WHO recommended the use of type 2 novel oral poliovirus (nOPV2) in outbreaks due to circulating vaccine-derived poliovirus 2 (cVDPV2). The strains contained in the vaccine are modified versions of the original OPV strain with enhanced genetic stability.

IPV is the preferred strategy for polio prevention. In the event of supply limitations, practitioners should refer to current MOH circulars and NPRA updates. As of the end of 2022, no cases of acute poliomyelitis were reported.

Table 21.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	Imovax Polio®	Sanofi Aventis (M) Sdn Bhd/ Sanofi Pasteur, France*	Administered subcutaneously. Formaldehyde inactivated poliovirus vaccine containing all 3 poliovirus types 1,2,3.

**Imovax is no longer made available by Sanofi as the NPRA registration was not renewed since July 2025 due to negligible demand from the private sector. Need special import permits from MOH. Further detailed information may be obtained from (<http://www.pharmacy.gov.my/v2/sites/default/files/>)*



Table 21.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Travelers to polio-affected countries	• Should have completed the primary vaccination schedule. • If unvaccinated or if vaccination status is not documented, should receive the primary vaccination series with IPV. • 3 dose series: Two doses of IPV 4–8 weeks apart & a third dose 6–12 months after the second dose.
2.	Residents or long-term visitors (i.e., >4 weeks) from polio-affected countries	• Should complete the full course of polio vaccination according to their national schedule. • In addition, receive 1 dose of IPV or bOPV 4 weeks to 12 months before departure, if have not had a booster vaccination in the preceding 12 months.

Implication for Health Care Workers (HCWs)

All healthcare workers should have completed a full course of primary vaccination.

Evidence of Safety & Effectiveness

Contraindications and Adverse Effects

- Pregnant or breastfeeding women and immunocompromised persons can receive IPV only if they are at immediate risk of exposure.
- Reported adverse events include transient minor local erythema (0.5–1.5%), induration (3–11%), and tenderness (14–29%).
- To date, the most frequently reported adverse event for OPV received by the National Pharmaceutical Regulatory Agency (NPRA) is fever.



Evidence of effectiveness of IPV

IPV vaccine is highly effective in producing immunity to poliovirus and protection from paralytic poliomyelitis. Ninety percent or more of vaccine recipients develop protective antibody to all three poliovirus types after 2 doses, and at least 99% are immune following 3 doses.

References

1. World Health Organization. (June 24, 2022). Polio vaccines: *WHO position paper-June 2022*. Weekly Epidemiological Record, 97(25), 277–300.
2. Centers for Disease Control and Prevention.(August 2021). *Poliomyelitis in Epidemiology and Prevention of Vaccine-Preventable Diseases*. Hall E., Wodi A.P., Hamborsky J.,et al., eds. 14th ed. Washington, D.C. Public Health Foundation. Chapter 18: 275-287. <https://www.cdc.gov/vccines/pubs/pinkbook/index.html>
3. Ministry of Health Malaysia (2023) *Malaysia Health Facts 2022*. Disease Control Division. https://www.moh.gov.my/moh/resources/Penerbitan/Penerbitan%20Utama/4._Health_Facts_2023-compressed_.pdf



Introduction



Rabies is an acute progressive and almost always lethal zoonotic neurological infection. It is caused by the Rabies virus (RABV), an unsegmented, single-stranded, enveloped RNA virus that belongs to the *Rhabdoviridae* family and the *Lyssavirus* genus.

Dogs are the most important animal reservoir for RABV. In rabies endemic areas virtually all human rabies cases are caused by infected dogs. RABV, which is found in saliva of an infected host, is predominantly transmitted through the bites, licks and scratches of rabid animals to new susceptible hosts. Direct person-to-person transmission of rabies has not been confirmed, except through organ transplantations that involved rabies-infected donors. The incubation period of the majority of cases is 1-3 months. Human rabies manifest clinically as the widely recognized 'furious' form, or the paralytic form. Rabies is almost always fatal once clinical signs appear.

The RABV is distributed worldwide except in Antarctica and some islands. Each year approximately 60,000 people die from the vaccine-preventable brain infection; more than 80% of the deaths occur in Asia and Africa.

Human and animal rabies cases were first documented in Peninsular Malaysia in 1924 and 1925, respectively. Sporadic human cases have been reported in Peninsular Malaysia with the last case occurring in 1998. In July 2017, a rabies outbreak affecting humans, dogs and cats was detected through human cases in Southern Sarawak.

Table 22.1 Vaccines Available in Malaysia (For pre-exposure (PrEP) and post-exposure (PEP) prophylaxis)

No.	Name	PRH/Manufacturer	Type
1.	VERORAB®	Sanofi-Aventis (M) Sdn Bhd/ Sanofi Winthrop Industrie (France)	Inactivated, purified Vero cell, PVRV



Table 22.2 High Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Travellers to rabies endemic areas	- Schedules: » 2-site ID vaccine administered on Day 0 and 7, or » 1-site IM vaccine administration on Day 0 and 7
2.	Veterinarians and animal handlers	- If any doses are delayed, vaccination should be resumed, NOT restarted. - A change in the administration route or vaccine product during a PEP course is acceptable if such a change is unavoidable

Table 22.3: Post-exposure Prophylaxis (PEP) Based on Category of Exposure and Rabies-Immune Status

	Category I exposure	Category II exposure	Category III exposure
Immunologically naive individuals of all age groups	Wash exposed skin surfaces No PEP required	Wound washing and immediate vaccination: 2-site ID on days 0, 3 and 7[#] OR 1-site IM on days 0, 3, 7 and 14 to 28^{\$} RIG is not indicated	Wound washing and immediate vaccination: 2-site ID on days 0, 3 and 7[#] OR 1-site IM on days 0, 3, 7 and 14 to 28^{\$} RIG is indicated



	Category I exposure	Category II exposure	Category III exposure
Previously immunised* individuals of all age groups (<3 months from last date of completed vaccination series – PEP or PrEP)	Wash exposed skin surfaces No PEP required	Wash exposed skin surfaces No PEP required	Wash exposed skin surfaces No PEP required
Previously immunised* individuals of all age groups (>3 months from last date of completed vaccination series – PEP or PrEP)	Wash exposed skin surfaces No PEP required	Wound washing and immediate vaccination: • 1-site ID on days 0 & 3; OR • 4-sites ID on day 0 OR • 1-site IM on days 0 & 3 RIG is not indicated.	Wound washing and immediate vaccination: • 1-site ID on days 0 & 3; OR • 4-sites ID on day 0 OR • 1-site IM on days 0 & 3 RIG is not indicated.

(Adapted from WHO Position Paper April 2018)

NOTE:

One-week, 2-site ID regimen (Institut Pasteur du Cambodge regimen); duration of the entire PEP course: 7 days.

\$ Two-week, 1-site IM regimen (4-dose modified Essen regimen); duration of entire PEP course: between 14 and 28 days.

* Individuals with documented evidence of previous PrEP, or at least 2 previous administrations of rabies vaccine as PEP are considered previously immunised and benefit from an abridged PEP without RIG in case of exposure.



Rabies Immunoglobulin (RIG) and Rabies Monoclonal Antibody (mAb)

1. RIG types. 2 types available for passive immunization:

- human rabies immunoglobulin (hRIG) with max. dose of 20 IU/kg body weight; and
- equine rabies immunoglobulin (eRIG) with max. dose of 40 IU/kg body weight

(Both hRIG and eRIG are equally effective and safe).

2. Rabies monoclonal antibody (mAb)

- There is only a single mAb product against RABV (Rabishield®, Serum Institute of India) licensed for use in humans to date.
- Maximum dose allowed: 3.33 IU/kg body weight.

NOTE:

RIG and mAb are not readily available in Malaysia but may be imported upon special request from the Ministry of Health.

The import permits of biologics may be applied by using Borang Bpf/213-1: Borang Permohonan Mengimport/Mengilang Keluaran Tidak Berdaftar Bagi Tujuan Merawat Penyakit Yang Mengancam Nyawa https://pharmacy.moh.gov.my/sites/default/files/document-upload/panduan-syarat-mengisi-borang-lampiran-bpf213-1-pindaan-1_1.pdf



The completed forms should be submitted to:

Pengarah Kanan Perkhidmatan Farmasi, Bahagian Perkhidmatan Farmasi, Kementerian Kesihatan Malaysia, Lot 36, Jalan Universiti, 46200 Petaling Jaya,
(U/P: Cawangan Perundangan, Bahagian Penguatkuasaan Farmasi)

No. Tel: 03-78413200; No. Faks: 03-79682251



Implication for Healthcare Workers (HCWs)

PrEP may be considered for HCWs who regularly provide care to persons with rabies.

Evidence of Safety & Effectiveness

Contraindications and Adverse Effects

1. Individuals with a history of severe hypersensitivity to any of the components or to excipients listed by the vaccine manufacturer should receive an alternative rabies vaccine product for PrEP.
2. There is no contraindication to PEP and PrEP, including for infants, pregnant and lactating women, HIV-infected and other immunocompromised individuals and those receiving with chloroquine or hydroxychloroquine treatment. Where possible, PrEP should be completed before chloroquine or hydroxychloroquine treatment is initiated.
3. Reported adverse events include transient minor local erythema (0.5–1%), induration (3–11%), and tenderness (14–29%).

To date, the most frequently reported adverse events for rabies received by the National Pharmaceutical Regulatory Agency (NPRA) is pruritus, rash and fever.

Unlike nerve-tissue derived rabies vaccines that can induce severe adverse reactions and is no longer recommended by WHO, cell culture and embryonated egg-based vaccines (CCEEVs) are safe and well-tolerated. Minor and transient local adverse reaction such as erythema, pain and/or swelling may occur at the site of injection in 35–45% of recipients. Mild systemic adverse events such as transient fever, headache, dizziness and gastrointestinal symptoms, have been reported in 5–15% of recipients.



Evidence for Effectiveness

Modern CCEEVs are highly immunogenic. They induce a prompt and strong vaccine-induced neutralising antibody response against the G protein of RABV. A minimum serum antibody concentration of 0.5 IU/mL is widely used and recommended by WHO as a measure of adequate seroconversion following vaccination. The antibody titre is reached by day 7–14 of a PEP regimen, with or without simultaneous administration of RIG in most individuals, regardless of their age or nutritional status.

Whilst PEP using modern CCEEVs is known to be highly effective, it does not necessarily confer 100% protection against the development of human rabies infection. Delay in seeking PEP, inadequate wound care, unnoticed wounds, direct neural inoculation, use of ineffective rabies vaccine, improper vaccine administration (e.g., subcutaneous injection) or non-adherence to vaccination schedule and poor quality vaccine (non-WHO prequalified or cold-chain quality issue) are several important causes of PEP failure in humans.

References

1. Hemachudha, T., Ugolini, G., Wacharapluesadee, S., Sungkarat, W., Shuangshoti, S., & Laothamatas, J. (2013). Human rabies: neuropathogenesis, diagnosis, and management. *The Lancet. Neurology*, 12(5), 498–513. [https://doi.org/10.1016/S1474-4422\(13\)70038-3](https://doi.org/10.1016/S1474-4422(13)70038-3)
2. World Health Organization (2018). Rabies vaccines: *WHO position paper – April 2018* Weekly Epidemiological Record, 93(16): 201–220
3. Ministry of Health Malaysia (2023) *Malaysia Health Facts 2022*. Disease Control Division. https://www.moh.gov.my/moh/resources/Penerbitan/Penerbitan%20Utama/4_Health_Facts_2023-compressed_.pdf
4. National Pharmaceutical Regulatory Agency (NPRA), *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>
5. The Malaysian National Centre of Adverse Drug Reactions Database. Accessed October 10, 2019



Introduction



Respiratory Syncytial Virus (RSV) is a leading cause of acute lower respiratory tract infections globally, not only in infants but is increasingly recognised as a major pathogen in older adults and high-risk groups. The RSV is a single-stranded RNS virus from *Pneumovirus* genus and *Paramyxoviridae* family with two serogroups A and B. Infections can lead to serious complications such as bronchiolitis and pneumonia, contributing to significant morbidity and mortality in adults aged 60 years and older, particularly those with comorbidities like chronic obstructive pulmonary disease (COPD), cardiovascular disease, and diabetes.

In Malaysia, RSV outbreaks are commonly observed during the monsoon seasons and contribute to seasonal strain on hospitals. Older individuals hospitalised with RSV are at risk of cardiovascular complications, while individuals with existing cardiovascular disease are at increased risk of hospitalisation with RSV.

Table 23.1 Vaccines Registered in Malaysia

No.	Name	PRH/ Manufacturer	Type	Precaution
1.	Abrysvo®	Pfizer Malaysia Sdn Bhd/ Pfizer Manufacturing Belgium NV (Belgium)	Protein subunit vaccine containing: Bivalent RSV-A and RSV-B pre-fusion RSV F (fusion) glycoprotein	
2.	Arexvy®	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Protein subunit vaccine containing: RSVPreF3 antigen combined with AS01E adjuvant system	Not licensed for maternal vaccination



Table 23.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Adults aged 60 years and older	Single-dose intramuscular injection
2.	Women at 32–36 weeks of pregnancy, to protect infants at birth	Single-dose intramuscular injection *Only Abrysvo® (Pfizer) is licensed for this indication

Co-administration

RSV vaccines can be co-administered with other adult vaccines during the same visit.

Implications for Healthcare Workers (HCWs)

While HCWs are at an increased risk of exposure, there is currently no evidence supporting RSV vaccination in HCWs. However, vaccination of older adults is expected to reduce RSV admissions and in turn, reduce the risk of RSV exposure among HCWs.

Evidence of Safety & Effectiveness

Clinical trials have shown high efficacy for both vaccines. Arexvy demonstrated an efficacy of 82.6% in preventing RSV lower respiratory tract disease in older adults, while Abrysvo showed a similar efficacy of 85.7%. Importantly, both vaccines significantly reduce the risk of hospitalisation due to RSV complications, which is critical for resource-limited healthcare settings. Real-world data from the United States and Europe indicate reductions in RSV-related hospitalisations and acute exacerbations of chronic conditions among vaccinated older adults. Immunogenicity studies show durable antibody responses for at least six months post-vaccination, with protection potentially extending up to three years.



Emerging data also suggest that RSV vaccination may reduce the severity and duration of illness in breakthrough infections.

RSV vaccination given to pregnant women produces passive immunity to the infant for up to six months, reducing the risk of hospitalisation with bronchiolitis among infants.

In adults, the most common undesirable effects (>10%) included headache, nausea and muscle pain at the injection site.

References

1. Alfano, F., Bigoni, T., Caggiano, F. P., & Papi, A. (2024). Respiratory Syncytial Virus Infection in Older Adults: An Update. *Drugs & Aging*, 41(6), 487–505. <https://doi.org/10.1007/s40266-024-01118-9>
2. Nguyen-Van-Tam, J. S., O'Leary, M., Martin, E. T., Heijnen, E., Callendret, B., Fleischhackl, R., Comeaux, C., Tran, T. M. P., & Weber, K. (2022). Burden of respiratory syncytial virus infection in older and high-risk adults: a systematic review and meta-analysis of the evidence from developed countries. *European respiratory review : an official journal of the European Respiratory Society*, 31(166), 220105. <https://doi.org/10.1183/16000617.0105-2022>
3. Ivey, K. S., Edwards, K. M., & Talbot, H. K. (2018). Respiratory Syncytial Virus and Associations With Cardiovascular Disease in Adults. *Journal of the American College of Cardiology*, 71(14), 1574–1583. <https://doi.org/10.1016/j.jacc.2018.02.013>
4. Woodruff RC, Melgar M, Pham H, et al. (2024). Acute Cardiac Events in Hospitalized Older Adults With Respiratory Syncytial Virus Infection. *JAMA Intern Med*, <https://doi.org/10.1001/jamainternmed.2024.0212>
5. Wilson, E., Goswami, J., Baqui, A. H., Doreski, P. A., et al. (2023). Efficacy and Safety of an mRNA-Based RSV PreF Vaccine in Older Adults. *The New England Journal of Medicine*, 389(24), 2233–2244. <https://doi.org/10.1056/NEJMoa2307079>
6. Walsh, E. E., Pérez Marc, G., Zareba, A. M., Falsey, A. R., Jiang, Q., Patton, M., Polack, F. P., Llapur, C., Doreski, P. A., Ilangovan, K., Rămet, M., Fukushima, Y., Hussen, N., Bont, L. J., Cardona, J., DeHaan, E., Castillo Villa, G., Ingilizova, M., Eiras, D., Mikati, T., RENOIR Clinical Trial Group (2023). Efficacy and Safety of a Bivalent RSV Prefusion F Vaccine in Older Adults. *The New England Journal of Medicine*, 388(16), 1465–1477. <https://doi.org/10.1056/NEJMoa2213836>
7. Madhi, S. A., Polack, F. P., Piedra, P. A., Munoz, F. M., et al. (2020). Respiratory Syncytial Virus Vaccination during Pregnancy and Effects in Infants. *The New England Journal of Medicine*, 383(5), 426–439. <https://doi.org/10.1056/NEJMoa1908380>
8. Molnar, D., La, E. M., Verelst, F., et al. (2024). Public Health Impact of the Adjuvanted RSVPreF3 Vaccine for Respiratory Syncytial Virus Prevention Among Older Adults in the United States. *Infectious Diseases and Therapy*, 13(4), 827–844. <https://doi.org/10.1007/s40121-024-00939-w>
9. Mensah, A. A., Whitaker, H., Andrews, N. J., & Watson, C. H. (2025). Early impact of RSV vaccination in older adults in England. *The Lancet*, 405(10485), 1139–1140. [https://doi.org/10.1016/S0140-6736\(25\)00346-0](https://doi.org/10.1016/S0140-6736(25)00346-0)
10. Use of RSV Vaccines in Adults Aged 60 years: Updated Recommendations of ACIP, CDC. USA, (August 2024). *Morbidity and Mortality Weekly Report*. Vol. 73 (32):696–702. <https://www.cdc.gov/mmwr/volumes/73/wr/mm7332e1.htm>



Introduction



Typhoid fever is a systemic infection caused by the gram-negative *Salmonella enterica*, subspecies *enterica*, serotype *Typhi*. Transmission is primarily via the oral route following ingestion of food or water contaminated by faeces and occasionally the urine of acutely ill persons or those who are chronic carriers. Direct faecal-oral transmission can also occur.

Following an incubation period of 10-20 days, clinical presentation range from mild fever, diarrhoea, myalgia and headache to severe disseminated disease with multi-organ involvement in 10-15% of cases. The case-fatality rate (CFR) is <1% with prompt antibiotic therapy, but may be as high as 20% in untreated or inappropriately treated cases.

Typhoid is also regarded as a travel-related disease with a considerably higher risk following travel to many developing areas of the WHO African, Eastern Mediterranean, South-east Asia and Western Pacific regions. In 2021, an estimated 9.3 million cases of enteric fever and 107,500 related deaths were reported worldwide, with South Asia bearing the highest burden.

Typhoid fever is endemic in Malaysia, with the incidence rate of typhoid and paratyphoid fever ranging from 0.20 to 0.55 per 100,000 population annually in recent years (2020–2024). The mortality rate during the same period was reported to be between 0.00-0.02 per 100,000 population. A recent outbreak of typhoid fever occurred in Kelantan in 2024.



Table 24.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	Typhim Vi®	Sanofi-Aventis (Malaysia) Sdn. Bhd./Sanofi Pasteur, France	Injectable subunit typhoid vaccine containing purified Vi capsular polysaccharide from <i>Salmonella enterica</i> , subspecies <i>enterica</i> , serotype Typhi, <i>Salmonella</i> Typhi Ty2 strain.
2.	Vivotif®	Propharm (M) Sdn. Bhd./Bavarian Nordic Berna GmbH, Switzerland	Oral typhoid vaccine containing live, attenuated <i>Salmonella enterica</i> , subspecies <i>enterica</i> , serotype Typhi, <i>Salmonella</i> Typhi Ty21a strain

Table 24.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Food handlers and vendors	Parenteral Vaccine (Typhim Vi) • IM or SC mode of administration. • Pre-filled syringe for adults and children >2 years old. • It does not provide protection against <i>Salmonella paratyphi</i> or non-typhoidal salmonella strains. • If the risk of exposure persists, a booster dose is recommended every 2 to 3 years.
2.	Travellers to areas where typhoid is endemic	
3.	Persons in close contact with a documented <i>S. typhi</i> carrier	



No.	Target group	Recommended Dosing Schedule
1.	Food handlers and vendors	Oral Vaccine (Vivotif) • 3 doses in capsules taken on days 0, 2 & 4. • For children aged >6 years and adults • All doses of should be completed at least 1 week before travel. • The oral vaccine induces immunity within 10 days after the last dose and lasts at least 1 year, with revaccination recommended every 3 years in endemic areas
2.	Travellers to areas where typhoid is endemic	
3.	Persons in close contact with a documented <i>S. typhi</i> carrier	

Implications for Healthcare Workers (HCWs)

The vaccine is not routinely recommended for HCWs in non-endemic settings.

Evidence of Safety and Effectiveness

Based on pooled estimates from clinical trials and post-marketing surveillance data, local reactions (pain, swelling, erythema and induration at injection site) are the most commonly reported symptoms following Vi vaccine. Following Ty21a vaccine, the most reported adverse events are gastro-intestinal symptoms, nausea, fever and headache.

Based on four eligible studies in recent systematic review and meta-analysis in 2024, the oral vaccine Ty21a reduced the incidence of typhoid fever with vaccine efficacy of 45% at 1–3 years. The protection declines slightly over time with protection at 1–5 years post-vaccination at 43%.



In the same 2024 systematic review and meta-analysis evaluating the Vi-Polysaccharide Vaccine, the vaccine efficacy was 67% at 1 year and 56% at 2 years post-vaccination, whereas the pooled 1–3 years post-vaccination indicated efficacy of 58%.

References

1. Piovani, D., Figlioli, G., Nikolopoulos, G.K., and Bonovas S. (2024). The global burden of enteric fever, 2017–2021: *A systematic analysis from the Global Burden of Disease Study 2021*. *EClinicalMedicine*, 77, 102883. <https://doi.org/10.1016/j.eclinm.2024.102883>
2. Ministry of Health Malaysia. (2023). *Health facts: Incidence rate and mortality rate of communicable diseases*. https://www.moh.gov.my/moh/resources/Penerbitan/Penerbitan%20Utama/4_Health_Facts_2023-compressed_.pd
3. World Health Organization. (March 30, 2023). *Typhoid*. <https://www.who.int/news-room/fact-sheets/detail/typhoid>
4. World Health Organization. (March 30, 2018). *Typhoid vaccines: WHO position paper, March 2018*. *Weekly Epidemiological Record*, 93:153–172. <https://www.who.int/publications/i/item/typhoid-vaccines-who-position-paper-march-2018>
5. Centers for Disease Control and Prevention. (April 23, 2025). *Typhoid and Paratyphoid Fever*. In *CDC Yellow Book 2026: Health Information for International Travel*. <https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/typhoid-and-paratyphoid-fever.html>
6. Vivotif. (2025). *Typhoid vaccine live oral Ty21a: Prescription information*. <https://vivotif.com/>
7. Batool, R., Haq Qamar, Z., Abdus Salam, R., Yousafzai, M.T., Ashorn, P., & Naz Qamar, F. (2024). *Efficacy of typhoid vaccines against culture-confirmed Salmonella typhi in typhoid-endemic countries: A systematic review and meta-analysis*. *The Lancet Global Health*, 12(4), e589–e598. [https://doi.org/10.1016/S2214-109X\(23\)00606-X](https://doi.org/10.1016/S2214-109X(23)00606-X)
8. Ministry of Health Malaysia. (2025). *Malaysian National Centre of Adverse Drug Reactions database*. <https://npra.gov.my>



Introduction

Chickenpox is caused by the varicella-zoster virus (VZV), now classified as *Varicellavirus humanalpha3*. It is a double-stranded virus that belongs to the *Varicellovirus* genus and *Orthoherpesviridae* family. It is transmitted by the airborne route or direct contact with fluid from vesicles. VZV is highly contagious with 61–100% of household contacts with no prior infection developing an infection. Commonly known as a childhood infection, seroconversion in tropical countries occurs at a later age than in temperate countries, making chickenpox common in adolescents and adults in the former. VZV can also be transmitted to susceptible persons from patients with shingles. Studies suggest that the risk of viral transmission is considerably less from shingles than from chickenpox. The widespread vaccination of healthy children against chickenpox in the US has led to herd protection and extremely low levels of hospitalisation and mortality from chickenpox in children and adults.

Varicella may be more severe in pregnant women, particularly in the last trimester, with the potential for congenital varicella syndrome or foetal mortality. Maternal varicella that develops within 5 days before or 2 days after delivery is potentially most serious for the newborn resulting in congenital chickenpox infection. Maternal antibodies to VZV may not have been formed or crossed the placenta, and VZV may infect the baby before or after delivery. Vaccination of women before pregnancy is therefore recommended.

Table 25.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type	Precaution
1.	Varilrix®	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Live attenuated Oka strain	



No.	Name	PRH/Manufacturer	Type	Precaution
2.	Varivax®	Merck Sharp & Dohme B.V. (Netherlands)	Live attenuated varicella virus (Oka/Merck strain)	The interval recommended is longer (min 3 months for 12 months–12 years old)

While pregnant women should not have the vaccine, a pregnancy registry for those inadvertently given the vaccine within three months or during pregnancy found no cases of increased birth defects. To date, the reported adverse events for chickenpox vaccine received by the National Pharmaceutical Regulatory Agency (NPRA) are chickenpox-like rashes occurring 7–23 days post vaccination and fever.

Table 25.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Adults aged 18 years and older without evidence of immunity to varicella. Evidence of immunity includes: • Documentation of 2 doses of chickenpox vaccination • Laboratory evidence of immunity or confirmation of disease • Diagnosis or verification of a history of chickenpox or shingles by a healthcare professional	Varilrix® : Two 0.5 ml IM/SC doses at least 6 weeks apart (not <4 weeks) Varivax® : Two 0.5 ml IM/SC 4–8 weeks apart
2.	High-priority adult groups: • Healthcare workers • Childcare staff • Residents and staff in institutional settings (e.g., aged-care facilities) • Women planning pregnancy • Immunocompromised individuals	Varilrix® : Two 0.5 ml IM/SC doses at least 6 weeks apart (not <4 weeks) Varivax® : Two 0.5ml IM/SC 4–8 weeks apart

Implication for Healthcare Workers (HCWs)



Healthcare workers are at elevated risk for VZV exposure and transmission. All HCWs without evidence of immunity should receive two doses of chickenpox vaccine. Serologic testing post-vaccination is not routinely recommended due to the limited sensitivity of commercial assays.



Evidence of Safety & Effectiveness

Studies have demonstrated high immunogenicity in adults following two doses of the Oka strain vaccine. Seroconversion rates exceed 94% after the second dose. Real-world data indicate a significant decline in chickenpox incidence and complications following implementation of adult and childhood vaccination programmes.

References

1. Varicella and herpes zoster vaccines (2016). WHO position paper, June 2014--Recommendations. *Vaccine*. 34(2):198-199. doi: 10.1016/j.vaccine.2014.07.068. PMID: 26723191.
2. Gabutti, G., Bolognesi, N., Sandri, F., Florescu, C., & Stefanati, A. (2019). Varicella zoster virus vaccines: an update. *ImmunoTargets and Therapy*. 8, 15–28. https://academic.oup.com/jid/article/224/Supplement_4/S387/6378094
3. Anne A Gershon, Michael D Gershon, Eugene D Shapiro (2021). Live Attenuated Varicella Vaccine: Prevention of Varicella and of Zoster. *Journal of Infectious Disease*. 224. S387–S397, <https://doi.org/10.1093/infdis/jiaa573>
4. Centers for Disease Control and Prevention (2021). Epidemiology and Prevention of Vaccine-Preventable Diseases. Hall E., Wodi A.P., Hamborsky J., *et al.*, eds. 14th ed. Washington, D.C. Public Health Foundation.



Introduction



Yellow fever (YF) is an acute viral haemorrhagic disease caused by an arbovirus belonging to the *Flavivirus* genus in the *Flaviviridae* family. It is primarily transmitted through the bite of day-biting female mosquitoes, particularly *Aedes* species, *Haemagogus* species and *Sabethes* species. These mosquitoes breed in domestic, semi-domestic and forest environments.



Following an incubation period of 3-6 days, yellow fever presents with fever, headache, general body aches, vomiting and weakness, for 3-4 days. Around 15% present with severe infection that includes high fever, jaundice, vomiting, bleeding, organ failure and shock, resulting in death within 7-10 days for 50% of these patients.

YF is endemic in sub-Saharan Africa and the tropical regions of South America. However, it is not naturally found in Asia. Outbreaks are periodic in Africa and occur sporadically in South America. The presence of *Aedes* mosquitoes in Asia heightens the potential risk of YF transmission, making Malaysia at risk.

Table 26.1 Vaccines Registered in Malaysia

No.	Name	PRH/Manufacturer	Type
1.	Stamaril®	Sanofi-Aventis (Malaysia) Sdn. Bhd./Sanofi Pasteur, Lyon, France	Live, attenuated yellow fever virus
<i>The list of approved private YF vaccination centres in Malaysia:</i> https://www.moh.gov.my/images/perkhidmatan-utama/info-kesihatan/yellow-fever/List_of_approved_Yellow_Fever_Vaccination_Centres_in_Malaysia_-_updated_24_Nov_2025.pdf 			



Table 26.2 High-Risk Groups in Malaysia

No.	Target group	Recommended Dosing Schedule
1.	Travellers to YF countries: • Mandatory for all persons >9-month-old travelling from or to certain WHO-listed endemic countries. Refer to Special Group (Travellers) Page 237. • In areas where there is evidence of persistent or periodic YF virus transmission, that are not listed above.	• Subcutaneous or intramuscular injection as a single 0.5 mL dose. • Vaccinate 10 days prior to entering the endemic area. • YF vaccine may be administered simultaneously with other vaccines.

NOTE:

- Travellers from endemic countries without a valid YF vaccination or prophylaxis certificate shall be quarantined upon arrival in Malaysia for a period not exceeding 6 days.
- If vaccination is contraindicated for medical reasons, an exemption letter or waiver should be issued to the traveller. However, acceptance or acknowledgment of such a letter is at the discretion of the destination country, and entry might be denied

Implication for Healthcare Workers (HCWs)

The vaccine is not routinely recommended for HCWs in non-endemic settings.

Evidence of Safety & Effectiveness

In a meta-analysis reported in 2024, pooled seroprotection rates among healthy adults (mostly travellers) in a non-endemic setting were 94% (95% CI 86–99), whereas it was 76% (65–85) in an endemic setting.



These findings align with clinical evidence showing that protective immunity develops in 80–100% of people within 10 days, and in over 99% within 30 days. A single dose provides protection for at least 10 years, possibly lifelong, and therefore a booster is not recommended.

Yellow fever vaccine generally safe. However, a careful risk-benefit assessment for the adult >60-year-old, because they are higher risk of serious adverse effects related to Yellow Fever vaccine i.e:

- Yellow fever vaccine–associated viscerotropic disease (YEL-AVD): a very rare condition resembling severe yellow fever infection.
- Yellow fever vaccine–associated neurotropic disease (YEL-AND): rare neurological complications such as encephalitis or Guillain-Barré syndrome.

References

1. World Health Organization. (October 20, 2025). *Yellow fever: Fact sheet*. <https://www.who.int/news-room/fact-sheets/detail/yellow-fever>
2. World Health Organization. (November 19, 2022). *Vaccination requirements and recommendations for international travellers, and malaria situation per country (2022 edition)*. <https://www.who.int/publications/m/item/vaccination-requirements-and-recommendations-for-international-travellers-and-malaria-situation-per-country-2022-edition>
3. Centers for Disease Control and Prevention. (April 23, 2025). Yellow fever. In *CDC Yellow Book 2026: Health information for international travel*. <https://www.cdc.gov/yellow-book/hcp/travel-associated-infections-diseases/yellow-fever.html>
4. Schnyder, J. L., de Jong, H.K., Bache, B.E., Schaumburg, F., and Grobusch, M.P. (2024). Long-term immunity following yellow fever vaccination: A systematic review and meta-analysis. *The Lancet Global Health*, 12(3), e445–e456. [https://doi.org/10.1016/S2214-109X\(23\)00556-9](https://doi.org/10.1016/S2214-109X(23)00556-9)
5. Ministry of Health Malaysia. (October 12, 2022). *Yellow fever travel advisory*. https://www.moh.gov.my/images/perkhidmatan-utama/info-kesihatan/yellow-fever/Yellow_Fever_Travel_Advisory_updated_12_October_2022.pdf
6. Ministry of Health Malaysia. (January 17, 2025). List of approved private yellow fever vaccination centres in Malaysia https://www.moh.gov.my/images/perkhidmatan-utama/info-kesihatan/yellow-fever/List_of_approved_Yellow_Fever_Vaccination_Centres_in_Malaysia_-_updated_24_Nov_2025.pdf
7. National Pharmaceutical Regulatory Agency (NPRA) *Sistem Pendaftaran Produk & Perlesenan*. <https://quest3plus.bpfk.gov.my/pmo2/index.php>



Introduction

Shingles is caused by the reactivation of the latent varicella–zoster virus (VZV) from previous infection with chickenpox and often occurs following waning VZV cellular immunity, which presents as a painful vesicular rash with a dermatomal distribution. Latency also occurs after chickenpox vaccination. Prodromal pain lasts 3–4 days, but it can extend to a week. A maculopapular rash develops into clusters of vesicles. In immunocompromised persons, multidermatomal disease may occur. Postherpetic neuralgia (PHN) is the most common complication of shingles. This pain can be extremely severe and may persist over years. Other complications include ophthalmic involvement, bacterial superinfection, cranial and peripheral nerve palsies, meningoencephalitis, pneumonitis, hepatitis, and acute retinal necrosis. Observational studies in older adults suggest that shingles is associated with increased risk of stroke and myocardial infarction, particularly in the first 6 months post-infection.

For further information on shingles in older adults, please refer to the ‘Malaysian Society of Geriatric Medicine Position Statement for Vaccine Preventable Diseases in Older Adults’ (www.msgm.com.my).



Table 27.1 Vaccines Registered in Malaysia

No.	Name	PRH/ Manufacturer	Type	Precaution
1.	Shingrix®	GlaxoSmithKline Pharmaceuticals (M) Sdn Bhd/ GlaxoSmithKline Biologicals S.A., Belgium	Recombinant, adjuvanted zoster vaccine (RZV)	RZV is not a treatment for shingles or postherpetic neuralgia. Avoid vaccination during an acute episode of shingles.



Table 27.2 High-Risk Groups in Malaysia

No.	High-Risk Group	Recommended Dosing Schedule
1.	Persons aged 50 years and above, regardless of prior history of chickenpox or shingles	• Shingles can recur. Adults with a history of shingles should receive RZV. • Intramuscular injection. • 2nd dose to be administered 2–6 months after the first dose. • The vaccine series need not be restarted if more than 6 months have elapsed since the first dose.
2.	Immunosuppressed patients aged 18 years and older	• Individuals who are immunodeficient may benefit from a shorter vaccination schedule. • The second dose may be administered 1–2 months after the first dose

Implication for Healthcare Workers (HCWs)

There are no specific recommendations for RZV for HCWs.

Co-administration

Studies on co-administration of RZV with influenza, PPSV23, PCV13, and Tdap have found no evidence of interference in the immune response and no safety concerns.



Evidence of Safety & Effectiveness



Immunocompetent persons



- Efficacy of the recombinant zoster vaccine (RZV) for prevention of herpes zoster in 3- year studies, was 97.2% in persons aged >50 years and 89.9% in participants aged >70 years.
- Efficacy for prevention of postherpetic neuralgia was 91.2% in adults aged >50 years and 88.8% in those aged >70 years.
- Humoral and cellular immune responses persisted for 10 years in older adults after the initial 2-dose RZV.
- Humoral immune response to RZV post-2-dose was comparable in adults >65 years who were previously vaccinated with live attenuated zoster vaccine, Zostavax (ZVL), >5 years ago compared to ZVL-naïve adults. RZV was well tolerated in both study groups and no safety concerns were identified up to one month post dose 2.
- Vaccination with RZV has been linked to a decreased incidence of major adverse cardiovascular events.
- Recent, highly publicized, evidence confirms previous findings of a protective effect against dementia by demonstrating that RZV reduced the probability of a new dementia diagnosis by approximately one-fifth over a seven-year follow-up period.

Evidence for immunocompromised patients

- The efficacy of RZV in prevention of shingles in immunocompromised autologous haematopoietic stem cell transplantation (HSCT) recipients was 68.2%.
- Immunogenicity and safety studies on patients with haematological malignancies showed that humoral and cellular immune responses persisted above the baseline 13 months after vaccination. Post-hoc analysis showed vaccine efficacy of 87.2% against shingles in the population of immunocompromised adults, 18 years and older. The safety profile was acceptable in adults with haematological malignancies.



- Recombinant zoster vaccines were immunogenic in patients with solid tumours receiving immunosuppressive therapy regimen. Immunogenicity persisted 12 months after vaccination regardless of timing of the first vaccination in relation to the start of chemotherapy.
- Recombinant zoster vaccine was immunogenic in renal transplant patients > 18 years of age under chronic daily suppression and the immunogenicity persisted through one year after vaccination.
- The most common solicited adverse reactions (grade1-3) following RZV vaccine were pain (78%), myalgia (45%), and fatigue (45%).

References

1. Dooling, K.I., Guo, A., Patel, M., et al. (2018) Recommendations of the Advisory Committee on Immunization Practices for Use of Herpes Zoster Vaccines. *MMWR, Morb Mortal Wkly Rep*, 67(3):103-108. DOI: <http://dx.doi.org/10.15585/mmwr.mm6703a5>
2. Zhang, Y., Luo, G., Huang, Y., Yu, Q., Wang, L., & Li, K. (2017). Risk of Stroke/Transient Ischemic Attack or Myocardial Infarction with Herpes Zoster: A Systematic Review and Meta-Analysis. *Journal of Stroke and Cerebrovascular Diseases : The official Journal of National Stroke Association*, 26(8), 1807–1816. [https://www.strokejournal.org/article/S1052-3057\(17\)30171-4/abstract](https://www.strokejournal.org/article/S1052-3057(17)30171-4/abstract)
3. Lal, H., Cunningham, A. L., Godeaux, O., Chlibek, R., Diez-Domingo, J., Hwang, S. J., Levin, M. J., McElhaney, J. E., Poder, A., Puig-Barberà, J., Vesikari, T., Watanabe, D., Weckx, L., Zahaf, T., Heineman, T. C., & ZOE-50 Study Group (2015). Efficacy of an adjuvanted herpes zoster subunit vaccine in older adults. *The New England Journal of Medicine*, 372(22), 2087–2096. <https://doi.org/10.1056/NEJMoa1501184>
4. Cunningham, A. L., Lal, H., Kovac, M., et al. (2016). Efficacy of the Herpes Zoster Subunit Vaccine in Adults 70 Years of Age or Older. *The New England Journal of Medicine*, 375(11), 1019–1032. <https://doi.org/10.1056/NEJMoa1603800>
5. Maréchal, C., Lal, H., Poder, A., et al. (2018). Immunogenicity and safety of the adjuvanted recombinant zoster vaccine co-administered with the 23-valent pneumococcal polysaccharide vaccine in adults ≥50 years of age: A randomized trial. *Vaccine*, 36(29), 4278–4286. <https://doi.org/10.1016/j.vaccine.2018.05.110>
6. Schwarz, T. F., Aggarwal, N., Moeckesch, B., et al. (2017). Immunogenicity and Safety of an Adjuvanted Herpes Zoster Subunit Vaccine Coadministered With Seasonal Influenza Vaccine in Adults Aged 50 Years or Older. *The Journal of Infectious Diseases*, 216(11), 1352–1361. <https://doi.org/10.1093/infdis/jix481>
7. López-Fauqued, M., Co-van der Mee, M., Bastidas, A., et al. (2021). Safety Profile of the Adjuvanted Recombinant Zoster Vaccine in Immunocompromised Populations: An Overview of Six Trials. *Drug Safety*, 44(7), 811–823. <https://link.springer.com/article/10.1007/s40264-021-01076-w>
8. Bastidas, A., de la Serna, J., El Idrissi, M., et al. (2019). Effect of Recombinant Zoster Vaccine on Incidence of Herpes Zoster After Autologous Stem Cell Transplantation: A Randomized Clinical Trial. *JAMA*, 322(2), 123–133. <https://jamanetwork.com/journals/jama/fullarticle/2737683>



9. Dagnew, A. F., Ilhan, O., Lee, W. S., et al. (2019). Immunogenicity and safety of the adjuvanted recombinant zoster vaccine in adults with haematological malignancies: a phase 3, randomised, clinical trial and post-hoc efficacy analysis. *The Lancet. Infectious Diseases*, 19(9), 988–1000. [https://doi.org/10.1016/S1473-3099\(19\)30163-X](https://doi.org/10.1016/S1473-3099(19)30163-X)
10. Vink, P., Ramon Torrell, J. M., Sanchez Fructuoso, A., et al. (2020). Immunogenicity and Safety of the Adjuvanted Recombinant Zoster Vaccine in Chronically Immunosuppressed Adults Following Renal Transplant: A Phase 3, Randomized Clinical Trial. *Clinical infectious Diseases: an official publication of the Infectious Diseases Society of America*, 70(2), 181–190. <https://doi.org/10.1093/cid/ciz177>
11. Vink, P., Delgado Mingorance, I., Maximiano Alonso, C., et al. (2019). Immunogenicity and safety of the adjuvanted recombinant zoster vaccine in patients with solid tumors, vaccinated before or during chemotherapy: A randomized trial. *Cancer*, 125(8), 1301–1312. <https://doi.org/10.1002/cncr.31909>
12. Grunning, K., Campora, L., Douha, M., Heineman, T. C., Klein, N. P., Lal, H., Peterson, J., Vastiau, I., & Oostvogels, L. (2017). Immunogenicity and Safety of the HZ/su Adjuvanted Herpes Zoster Subunit Vaccine in Adults Previously Vaccinated with a Live Attenuated Herpes Zoster Vaccine. *The Journal of Infectious Diseases*, 216(11), 1343–1351. <https://doi.org/10.1093/infdis/jix482>
13. Xinyi Xu, Isabel Ray, Emily Tang, Benjamin F Arnold, Nisha R Acharya. (2025) Protective Effects of Recombinant Zoster Vaccine and Antiviral Therapy Against Cardiovascular Disease Following Herpes Zoster Infection. *The Journal of Infectious Diseases*, 232(2), 465–473. <https://doi.org/10.1093/infdis/jiaf105>
14. Eyting, M., Xie, M., Michalik, F. HeB, S., Chung, A., and Geldsetzer P. (2025). A natural experiment on the effect of herpes zoster vaccination on dementia. *Nature* 641, 438–446 <https://doi.org/10.1038/s41586-025-08800-x>



Introduction



Passive immunisation involves the administration of antibodies (immunoglobulins, primarily IgG) pooled from blood donors to provide temporary protection in the following situations:

- i. Unimmunised individuals exposed to an infection.
- ii. Individuals infected with a disease for which active immunisation is unavailable.

The protective effect of the administered immunoglobulin is immediate; however, the protection may be incomplete and short-lived, lasting for several weeks up to 3–4 months.

There are 2 types of immunoglobulins that will be discussed in this guideline:

- i. Normal (non-specific) human immunoglobulin: derived from unselected donors.
- ii. Hyperimmune (specific) immunoglobulin: derived from selected donors

Potential side effects of both immunoglobulins include malaise, chills, fever, headache, nausea, facial flushing and, rarely, anaphylaxis.

I. Normal Human Immunoglobulin (NHlg)

Normal human immunoglobulin (NHlg) is derived from pooled plasma of blood donors and contains antibodies against microbial agents commonly circulating in the general population, including hepatitis A, rubella, measles, and other prevalent viruses. NHlg provides immediate, temporary protection when administered within 72 hours (3 days) of exposure, with the protective effect lasting for several weeks. It is administered via intramuscular injection.

Important considerations with live vaccines:

- NHlg interferes with the immune response to live vaccines (except for yellow fever) for up to 3 months.



- Ideally, live vaccines should be administered at least 3 weeks before, or delayed for 3 months after, NHlg administration to ensure vaccine effectiveness.

Currently, passive immunisation with NHlg remains an important preventive measure for measles and hepatitis A among non-immune contacts in countries with low disease incidence. It is also recommended for non-immune pregnant contacts of rubella. There are variations in practice regarding the use of passive immunisation for measles, hepatitis A, and rubella contacts in high-income countries. In Australia, post-exposure administration of immunoglobulin has not been shown to provide benefit. In contrast, in the United Kingdom and New Zealand, the use of passive immunisation may be considered for pregnant women exposed to rubella, particularly in situations where termination of the pregnancy is not an option.

Indications for Normal Human Immunoglobulin (NHlg)

A. Hepatitis A

NHlg is indicated for the prevention of hepatitis A infection in:

- **Close contacts of confirmed cases**, especially when identification is delayed beyond 7 days or if they are at high risk of severe disease.
- **Immunocompromised individuals**, in whom the antibody response to vaccination may be suboptimal.

NHlg is most effective if given within **72 hours of exposure**.

Specific recommendations:

- **Healthy individuals aged 12 months–40 years:** Single-antigen hepatitis A vaccine is preferred due to long-term protection, ease of administration, and comparable efficacy to NHlg.



- **Individuals ≥ 40 years:** NHlg is preferred due to limited data on vaccine performance in this age group and increased risk of severe disease. The decision to use vaccine or NHlg should consider the individual's risk of HAV transmission.
- **If NHlg is unavailable,** hepatitis A vaccine may be used as an alternative.
- **NHlg is recommended for:**
 - » Immunocompromised individuals
 - » Individuals with chronic liver disease
 - » Individuals with contraindications to the hepatitis A vaccine

B. Measles

NHlg may be administered to prevent or attenuate measles infection in:

- Immunocompromised adults and children following close contact with a confirmed measles case.
- Non-immune pregnant women exposed to confirmed cases or during local outbreaks.

NHlg is most effective within 72 hours but can still be considered up to 6 days post-exposure.

For individuals with normal immunity who do not fall into the above categories and are not fully immunised, measles vaccination is preferred.

C. Rubella

Post-exposure NHlg does not prevent rubella infection and is not routinely recommended for pregnant women exposed to rubella.

However, it may reduce the severity of clinical illness in the mother and possibly lower foetal risk and may be considered only when pregnancy termination is not an option.

- Serological follow-up is essential to determine whether infection occurred despite administration.



Table 28.1 Overview of Normal Human Immunoglobulin (NHlg) and Clinical Application

Infection	Indication	Target population	Ig dosage
Hepatitis A	Contacts for post-exposure passive immunisation	Within 2 weeks of last exposure to an infectious case: • Age 40 years or older • Vaccine is contraindicated	• <25 kg: 0.5 mL • 25–50 kg: 1.0 mL • >50 kg: 2.0 mL
Measles		Up to 6 days after first exposure if: • >72 h since first contact with the case • Pregnant • Immunosuppressed • Vaccine contraindicated	• 0.25 ml/kg: maximum 15 ml • immunocompromised 0.5 ml/kg: maximum 15 ml
Rubella		Consider only if pregnant women exposed to rubella will not consider termination under any circumstances In these cases, administer immunoglobulin within 72 hours of exposure	• 20 mL in divided doses

NOTE:

- For healthy individuals aged 12 months–40 years, single-antigen Hepatitis A vaccine at the age-appropriate dose is preferred to IG because of the vaccine’s advantages, including long-term protection and ease of administration, as well as the equivalent efficacy of the vaccine to IG.



- For individuals aged 41 years and older, IG is preferred because of the absence of information regarding vaccine performance in this age group and because of the more severe manifestations of hepatitis A in older adults. The magnitude of the risk of HAV transmission from the exposure should be considered in decisions to use vaccine or IG in this age group.
- Vaccines can be used if IG cannot be obtained

II. Hyperimmune Immunoglobulin

Hyperimmune immunoglobulin is derived from the pooled plasma of selected donors with high antibody titres against specific pathogens. It contains high concentrations of antibodies targeting particular infectious agents, providing immediate, temporary protection in specific high-risk exposures or in individuals for whom active immunisation is not feasible or effective. The protective effect of administered specific immunoglobulin is immediate, but protection may be incomplete and short-lived, typically lasting for several weeks up to 3–4 months.

Hyperimmune immunoglobulin products are available for various infections, including hepatitis B, varicella-zoster, rabies, and tetanus, and are used for post-exposure prophylaxis or treatment in specific clinical scenarios.

Potential side effects are similar to those of NHlg and may include malaise, chills, fever, headache, nausea, facial flushing, and, rarely, anaphylaxis.



Table 28.2 Overview of Specific Immunoglobulin and Clinical Considerations

Immunoglobulin	Indications	Comments
Diphtheria Antitoxin	Clinical suspicion of diphtheria before bacteriological confirmation.	• Not for prophylactic use in unimmunised contacts. • Used only in confirmed or suspected cases
Hepatitis B Ig (HBIG)	• Percutaneous or mucosal exposure to blood containing HBV (e.g., needlestick, bite) • Sexual contact with an HBV-infected person • Infants in HBsAg-positive households • Newborns of HBV-infected mothers	• Immediate, short-term protection. • Ideally within 12 hours (birth) or 14 days (exposure) • Can be given with vaccine for long-term protection
Varicella Zoster Ig (VZIg)	For high-risk individuals not eligible for vaccination: • Immunocompromised • Long-term corticosteroid use • Pregnant women	• Administer within 96 hours of exposure • Assess risk of infection and complications
Rabies Ig	Post-exposure prophylaxis for suspected rabies exposure	• Given with the first rabies vaccine dose • Not needed if previously vaccinated



Immunoglobulin	Indications	Comments
Human Tetanus Ig (TIG)	• Tetanus-prone wounds with unknown/incomplete immunity • Neonatal tetanus (unclean cord care) Refer (Table 7.2): tetanus	• Given with tetanus toxoid booster • Urgent in contaminated wounds or unclear vaccination history • Essential part of tetanus treatment
COVID-19 HIG		• Not routinely recommended • Limited evidence of benefit • Effectiveness reduced by emerging variants • Consider only if antivirals or monoclonals are unavailable or contraindicated



Passive Immunisation for Immunocompromised Hosts (ICH)

Immunocompromised hosts (ICH) are at increased risk of severe infections due to their impaired ability to mount an adequate immune response. Passive immunisation using immunoglobulin provides immediate, temporary protection in these individuals, helping to prevent infections or reduce the severity of disease. Intravenous normal human immunoglobulin (IV NHlg) is used for replacement therapy in patients with primary or secondary hypogammaglobulinemia, while intramuscular NHlg may be administered for post-exposure prophylaxis against specific infections such as measles and hepatitis A in immunocompromised patients.

Table 28.3 Passive Immunisation Recommendations for Immunocompromised Hosts (ICH)

Subgroup at risk	Ig	Recommendation	Additional comments
Primary hypogammaglobulinemia	IV NHlg	0.4–0.6 g/kg, every 4 weeks	In general, replacement therapy is initiated if serum Ig level <150 mg/dl (severe hypogammaglobulinaemia)
Secondary hypogammaglobulinemia with recurrent severe infections (>2 episodes/year)	IV NHlg		This includes patients with multiple myeloma and recipients of haematopoietic stem cell transplantation



Subgroup at risk	Ig	Recommendation	Additional comments
ICH exposed to Measles	IV NHlg	IM 0.25–0.5mL/kg (maximum 15mL) administered as soon as possible (within 6 days after exposure) regardless of previous vaccination status	IM NHlg may not be necessary for patients who are receiving IV NHlg at regular intervals if the last dose was administered within 3 weeks of exposure
ICH exposed to Hepatitis A	IV NHlg	IM 0.02mL/kg (maximum 15mL) administered as soon as possible (within 2 weeks of exposure)	
ICH exposed to hepatitis B	HBlg	IM 0.06 mL/kg as soon as possible after exposure, preferably within 48 hours of exposure but up to 2 weeks from the last known sexual contact. If hepatitis B vaccine series has not been started, a second dose of HBlg should be administered one month later (for percutaneous/ mucous membrane exposure) or 3 months after sexual exposure	



Subgroup at risk	Ig	Recommendation	Additional comments
ICH exposed to varicella zoster	VZIg	IM 125 units/10 kg (maximum 625 units) administered as soon as possible or within 96 hours of contact	Definition of contact: Household contact; close contact indoors >1 hour sharing a 2–4 bed hospital cubicle/room; prolonged direct face-to-face contact (e.g., doctor/nurse and patient)
ICH with unknown/inadequate tetanus vaccination status and a non-clean, non-minor wound	TIg	For wounds <24 hours: IM 250 units For wounds >24 hours or heavy contamination: IM 500 units	Inadequate tetanus vaccination is defined as having received fewer than 2 previous doses of tetanus vaccine
ICH exposed to rabies and with unknown vaccination status	RIg	20IU/kg (human RIG) or 40 IU/kg (Horse RIG) up to half to be infiltrated around the wound	IM rabies vaccine to be given on days 0, 3, 7, 14–28



References

1. Baxter, D. (2007). Active and passive immunity, vaccine types, excipients and licensing. *Occupational Medicine*, 57(8), 552-556. <https://academic.oup.com/occmed/article-abstract/57/8/552/1474357?redirectedFrom=fulltext>
2. Perez, E. E., Orange, J. S., Bonilla, F., Chinen, J., Chinn, I. K., Dorsey, M., El-Gamal, Y., Harville, T. O., Hossny, E., Mazer, B., Nelson, R., Secord, E., Jordan, S. C., Stiehm, E. R., Vo, A. A., & Ballow, M. (2017). Update on the use of immunoglobulin in human disease: A review of evidence. *The Journal of allergy and clinical immunology*, 139(3S), S1-S46. <https://doi.org/10.1016/j.jaci.2016.09.023>
3. Advisory Committee on Immunization Practices (ACIP) Centers for Disease Control and Prevention (CDC) (2007). Update: Prevention of hepatitis A after exposure to hepatitis A virus and in international travelers. Updated recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR. Morbidity and mortality weekly report*, 56(41), 1080-1084. <https://pubmed.ncbi.nlm.nih.gov/17947967/>
4. Young, M. K., & Cripps, A. W. (2013). Passive immunization for the public health control of communicable diseases: current status in four high-income countries and where to next. *Human vaccines & immunotherapeutics*, 9(9), 1885-1893. <https://doi.org/10.4161/hv.25311>



Avian Influenza



Introduction

Avian influenza, also known as bird flu, is caused by a virus that mainly affects birds but can also affect other mammals, including humans. Avian influenza viruses are classified into 2 types: low pathogenic avian (LPAI) and highly pathogenic avian (HPAI). While 16 HA and 9 NA virus subtypes infect birds, the highly pathogenic viruses (HPAI) are typically H5 and H7 subtypes. Avian influenza viruses are normally species-specific, but five strains (H5N1, H7N3, H7N7, H7N9 and H9N2) have infected humans.

The H5N1 virus can cause severe disease and death in humans and has appeared in countries across Asia, Europe and Africa. H5N1 has spread rapidly in bird populations worldwide since the mid-1990s, and there is concern that this virus will begin to transmit between humans and cause a global pandemic. It primarily spreads from infected birds to humans through close contact with birds or contaminated environments, such as backyard poultry farms and live bird markets.

From 1 January 2003 to 29 September 2025, a total of 479 cases of human infection with the avian influenza A(H5N1) virus were reported to WHO from six countries within the Western Pacific Region. Of these cases, 318 were fatal, resulting in a case fatality rate (CFR) of 66.4%. Globally, from 1 January 2003 to 29 September 2025, 991 cases of human infection with the avian influenza A(H5N1) virus were reported from 25 countries. Of these cases, 476 were fatal (CFR of 48.0%).

Based on limited epidemiological data, the overall risk of HPAI H5N1 virus transmission to humans appears to be very low. Key factors include the intensity of exposure to the virus, potentially modifiable factors such as behaviour or use of protective equipment, and possibly other unknown host factors. Sustained human-to-human transmission has not been identified to date. The likelihood of occurrence and potential severity of an H5N1 pandemic are not known.



Vaccines

Vaccines are the cornerstone of pandemic preparedness strategies, but challenges remain, including the unpredictability of the emerging viral strain, limited production capacity for a pandemic vaccine, rapid deployment to meet worldwide demand, and the expiry of stockpiled vaccines during the interpandemic period. Currently, the risk of human infection with avian influenza is very low in the general population, and WHO does not recommend vaccination. The seasonal influenza vaccine does not protect against avian influenza, but it may reduce the likelihood of simultaneous infection with both avian and seasonal influenza viruses.

The initial H5N1 vaccines were produced using the same manufacturing methods and regulatory approval criteria as seasonal influenza vaccines, which involve producing a virus seed stock optimised for growth in chicken eggs and inactivated. These conventional influenza vaccine platforms are inefficient to produce and have low immunogenicity. New egg-independent vaccine approaches that have shown effectiveness in human clinical trials include cell-based virus production, recombinant proteins, and virus-like particles.

An ideal vaccine for an avian influenza pandemic should induce a robust protective immune response with minimal antigen use, provide cross-protection against viruses from different clades, and be rapidly scalable for global supply in the event of a pandemic. Better, faster and more efficient avian influenza vaccine development has expanded to several different platforms to overcome current limitations. All available technologies will be needed to produce a global supply of vaccines within six months of a pandemic outbreak.

Some countries have developed and licensed vaccines that could be used for avian influenza. The U.S. FDA licensed three H5N1-focused vaccines in 2007, 2013 and 2020. Additional vaccines have been authorized by the European Medicines Association (EMA) or protection against various H5 influenza viruses. The target population for these vaccines and H5N1 vaccines is not the general public, but individuals at highest risk of exposure, such as those who work with poultry or cattle.



Pandemic preparedness influenza vaccines are intended for use only once a pandemic has been officially declared. These vaccines may be authorised in advance but cannot be marketed before an influenza pandemic. They must be specifically developed against the viral strain causing the pandemic. Pandemic influenza vaccines can only be fully prepared once the pandemic has begun, because the exact strain cannot be known until a pandemic emerges. During a pandemic, data on vaccine effectiveness and safety must be collected against the circulating strain. These vaccines can be adapted to protect against any pandemic influenza virus strain if required. Several pandemic preparedness influenza vaccines are authorised in the EU and can be rapidly modified in a pandemic situation.

Table 29.1 Licensed Pandemic Preparedness H5N1 Influenza Vaccines

Vaccines	Developer	Type
Pandemic influenza vaccine (H5N1)	AstraZeneca	Live attenuated intranasal vaccine
Adjupanrix H5N1	GlaxoSmithKline Biologicals	Inactivated vaccine containing split virion, adjuvanted.
Foclivia H5N1	Seqirus UK, Ltd	Inactivated vaccine containing surface antigen from egg-based culture, adjuvanted.
Incellipan H5N1	Seqirus UK, Ltd	Inactivated vaccine containing surface antigen prepared from cell culture, adjuvanted.



Table 29.2 Candidate Pandemic Preparedness H5N1 Influenza Vaccines

Type / Developer	Trial Phase / Status Regulatory Review
Self-amplifying H5N1 mRNA vaccine / Arcturus Therapeutics	• Began a Phase 1 trial in December 2024 to evaluate the safety and immune response
mRNA vaccine / Moderna	• Completed a Phase 1/2 trial for its mRNA vaccine candidate targeting H5 and H7 avian influenza viruses. • Interim analysis showed robust immune response and safety profile.

Zoonotic influenza vaccines are intended for immunisation during outbreaks of influenza viruses originating from animals, including to protect poultry workers, veterinarians and others at increased risk of exposure. The use of these vaccines during the interpandemic period should be based on risk assessment. They may require modifications to more closely match circulating virus strains, particularly if a pandemic is anticipated to be caused by that strain or a related one. The currently available vaccines contain the virus subtype A/H5 because this subtype is responsible for recurrent outbreaks and is believed to pose a significant pandemic threat. These vaccines were authorised based on immunogenicity data. Three zoonotic influenza vaccines are authorised for use in the EU during avian influenza outbreaks without declaration of a pandemic:



Table 29.3 Licensed Zoonotic A/H5 Influenza Vaccines

Vaccines	Developer	Type / Schedule / Indication
Aflunov zoonotic influenza vaccine (H5N1)	Seqirus UK, Ltd (authorized in Nov 2010)	• Inactivated vaccine containing surface antigen prepared from cell culture, adjuvanted. • IM, 2 doses, 3 weeks apart • For adults working with poultry during outbreaks • Authorized for use in EU during outbreak without declaration of a pandemic.
Celldemic zoonotic influenza vaccine (H5N1)	Celldemic zoonotic influenza vaccine (H5N1) Seqirus Netherlands B.V (authorized in Nov 2014)	
Seqirus’s zoonotic influenza vaccine (H5N8)	Seqirus UK, Ltd (authorized in Nov 2023)	

Prevention of H5N1 infection involves avoiding sources of exposure and reducing animal-to-human transmission. People who come into contact with infected poultry—or with wild birds, domesticated animals (live or dead), or contaminated environments such as farms or live bird markets—are at risk of exposure to avian influenza viruses. Those at risk should wear appropriate personal protective equipment (PPE), including safety goggles, disposable gloves, and N95 respirators. Individuals living in or travelling to regions experiencing outbreaks in birds or other animals should take precautions and monitor their health. Recommended food-safety practices include avoiding the consumption of unpasteurized or raw milk, eggs and meat, as well as maintaining strict hand hygiene such as regular handwashing with soap and water. With a global rise in HPAI outbreaks, poultry vaccination is an important tool, as outlined in the World Organisation for Animal Health (WOAH) 2023 policy recommendations for avian influenza vaccination

References

1. Strategic Advisory Group of Experts.(2009). *Report of the H5N1 SAGE Working Group to the April 2009 meeting: Use of licensed H5N1 influenza vaccines in the interpandemic period.* World Health Organization. http://www.who.int/immunization/sage/SAGE_H5N1_26Mayb.pdf



2. SAGE Working Group on Influenza Vaccines and Immunizations. (2013). *Influenza A (H5N1) vaccine stockpile and inter-pandemic vaccine use*. World Health Organization. https://terrance.who.int/mediacentre/data/sage/SAGE_Docs_Ppt_Nov2013/6_session_influenza/Nov2013_session6_h5n1_vaccine_stockpile.pdf
3. World Health Organization.(2025).*Zoonotic influenza: Candidate vaccine viruses and potency testing reagents*. Global Influenza Programme. <https://www.who.int/teams/global-influenza-programme/vaccines/who-recommendations/zoonotic-influenza-viruses-and-candidate-vaccine-viruses>
4. World Health Organization, Regional Office for the Western Pacific. (November 14, 2025). *Avian Influenza Weekly Update Number 1022*. https://cdn.who.int/media/docs/default-source/wpro---documents/emergency/surveillance/avian-influenza/ai_20251114.pdf
5. World Organisation for Animal Health (WOAH). (2023). *Avian influenza vaccination: Why it should not be a barrier to safe trade* [Policy brief]. <https://www.woah.org/app/uploads/2023/12/en-woah-policybrief-avianinflenzavaccinationandtrade.pdf>
6. European Medicines Agency. (2025). *Avian influenza (bird flu)*. <https://www.ema.europa.eu/en/human-regulatory-overview/public-health-threats/avian-influenza-bird-flu>
7. Taaffe, J., Zhong, S., Goldin, S., Rawlings, K. S., Cowling, B. J., & Zhang, W. (2025). An overview of influenza H5 vaccines. *The Lancet Respiratory Medicine*, 13(4), e20–e21. [https://www.thelancet.com/journals/lanres/article/PIIS2213-2600\(25\)00052-9/fulltext](https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(25)00052-9/fulltext)
8. Clegg, C. H., Rininger, J. A., & Baldwin, S. L. (2013). Clinical vaccine development for H5N1 influenza. *Expert Review of Vaccines*, 12(7), 767–777. <https://www.tandfonline.com/doi/full/10.1586/14760584.2013.811178>
9. Langley, J. M., Risi, G., Caldwell, M., et al. (2011). Dose-sparing H5N1 A/Indonesia/05/2005 pre-pandemic influenza vaccine in adults and elderly adults: A phase III, placebo-controlled, randomized study. *Journal of Infectious Diseases*, 203(12), 1729–1738. <https://doi.org/10.1093/infdis/jir172>
10. Herbing, K. H., von Sonnenburg, F., Nothdurft, H. D., et al. (2014). A phase II study of an investigational tetravalent influenza vaccine formulation combining MF59-adjuvanted, pre-pandemic A/H5N1 vaccine and trivalent seasonal influenza vaccine in healthy adults. *Human Vaccines & Immunotherapeutics*, 10(1), 92–99. <https://www.tandfonline.com/doi/full/10.4161/hv.26495>
11. Kreijtz, J. H., Goeijenbier, M., Moesker, F. M., et al. (2014). Safety and immunogenicity of a modified-vaccinia-virus-Ankara-based influenza A H5N1 vaccine: A randomised, double-blind phase 1/2a clinical trial. *The Lancet Infectious Diseases*, 14(12), 1196–1207. <https://www.ema.europa.eu/en/medicines/human/EPAR/foclivia>
12. European Medicines Agency. (2021). *Foclivia*. <https://www.ema.europa.eu/en/medicines/human/EPAR/foclivia>
13. Kerstetter, L. J., Buckley, S., Bliss, C. M., & Coughlan, L. (2021). Adenoviral vectors as vaccines for emerging avian influenza viruses. *Frontiers in Immunology*, 11, 607333. <https://doi.org/10.3389/fimmu.2020.607333>
14. Kosalaraksa, P., Jeanfreau, R., Frenette, L., et al. (2015). AS03B-adjuvanted H5N1 influenza vaccine in children 6 months through 17 years of age: A phase 2/3 randomized, placebo-controlled, observer-blinded trial. *The Journal of Infectious Diseases*, 211(5), 801–810. <https://doi.org/10.1093/infdis/jiu548>
15. Focosi, D., Nicastri, E., & Maggi, F. (2025). An overview of the H5N1 mRNA vaccine pipeline. *Influenza and Other Respiratory Viruses*, 19, e70113. <https://doi.org/10.1111/irv.70113>



Chikungunya



Introduction

Chikungunya is a mosquito-borne viral disease caused by the chikungunya virus (CHIKV), an RNA virus in the *Alphavirus* genus of the family *Togaviridae*. During epidemics and endemic circulation, CHIKV is transmitted primarily by *Aedes aegypti* and, to a lesser extent, by *Aedes albopictus* mosquitoes.

Chikungunya virus causes clinical illness in more than 70% of infected individuals, typically 4–7 days after an infected mosquito bite (range 2–12 days). CHIKV Infection usually results in a self-limiting febrile illness with acute onset of fever, characterised by severe joint and muscle pain, and sometimes accompanied by an itchy maculopapular rash. Other common signs and symptoms include joint swelling, headache, nausea, and fatigue. Severe complications, such as encephalitis, may occur in the elderly and individuals with comorbidities. Persistent arthralgia and joint swelling are common long-term manifestations. Fatalities have been reported, with case fatality rates of 0.1 - 4.9% during epidemics in elderly patients, who are at higher risk. There is no specific antiviral treatment for CHIKV infections.

CHIKV was first identified in the United Republic of Tanzania in 1952 and subsequently in other countries in Africa and Asia. Since 2004, outbreaks have become more frequent and widespread. Globally as of December 2024, current or previous autochthonous mosquito-borne transmission of CHIKV has been reported in 119 countries and territories, including in Asia, Africa, Europe and the Americas. Transmission often persists in countries where large segments of the population have not yet been infected. In Asia, CHIKV is endemic and causes recurrent, sometimes large epidemics, particularly in the Indian subcontinent and in Southeast Asia.



In Malaysia, an increase in chikungunya cases was reported in 2019, 11 years after the previous outbreak. More than 2,000 cases were reported in 2020, mainly in states bordering Thailand, with further expansion across Peninsular Malaysia in 2021. Since then, it was noted that the number of cases began to reduce significantly. As of 2 August 2025, only 40 CHIKV disease cases have been reported, compared with 63 cases reported during the same period in 2024. Three chikungunya clusters have been reported in 2025. No chikungunya-related deaths have been recorded to date. Case investigation, integrated vector management, community engagement, and multisectoral collaboration efforts have been carried out. All outbreaks were successfully contained within two weeks of detection, indicating an effective public health response and outbreak management.

Vaccines

Two chikungunya vaccines have received regulatory approvals and/or have been recommended for use in populations at risk in several countries. None are available in Malaysia. More than 30 vaccine candidates have been reported, and several are in advanced clinical trials or under regulatory review.

Table 29.4 Chikungunya Vaccines

Vaccines	Developer	Type / Schedule
VIMKUNYA	Bavarian Nordic, Denmark	- Recombinant adsorbed vaccine containing capsid proteins and envelope proteins E1 and E2, assembled into VLPs, and adsorbed onto aluminum compound. - IM, single dose. No booster needed.
		- February 2025: US FDA approved for individuals 12 years and older. - May 2025: ACIP recommended its use for people 12 years and older who are travelling to a country or territory where a chikungunya outbreak is occurring, or planning on extended stay (>6 months)



Vaccines	Developer	Type / Schedule
IXCHIQ (VLA1553)	Valneva Austria GmbH	• Live-attenuated virus using weakened form of the virus. • IM, single dose. No booster needed
		• November 2023: US FDA approved via Accelerated Approval pathway for individuals 18 years and older who are at increased risk of exposure. • February 2024: ACIP recommended for use in travelers & laboratory workers. • May 2025: ACIP revised traveler recommendations. • August 2025: US FDA suspended the biologics license due to safety concerns (cardiac/neurological events, especially among >60 years old)

Table 29.5 Chikungunya Vaccine Candidates

Vaccines	Type / Developer	Trial Phase / Status Regulatory Review
PXVX0317	Virus-like particle / Emergent BioSolutions (formerly PaxVax)	• Phase 3 completed • Under review in multiple regions • Safer profile; mimics virus without live replication
CHIKV VLP	Adjuvanted, virus-like particle /Consortium (NIH-supported)	• Phase 3 trials ongoing • Review: not yet submitted • Robust antibody response; promising safety
MV-CHIK	Measles-vectored vaccine, recombinant /Themis Bioscience (acquired by Merck)	• Phase 2 completed • Development paused • Uses measles virus vector; early immunogenicity shown
BBV87	Inactivated whole-virus strain CHIK/03/06 / Bharat Biotech, India	• Phase 2/3 ongoing • India-focused regulatory pathway • Traditional approach; targeting endemic regions



References

1. Bettis, A. A., L'Azou Jackson, M., Yoon, I. K., et al. (2022). The global epidemiology of chikungunya from 1999 to 2020: A systematic literature review to inform the development and introduction of vaccines. *PLoS Neglected Tropical Diseases*, 16, e0010069. <https://doi.org/10.1371/journal.pntd.0010069>
2. Clara Maure, C., Khazhidinov, K., Kang, H., et al. (2024). Chikungunya vaccine development, challenges, and pathway toward public health impact. *Vaccine*, 42(26). <https://doi.org/10.1016/j.vaccine.2024.126483>
3. Gao, S., Song, S., & Zhang, L. (2019). Recent progress in vaccine development against chikungunya virus. *Frontiers in Microbiology*, 10, 2881. <https://doi.org/10.3389/fmicb.2019.02881>
4. Rezza, G., & Weaver, S. C. (2019). Chikungunya as a paradigm for emerging viral diseases: Evaluating disease impact and hurdles to vaccine development. *PLoS Neglected Tropical Diseases*, 13(1), e0006919. <https://doi.org/10.1371/journal.pntd.0006919>
5. Rosso, A., Flacco, M. E., Cioni, G., et al. (2024). Immunogenicity and safety of chikungunya vaccines: A systematic review and meta-analysis. *Vaccines*, 12(9), 969. <https://doi.org/10.3390/vaccines12090969>
6. U.S. Food & Drug Administration. (2024). *IXCHIQ*. <https://www.fda.gov/vaccines-blood-biologics/ixchiq>
7. U.S. Food & Drug Administration. (2025). *Vimkunya*. <https://www.fda.gov/vaccines-blood-biologics/vimkunya>
8. Weaver, S. C., & Lecuit, M. (2015). Chikungunya virus and the global spread of a mosquito-borne disease. *The New England Journal of Medicine*, 372(13), 1231–1239. <https://doi.org/10.1056/NEJMr1406035>
9. Weber, W. C., Streblow, D. N., & Coffey, L. L. (2024). Chikungunya virus vaccines: A review of IXCHIQ and PXVX0317 from pre-clinical evaluation to licensure. *BioDrugs*, 38(6), 727–742. <https://doi.org/10.1007/s40259-024-00677-y>
10. World Health Organization. (2024). Strategic preparedness, readiness and response plan: Dengue and other Aedes-borne arboviruses. Geneva: World Health Organization.
11. World Health Organization. (2025a). *Global chikungunya epidemiology update – June 2025*. <https://www.who.int/publications/m/item/chikungunya-epidemiology-update-june-2025>
12. World Health Organization. (2025b). *Chikungunya virus disease – Global situation, 3 October 2025*. <https://www.who.int/emergencies/disease-outbreak-news/item/2025-DON581>



Clostridioides difficile infection



Introduction

Clostridioides difficile (formerly *Clostridium difficile*) infection (CDI) is a major cause of antibiotic-associated diarrhoea and colitis and remains one of the most common pathogens in healthcare-associated infections. The spectrum of CDI ranges from asymptomatic carriage and mild diarrhoea to life-threatening pseudomembranous colitis, toxic megacolon, and fulminant colitis.

Long-term symptom resolution is difficult to achieve for many patients; approximately 20% experience recurrent infections after initially responding to therapy. Although traditionally associated with antibiotic use in healthcare settings, CDI has increasingly occurred in the community since the emergence of hypervirulent strains in the early 2000s.

CDI is mainly mediated by the protein exotoxins toxin A (TcdA) and toxin B (TcdB). Antibodies to TcdA and TcdB confer protection against primary and recurrent CDI.

Vaccines

Vaccine candidates targeting TcdA and TcdB may prevent clinical illness but do not prevent gastrointestinal tract colonisation. This has generated interest in targeting non-toxin pathogenic factors such as binary toxin (CDT), cell-surface antigens, spore-coat antigens, and flagella. Alternative *C. difficile* antigens show potential as immunogenic targets and novel pathways for vaccine development and are currently under pre-clinical investigation. Other considerations include the cross-reactivity of antibodies to antigens across different *C. difficile* strains, the need for the most suitable type of adjuvants, the optimal age for immunisation, demonstrating immune responses in high-risk elderly individuals, and the duration of protection.



Table 29.6 *Clostridioides difficile* candidate vaccines

Vaccines	Manufacturer	Type
Cdiffense	Sanofi Pasteur	- Bivalent formalin-inactivated toxoid vaccine - Contain purified TcdA and TcdB from VPI10463, aluminum hydroxide adjuvant
<u>Clinical Trial: Phase 3</u> - IM, 3 doses on days 0, 7 & 30; for adults aged >50 years. - Could not achieve the goal of preventing primary CDI. - The trial was discontinued in December 2017.		
PF-06425090	Pfizer	- Recombinant toxin vaccine - Contain Genetically modified and chemically treated recombinant TcdA and TcdB, aluminum hydroxide adjuvant
<u>Clinical Trial: Phase 3 (CLOVER-initiated in 2017)</u> - IM, 3 doses on days 1, 8 & 30; for adults aged 50 to 85 years. - Concluded in 2022: failed to achieve primary endpoint of infection prevention. - Reached secondary endpoints: reduce disease duration, reduce disease severity		
VLA84	Valneva	- Subunit vaccine - Contains recombinant fusion protein of TcdA and TcdB binding regions, used heterologous expression system without culture, +/- aluminum adjuvant
<u>Clinical Trial: Phase 2 (completed in 2016).</u> - IM, 3 doses on days 0, 7 & 28; for adults aged 50-64 and >65 years. - Neutralising antibodies were able to block the activity of TcdA and TcdB. - As of 2025 this candidate is ready for Phase 3.		



References

1. Bézay,c N., Ayad, A., Dubischar, K., et al. (2016). Safety, immunogenicity and dose response of VLA84, a new vaccine candidate against *Clostridium difficile*, in healthy volunteers. *Vaccine*, 34(23),2585–2592. <https://doi.org/10.1016/j.vaccine.2016.03.098>
2. de Bruyn, G., Gordon, D. L., Steiner, T., et al. (2020). Safety, immunogenicity, and efficacy of a Clostridioides *difficile* toxoid vaccine candidate: A phase 3 multicentre, observer-blind, randomised, controlled trial. *The Lancet Infectious Diseases* [https://doi.org/10.1016/S1473-3099\(20\)30331-5](https://doi.org/10.1016/S1473-3099(20)30331-5)
3. de Bruyn, G., Saleh, J., Workman, D., et al. & H-030-012 Clinical Investigator Study Team (2016). Defining the optimal formulation and schedule of a candidate toxoid vaccine against *Clostridium difficile* infection: A randomized Phase 2 clinical trial. *Vaccine*, 34(19), 2170–2178. <https://doi.org/10.1016/j.vaccine.2016.03.028>
4. Henderson, M., Bragg, A., Fahim, G., Shah, M., & Hermes-DeSantis, E. R. (2017). A Review of the Safety and Efficacy of Vaccines as Prophylaxis for *Clostridium difficile* Infections. *Vaccines*, 5(3), 25. <https://doi.org/10.3390/vaccines5030025>
5. Kitchin, N., Remich, S. A., Peterson, J., et al. (2020). A Phase 2 Study Evaluating the Safety, Tolerability, and Immunogenicity of Two 3-Dose Regimens of a *Clostridium difficile* Vaccine in Healthy US Adults Aged 65 to 85 Years. *Clinical Infectious Diseases* 70(1), 1–10. <https://doi.org/10.1093/cid/ciz153>
6. Kociolek, L. K., & Gerding, D. N. (2016). Breakthroughs in the treatment and prevention of *Clostridium difficile* infection. *Nature reviews. Gastroenterology & Hepatology*, 13(3), 150–160. <https://doi.org/10.1038/nrgastro.2015.220>
7. Sheldon, E., Kitchin, N., Peng, Y., et al. (2016). A phase 1, placebo-controlled, randomized study of the safety, tolerability, and immunogenicity of a *Clostridium difficile* vaccine administered with or without aluminum hydroxide in healthy adults. *Vaccine*, 34(18),2082–2091. <https://doi.org/10.1016/j.vaccine.2016.03.010>
8. Wang, J., Ma, Q., & Tian, S. (2025). Against *Clostridium difficile* Infection: An Update on Vaccine Development. *Toxins*, 17(5), 222. <https://doi.org/10.3390/toxins17050222>
9. Donskey, C. J., Dubberke, E. R., Klein, N. P., et al. (2024). CLOVER (CLOstridium difficile Vaccine Efficacy tRial) Study: A Phase 3, Randomized Trial Investigating the Efficacy and Safety of a Detoxified Toxin A/B Vaccine in Adults 50 Years and Older at Increased Risk of *Clostridium difficile* Infection. *Clinical Infectious Diseases* 79(6), 1503–1511. <https://doi.org/10.1093/cid/ciae410>
10. Vincent B. Young. (2025). Vaccinating against *Clostridium difficile* Infection. *N Engl J Med*; 392:1237-1240. <https://www.nejm.org/doi/full/10.1056/NEJMcibr2413794>
11. Alameh, M.G., Semin, A., Bayard, NU., et al. (2024). A multivalent mRNA-LNP vaccine protects against *Clostridium difficile* infection. *Science* 386,69-75. <https://doi.org/10.1126/science.adn4955>
12. Riley, T.V.; Lyras, D.; Douce, G.R. (2019). Status of Vaccine Research and Development for *Clostridium difficile*. *Vaccine*, 37, 7300–7306. <https://doi.org/10.1016/j.vaccine.2019.02.052>
13. Akiyama, S., Yamada, A., Komaki, Y., Komaki, F., Micic, D., & Sakuraba, A. (2021). Efficacy and Safety of Monoclonal Antibodies Against *Clostridium difficile* Toxins for Prevention of Recurrent *Clostridium difficile* Infection: A Systematic Review and Meta-Analysis. *Journal of Clinical Gastroenterology*, 55(1), 43–51. <https://doi.org/10.1097/MCG.0000000000001330>



Ebola virus disease



Introduction

Ebola virus disease (EVD) is caused by the Ebola virus (EBOV), a linear non-segmented RNA virus that belongs to the *Orthoebolavirus* genus of the *Filoviridae* family. The EVD is rare but severe in humans and often fatal, with case fatality rates of 70%–90% when not treated.

The virus is mainly transmitted to humans from wild animals (especially bats) and spreads through human-to-human transmission via direct contact with blood, bodily fluids, or injured skin. The virus is highly transmissible and can be found in all body fluids of an infected person. If untreated, death from EVD occurs 7–10 days after the onset of symptoms. There is no specific treatment for EVD.

Ebola disease first occurred in 1976 in two simultaneous outbreaks: one outbreak was of Sudan virus disease in Nzara in what is now South Sudan, and the other outbreak was of Ebola virus disease in Yambuku, in what is now the Democratic Republic of the Congo. The latter occurred in a village near the Ebola River, from which the disease takes its name.

Vaccines

More than 10 candidate Ebola vaccines (including monovalent, bivalent and multivalent candidates) have undergone or are currently undergoing clinical development at different trial phases, and two have obtained approval. Ebola vaccines are currently not available in Malaysia.



Table 29.7 Approved Ebola Virus Vaccines (licensed in certain countries)

No.	Vaccines	Manufacturer	Type
1.	Ervebo (rVSVΔG-ZEBOV-GP)	Merck	Live, attenuated recombinant vesicular stomatitis virus (VSV) vaccine: The VSV has been genetically engineered to contain a protein from the <i>Zaire ebolavirus</i> • Single dose vaccine; for individuals aged ≥12 months • Prevent disease caused by Ebola virus (species <i>Orthoebolavirus zairense</i>).
2.	VAC52150 Combination of Zabdeno (Ad26. ZEBOV) & Mvabea (MVA-BN-Filo)	Johnson & Johnson, & Janssen Vaccines & Prevention B.V., The Netherlands	Recombinant vaccine consisting of Ad26- & MVA-vectored components: • Ad26- adenovirus serotype 26 expressing envelope GP of <i>Zaire ebolavirus</i> species, and • MVA (modified vaccinia Ankara) expressing 4 filoviruses nucleoproteins • IM. 2 doses (prime/boost), 56 days apart. • For people ≥1 year old. • Prevent EVD caused by the <i>Zaire ebolavirus</i> species.



Table 29.8 High-Risk Groups on the use of Ervebo vaccine

1.	Adults at risk for potential occupational exposure (ACIP): • health care personnel involved in the care and transport of patients with suspected or confirmed EVD at special pathogens treatment centres (SPTCs). • laboratorians & support staff at Laboratory Response Network (LRN) facilities that handle specimens that might contain replication-competent Ebola virus (Zaire ebolavirus) in the USA.
2.	'Ring vaccination' strategy (average of 150 persons for each 'ring'): • Contacts, & contacts of contacts, of confirmed Ebola virus disease patients (dead or alive), • Health care and frontline workers (local and international) in affected areas, & • Health care and frontline workers in areas at risk of spread of the outbreak.

Table 29.9 Other Approved Ebola Virus Vaccines (licensed in certain countries)

No.	Vaccines	Licensed in	Recommendations
1.	GamEvac-Combi	Russia	A replicative recombinant vesicular stomatitis virus (rVSV) and human adenovirus serotype 5 (Ad5) expressing the envelope GP of <i>Zaire ebolavirus</i> (Makona strain), prime/boost.
2.	CanSinoBio Ad5-EBOV	China	A platform based on rVSV- and Ad5-vectored technology, currently licensed for emergency use.
3.	cAD3-EBOZ		Still under development by NIAID/NIH, USA. Uses a platform similar to Zabdeno and Mvabea (with or without MVA-BN-Filo)



References

1. International Committee on Virus Taxonomy, ICTV (2026) *Filoviridae*: Available at <https://ictv.global/report/chapter/filoviridae/filoviridae/orthoebolavirus>
2. European Medicines Agency (EMA). (May 29, 2020). *New vaccine for prevention of Ebola virus disease recommended approval in the European Union*. Press release. <https://www.ema.europa.eu/en/news/new-vaccine-prevention-ebola-virus-disease-recommended-approval-european-union>
3. Trad, M. A., Naughton, W., Yeung, A., et al (2017). Ebola virus disease: An update on current prevention and management strategies. *Journal of Clinical Virology*, 86, 5–13. <https://doi.org/10.1016/j.jcv.2016.11.005>
4. U.S. Food and Drug Administration (December 19, 2019). *First FDA-approved vaccine for the prevention of Ebola virus disease, marking a critical milestone in public health preparedness and response*. Press release.
5. World Health Organisation (2025). *Ebola Disease*. Available at: <https://www.who.int/news-room/fact-sheets/detail/ebola-disease>
6. World Health Organization (May 2024). Extraordinary meeting of the Strategic Advisory Group of Experts on Immunization on Ebola vaccination: conclusions and recommendations. *Weekly Epidemiological Report*, 99(27), 355–362. <https://www.who.int/publications/i/item/WER-9927-355-362>
7. World Health Organization. (November 12, 2019). WHO prequalifies *Ebola vaccine, paving the way for its use in high-risk countries*. Press release <https://www.who.int/news/item/12-11-2019-who-prequalifies-ebola-vaccine-paving-the-way-for-its-use-in-high-risk-countries>
8. Choi, M.J., Cossaboom, C.M., Whitesell, A.N., et al. (January 8, 2021). Use of Ebola vaccine: recommendations of the Advisory Committee on Immunization Practices, United States, 2020. *Morbidity and Mortality Weekly Report*, 70(1):1–12. <https://doi.org/10.15585/mmwr.mm7001a1>
9. Feldmann, H., Geisbert, T.W. (2011). Ebola haemorrhagic fever. *Lancet*, 377:849–62. [https://doi.org/10.1016/S0140-6736\(10\)60667-8](https://doi.org/10.1016/S0140-6736(10)60667-8)
10. Malenfant, J.H., Joyce, A., Choi, M.J., et al. (2021). Use of Ebola Vaccine: Expansion of Recommendations of the Advisory Committee on Immunization Practices To Include Two Additional Populations, United States. *Morb Mortal Wkly Rep* ;71:290–292. DOI: <http://dx.doi.org/10.15585/mmwr.mm7108a2>
11. Malvy, D., McElroy, A.K., de Clerck, H., Günther, S., and van Griensven, J. (2019). Ebola virus disease. *Lancet* 393:936–48. [https://doi.org/10.1016/S0140-6736\(18\)33132-5](https://doi.org/10.1016/S0140-6736(18)33132-5)
12. Woolsey, C., & Geisbert, T. W. (2021). Current state of Ebola virus vaccines: A snapshot. *PLoS pathogens*, 17(12), e1010078. <https://doi.org/10.1371/journal.ppat.1010078>
13. Jenkin, D., Makinson, R., Sanders, H., et al. (May 2025). Safety and immunogenicity of a bivalent Ebola virus and Sudan virus ChAdOx1 vectored vaccine in adults in the UK: an open-label, non-randomised, first-in-human, phase 1 clinical trial. *The Lancet Microbe*, Volume 6, Issue 5, 101022 <https://doi.org/10.1016/j.lanmic.2024.101022>



Human Immunodeficiency Virus (HIV)

Introduction

HIV remains a major global public health issue, particularly in low- and middle-income countries. The HIV-related death toll is estimated at 44.1 million to date. Sub-Saharan Africa is the region most impacted by the virus, with 1 in 25 adults living with HIV. There were an estimated 40.8 million people living with HIV at the end of 2024, 65% of whom are in the WHO African Region. In 2024, an estimated 630,000 people died from HIV-related causes and an estimated 1.3 million people acquired HIV.

In Malaysia, the first HIV case was recorded in 1986. The current cumulative number of reported HIV cases is 131,815; the cumulative number of reported AIDS cases is 30,174; while the total number of deaths related to HIV/AIDS is 62,226. As of 2023, the estimated number of people living with HIV (PLHIV) was 86,142, where about 90% of cases are males and 69,589 (81%) were aware of their status and had been notified through the national surveillance system. By December 2022, 68% of the reported PLHIV were receiving antiretroviral treatment (ART). More than 70% of new HIV infections are reported among people 20 to 39 years old, and approximately 14% among those aged 13-19 years old.

Vaccines

While ART has dramatically improved the quality of life and life expectancy for people with HIV, a vaccine remains the most sustainable solution for prevention. Since 1987, more than 30 HIV candidate vaccines have been tested in approximately 60 Phase I/II trials. Most of these trials have been conducted in the United States and Europe, but several have also been conducted in developing countries in Africa, South America and Asia. The results have confirmed the safety of the vaccines and have provided important scientific information to develop newer generations of candidate vaccines.



As of late 2025, after more than 35 years of intensive vaccine research, various approaches have been tested but no fully approved HIV vaccine exists yet. Several promising approaches are in advanced trials. The most notable developments include virus-like particle (VLP) vaccines, mRNA vaccine platforms, and broadly neutralizing antibody (bNAb)-based strategies, which are in Phase 2/3 trials.

Numerous factors contribute to the challenges in obtaining an effective HIV vaccine. Lessons from the development of HIV vaccines include that effective vaccines would likely have to stimulate broadly neutralising humoral responses and effective T-cell immunity. Furthermore, certain correlates of protection and loss of protection have been identified. Insights gained from vaccine trials have advanced the understanding of HIV, as we continue to explore novel approaches in antigen designs, vaccine delivery and combinations of approaches. This chapter summarises the current status of HIV vaccine development and the promising vaccine candidates.

The development of an HIV vaccine is hindered by several key challenges:

- HIV's high genetic diversity: HIV exists in a multitude of subtypes (clades) and mutates rapidly within an individual, making it difficult to design a vaccine that can target all variants.
- Immune evasion: HIV has evolved mechanisms to evade the host immune system, particularly by integrating into host DNA, creating latent reservoirs and hiding critical epitopes on its envelope proteins through extensive glycosylation.
- Lack of natural immunity: Unlike most viral infections, natural infection with HIV does not confer sterilizing immunity, further complicating efforts to induce protective immunity.

Types of HIV Vaccines Under Investigation

1. Preventive Vaccines: These aim to prevent HIV infection in HIV-negative individuals and are the primary focus of vaccine development.



2. **Subunit Vaccines:** These vaccines use specific HIV proteins (e.g., the gp120 or gp140 envelope glycoproteins) to stimulate the immune system. However, these proteins have proven difficult to target due to their high variability.
3. **Viral Vector Vaccines:** Viral vectors (such as adenovirus or canarypox) are used to deliver HIV genes into the body. These vectors prompt the immune system to generate an immune response against the virus. The Step Study (HVTN 502) tested an adenovirus serotype 5-based vaccine, but it showed no protection and actually increased susceptibility to HIV in certain individuals.
4. **mRNA Vaccines:** Following the success of COVID-19 mRNA vaccines, this technology is now being explored for HIV. mRNA platforms can potentially generate a stronger and more targeted immune response. Moderna and the NIH Vaccine Research Center are working on mRNA-based HIV vaccine candidates that aim to elicit bNAbs.
5. **Therapeutic Vaccines:** These vaccines aim to control viral replication or induce an immune response in people already living with HIV, potentially reducing the need for ART or enabling HIV remission. Therapeutic HIV vaccines typically focus on enhancing the immune response to control viral load in chronically infected individuals, with the hope of eventually achieving a functional cure (i.e., long-term viral suppression without ART).

Broadly Neutralizing Antibodies (bNAbs)

Researchers have isolated bNAbs from the blood of people living with HIV and studied them in an effort to design novel vaccine candidates. The bNAbs are antibodies that can neutralize a wide range of HIV strains, making them a powerful tool in HIV prevention and treatment. Key bNAbs include VRC01, 3BNC117 and 10-1074. VRC01 is a human monoclonal antibody targeting the HIV-1 CD4 binding site. Early-phase clinical trials of VRC01 and 3BNC117 showed reduced viral load in HIV-1-infected individuals not on HAART. HVTN 703 and HVTN 704 trials investigate the effectiveness of VRC01.

While bNAb-based therapy has shown promise in preventing infection



and controlling viral load in HIV-infected individuals, inducing the immune system to produce bNAbs naturally through vaccination remains a major goal. Studies show bNAbs vary in effectiveness depending on regional HIV strains, meaning vaccines may need to be tailored to local viral clades. Efforts are focused on creating sequential immunization strategies to stimulate the production of these antibodies.

Progress in HIV Vaccine Development in 2025

- Proof-of-concept achieved: IAVI/Scripps Research bnAb Priming Vaccines—two Phase 1 trials (North America and Africa) demonstrated that bnAb germline-targeting vaccines can activate B cells to begin producing bNAbs, a critical step toward a universal HIV vaccine.
- bnAb strategies are the most promising, aiming for broad protection across HIV's diverse strains.
- Stepwise immunization may be the key to overcoming HIV's complexity and have proven capable of priming bNAbs in humans.
- mRNA vaccines are now in Phase 2 trials, leveraging rapid design and adaptability to HIV's mutations.
- VLP vaccines are progressing, offering safer platforms with strong immune responses.



Table 29.10 Leading HIV Vaccine Candidates

Vaccines	Manufacturer	Type
mRNA HIV vaccine (mRNA-1644)	Moderna + IAVI + NIH	mRNA vaccine using mRNA technology similar to COVID-19 vaccines; designed to trigger bNAbs against diverse HIV strains.
	Progress: Phase 2	
eOD-GT8 60mer	IAVI + Scripps Research	Protein nanoparticle vaccine using broadly neutralizing antibodies (bNAb) germline targeting
	Progress: Phase 2 First-in-human proof that germline-targeting can activate precursor B cells for producing VRC01-type bNAbs targeting the CD4 binding site on HIV's outer envelope.	
CHIKV VLP HIV-like vaccine	IAVI + partners	Using virus-like particles (VLPs)
	Progress: Phase 2/3 Mimics HIV's structure without live virus; safer and strong antibody responses	
DNA + Protein Prime-Boost Vaccine	Janssen (Johnson & Johnson) + partners	Using DNA + recombinant protein
	Progress: Phase 2 Imbokodo trial ended in 2021. Halted for lack of efficacy; redesigned approaches still in testing.	
Mosaic HIV Vaccine	Janssen + HVTN	Using Adenovirus (Ad26) vector
	Progress: Phase 2b (halted in 2023) Showed safety but insufficient efficacy; lessons informing new vector-based designs	



While no HIV vaccine has been licensed yet, significant progress has been made in understanding the complexities of the virus and how to induce immunity against it. The success of the COVID-19 mRNA vaccines has breathed new hope into HIV vaccine research, with mRNA technology being at the forefront of innovative approaches. Continued efforts in bNAb development, VLPs and mRNA vaccine platforms, and global collaboration are paving the way toward the goal of an HIV vaccine.

References

1. Gray, G.E., Mngadi, K., Lavreys, L., et al. (2024) Mosaic HIV-1 vaccine regimen in southern African women (Iimbokodo/HVTN 705/HPX2008): a randomised, double blind, placebo-controlled, phase 2b trial. *Lancet Infect Dis*;24:1201-1212. [https://doi.org/10.1016/S1473-3099\(24\)00358-X](https://doi.org/10.1016/S1473-3099(24)00358-X)
2. Gray, G.E., Laher, F., Lazarus, E., Ensoli, B., & Corey, L. (2016). Approaches to preventative and therapeutic HIV vaccines. *Current Opinion in Virology*, 17: 104–109. <https://doi.org/10.1016/j.coviro.2016.02.010>
3. Hammer, S. M., Sobieszczyk, M. E., Janes, H., Karuna, S. T., Mulligan, M. J., Grove, D., et al.; HVTN 505 Study Team. (2013). Efficacy trial of a DNA/rAd5 HIV-1 preventive vaccine. *The New England Journal of Medicine*, 369(22): 2083–2092. <https://doi.org/10.1056/NEJMoal310566>
4. Hannah, S., Chinyenze, K., Shattock, R., Yola, N., & Warren, M. (2022). HIV vaccines in 2022: Where to from here? *Journal of the International AIDS Society*, 25(5), e25923. <https://doi.org/10.1002/jia2.25923>
5. Jefferys, R. (2024). *The HIV vaccines and passive immunization pipeline report*. https://www.treatmentactiongroup.org/wp-content/uploads/2024/07/pipeline_HIV_VAX_2024_final.pdf
6. Joseph, S., Kaleebu, P., Ruzagira, E., et al. (2019). OC 8491 PREPVACC: A phase III, MAMS adaptive prophylactic HIV vaccine trial with a second randomisation to compare F/TAF with TDF/FTC PrEP. *BMJ Global Health*, 4, A10. https://doi.org/10.1136/bmjgh-2019-EDC.23?urlappend=%3Futm_source%3Dresearchgate.net%26utm_medium%3Darticle
7. Kim, J., Vasan, S., Kim, J. H., & Ake, J. A. (2021). Current approaches to HIV vaccine development: A narrative review. *Journal of the International AIDS Society*, 24(Suppl 7), e25793. <https://doi.org/10.1002/jia2.25793>
8. Lynch, R. M., Boritz, E., Coates, E. E., et al. (2015). Virologic effects of broadly neutralizing antibody VRC01 administration during chronic HIV-1 infection. *Science Translational Medicine*, 7(319), 319ra206. <https://doi.org/10.1126/scitranslmed.aad5752>
9. Mahomed, S., Pillay, K., Hassan-Moosa, R., et al. (2025). Clinical trials of broadly neutralizing monoclonal antibodies in people living with HIV: A review. *AIDS Research and Therapy*, 22, 44. <https://doi.org/10.1186/s12981-025-00734-8>
10. Ministry of Health Malaysia. (2023). *The Global AIDS Monitoring Report*. https://www.moh.gov.my/moh/resources/Penerbitan/Laporan/Umum/Laporan_Global_AIDS_Monitoring_2023.pdf



11. Ng'uni, T., Chasara, C., & Ndhlovu, Z. M. (2020). Major scientific hurdles in HIV vaccine development: Historical perspective and future directions. *Frontiers in Immunology*, 11, 590780. <https://doi.org/10.3389/fimmu.2020.590780>
12. Rerks-Ngarm, S., Pitisuttithum, P., Nitayaphan, S., et al. (2009). Vaccination with ALVAC and AIDSVAX to prevent HIV-1 infection in Thailand. *The New England Journal of Medicine*, 361(23), 2209–2220. <https://doi.org/10.1056/NEJMoa0908492>
13. Shim, I., Rogowski, L., & Venketaraman, V. (2025). Progress and recent developments in HIV vaccine research. *Vaccines*, 13(7), 690. <https://doi.org/10.3390/vaccines13070690>
14. World Health Organization. (2025). *HIV statistics, globally and by WHO region*, https://cdn.who.int/media/docs/default-source/hq-hiv-hepatitis-and-stis-library/who-ias-hiv-statistics_2025-new.pdf
15. Xu, K., Acharya, P., Kong, R., et al. (2018). Epitope-based vaccine design yields fusion peptide-directed antibodies that neutralize diverse strains of HIV-1. *Nature Medicine*, 24(6), 857–867. <https://doi.org/10.1038/s41591-018-0042-6>



Malaria



Introduction

Human malaria is caused by a protozoan parasite of five *Plasmodium* species - five *Plasmodium* species - *P. falciparum*, *P. ovale*, *P. malariae*, *P. knowlesi* and *P. vivax*. Humans are the only known reservoirs of these species, except *P. knowlesi* whose natural hosts are the long-tailed and pig-tailed macaques.

Human malaria is established following a bite from the female anopheline mosquitoes. The incubation period ranges from 8-14 days. The infection can range from mild fever to life-threatening disease ranging from coma, respiratory distress, severe anemia or circulatory shock. In young children and non-immune adults, the clinical picture can change rapidly from a mild condition to a life-threatening illness.

There were an estimated 263 million new malaria cases and 597,000 malaria deaths globally in 2023. The WHO African Region continues to shoulder the heaviest malaria burden, comprising 94% of malaria cases and 95% of malaria deaths globally. Almost all malaria deaths are caused by *Plasmodium falciparum*. The risk of *P. knowlesi*, a simian malaria parasite, is closely tied to rapid deforestation. *P. knowlesi* is increasingly reported in Southeast Asia, including Malaysia, Indonesia, Thailand, Vietnam, and Myanmar, and has established transmission in Southeast Asia.

Malaysia has come a long way in the prevention and control of malaria since the introduction of the Malaria Eradication Program in 1961 in Sabah and Sarawak, and in 1967 in Peninsular Malaysia. Malaria became a mandatory notifiable disease under the Malaysian Infectious Disease Prevention and Control Act 1988. By 2012, *Plasmodium vivax* accounted for 50.2% of human malaria cases, followed by *P. falciparum* (30.7%), *P. malariae* (16.7%) and mixed infection (2.2%). It's important to note that children <5 years old only



accounted for 2.5% of all cases, whereas 61.9% of the infected cases were those aged 20-49 years. In 2012, Malaysia also reported that of the 61.6% of human malaria cases, 38% were caused by the zoonotic *P. knowlesi*. Since 2008, Malaysia had already reported >15,000 cases of *P. knowlesi* infection and about 50 deaths. Infections in 2017 alone totalled 3,600.

Vaccines

Malaria vaccines have been in development since the 1960s, with significant progress in the last decade. Malaria vaccines are now classified by the parasite developmental stage targeted: pre-erythrocytic vaccines, blood stage vaccines, and transmission blocking vaccines. Some vaccines may target multiple developmental stages.

Table 29.11 *P. falciparum* Malaria Vaccines

No.	Vaccines	Manufacturer	Type
1.	Mosquirix (RTS,S/AS01)	GlaxoSmithKline Biologicals	• Sporozoite subunit vaccine containing CS protein (PfCSP), HBsAg, and AS01 adjuvant. • The pre-erythrocyte vaccine targets the circumsporozoite protein (CSP) on the sporozoite surface.
2.	R21/Matrix-M	Serum Institute of India (SII)	• Second generation pre-erythrocyte vaccine with similar mechanism of action as RTS,s/AS01. • Contains R21 and Matrix-M, a saponin-derived adjuvant.



Table 29.12 High-risk Groups (as recommended by WHO)

No.	Target group	Recommendation
1.	Children living in endemic areas, with moderate to high transmission	- Both vaccines are used to prevent <i>P. falciparum</i> infection in children. - There is no known cross-protection with other Plasmodium species. - The malaria vaccination series for each child should be completed with the same product whenever feasible.
2.	Special populations: - Malnourished children, - Children with HIV infection, - Infants and young children who relocate to an area of moderate to high transmission, including emergency situation.	RTS,S/AS01 (WHO approved Oct 2021) - For use in children 5-17 months old - Primary series: 3 doses (4 weeks apart). - Booster dose (4th) 18 months later R21/Matrix-M (WHO approved Dec 2023) - For use in children 5-36 months old. - Primary series: 3 doses (4 weeks apart). - Booster dose (4th) 12 months later.

As of 2024, WHO recommends the use of malaria vaccines for the prevention of *P. falciparum* malaria in children living in malaria endemic areas, prioritizing areas of moderate and high transmission. Malaria vaccines should be provided as part of a comprehensive malaria control strategy.

Malaysia reports an overall malaria incidence rate of 8.6/100,000 with a mortality rate of 0.03/100,000 by the end of 2022, indicating low transmission setting. Thus, Malaysia does not currently have widespread routine malaria vaccination programmes for the general public, nor travellers. Focus is currently on chemoprophylaxis and vector control



programmes for high risk areas to reduce transmission of *P. knowlesi* and *P. falciparum*.



As of 2024, WHO does not recommend the malaria vaccines for use in adults (including health workers and pregnant persons). The vaccine is not indicated for travellers, who should use chemoprophylaxis and vector control methods to prevent malaria when travelling to endemic settings.

Evidence of Safety and Effectiveness

Both vaccines are considered to be safe and well tolerated. There is a small risk of febrile seizures within 7 days (mainly within 2–3 days) of vaccination. The most commonly reported adverse reactions were fever, followed less frequently by irritability, and injection site reactions such as pain and swelling.

The two malaria vaccines have been shown to reduce clinical malaria cases by more than half during the 12 months following the initial three doses, and a fourth dose given in the second year of life prolonged efficacy. They have been shown to prevent three-quarters of malaria cases when given seasonally (prior to onset of the rainy season in areas of high seasonal transmission), where seasonal malaria chemoprevention is provided. There is no evidence one vaccine is superior to the other. Current malaria vaccines reduce uncomplicated malaria by ~40%, severe malaria by ~30%, and all-cause mortality by 13%.



References

1. World Health Organization (2023). World Malaria Report. <https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2023>
2. World Health Organization. (2024). WHO Position paper: Malaria vaccine. *Weekly Epidemiological Record*. No 19, 2024, 99, 225–248. Available at <https://www.who.int/publications/i/item/who-wer-9919-225-248>
3. World Health Organisation (2024). *Malaria. Malaysia country profile*. Available at <https://www.who.int/publications/m/item/malaria-2024-mys-country-profile>
4. Collins, K. A., Snaith, R., Cottingham, M. G., Gilbert, S. C., & Hill, A. (2017). Enhancing protective immunity to malaria with a highly immunogenic virus-like particle vaccine. *Scientific reports*, 7, 46621. <https://doi.org/10.1038/srep46621>
5. Draper, S. J., Sack, B. K., King, C. R., et al.(2018). Malaria Vaccines: Recent Advances and New Horizons. *Cell Host & Microbe*, 24(1), 43–56. <https://doi.org/10.1016/j.chom.2018.06.008>
6. Fornace, K. M., Abidin, T. R., Alexander, N., et al. (2016). Association between Landscape Factors and Spatial Patterns of *Plasmodium knowlesi* Infections in Sabah, Malaysia. *Emerging Infectious Diseases*, 22(2), 201–208. <https://doi.org/10.3201/eid2202.150656>
7. Ishizuka, A. S., Lyke, K. E., DeZure, A., et al (2016). Protection against malaria at 1 year and immune correlates following PfSPZ vaccination. *Nature Medicine*, 22(6), 614–623. <https://doi.org/10.1038/nm.4110>
8. Laurens, M.B. (2020). RTS,S/AS01 vaccine (Mosquirix™): an overview. *Human Vaccines and Immunotherapeutics*;16(3):480–489. Available at <https://doi.org/10.1080/21645515.2019.1669415>
9. Barber, B. E., Rajahram, G. S., Grigg, M. J., William, T., & Anstey, N. M. (2017). World Malaria Report: time to acknowledge *Plasmodium knowlesi* malaria. *Malaria Journal*, 16(1), 135. <https://doi.org/10.1186/s12936-017-1787-y>
10. Chin AZ, Maluda MCM, Jelip J, Jeffree MSB, Culleton R, and Ahmed K. (2020). Malaria elimination in Malaysia and the rising threat of *Plasmodium knowlesi*. *J Physiol Anthropol* ;39(1):36. <https://doi.org/10.1186/s40101-020-00247-5>.
11. Lee, WC., Cheong, F.W., Amir, A. et al. (2022). *Plasmodium knowlesi*: the game changer for malaria eradication. *Malaria J*; 21, 140. Available at <https://doi.org/10.1186/s12936-022-04131-8>
12. Malaysia Ministry of Health (2017). Malaria Vaccine. Report 003/2017. Malaysian Health Technology Assessment Section (MaHTAS), Medical Development Division.
13. Ministry of Health Malaysia (2023, October) Malaysia Health Facts 2022. https://www.moh.gov.my/images/04-penerbitan/health-facts/4_Health_Facts_2023-compressed_.pdf



Zika



Introduction

Zika is caused by Zika virus (ZIKV), a single-stranded RNA virus of the *Flavivirus* genus from the *Flaviviridae* family. ZIKV strains are divided into two major lineages: the African lineage and the Asian/American lineage. These two lineages differ in around 90% of their nucleotide sequence. Strains belonging to the Asian/American lineage have been isolated in Southeast Asia, in the Pacific Islands, and in the Americas. Within the Asian/American lineage, the strains from the Americas have formed a new American cluster.

ZIKV is predominantly transmitted by the *Aedes* mosquitoes, with humans representing the amplifying host. A sylvatic cycle of transmission also exists and involves non-human primates and arboreal zoophilic *Aedes* mosquitoes from African and Asian forests. ZIKV can also be transmitted from human to human through sexual transmission, blood transfusion, ocular transmission, or vertical transmission from mother to fetus. Clinically, the majority of ZIKV infections are asymptomatic, however some may present with fever, rash, arthritis and/or arthralgia and/or myalgia, which are typically self-limiting.

ZIKV was first isolated from a sentinel rhesus monkey in the Zika Forest in Uganda in 1947 and from *Aedes africanus* mosquitoes in 1948. The first human infection was recorded in Nigeria in 1954. In Asia, the virus was isolated in Malaysia in 1966 from *Aedes aegypti* mosquitoes, and the first human infections were reported in 1977 in Central Java, Indonesia. Prior to the outbreak in Yap State (part of the Federated States of Micronesia) in 2007, where an estimated 75% of the residents were infected, only 14 human cases had been confirmed.

The world was made aware of the alarming public health problem of ZIKV infection when Brazil reported a large outbreak in March 2015, and its subsequent direct association with Guillain-Barré syndrome and microcephaly. By August 31, 2016, 72 countries and territories had observed



local ZIKV transmission. In the Americas alone, over 500 000 locally acquired cases had been reported up to September 1, 2016. In November 2016, the WHO declared ZIKV infection a Public Health Emergency of International Concern (PHEIC), and two years later, ZIKV was listed as a priority disease in WHO's R&D Blueprint on preparedness for infectious disease outbreaks. The 2016 ZIKV epidemic propelled global efforts to develop diagnostic tests, vaccines and therapeutics.

In Malaysia, ever since the ZIKV was isolated in *Aedes aegypti* mosquitoes in 1966, serological evidence of ZIKV infections were reported in human and non-human primates in 1996 and 1997. The first ZIKV active case in Malaysia was reported in September 2016; a Malaysian woman with fever and facial rash a week after returning from a visit to Singapore. The first local infection was detected in a 61-year-old man from Kota Kinabalu. In Malaysia, ZIKV infection was not widespread compared to outbreaks in countries nearby such as Singapore and Thailand. To date, only 8 laboratory-confirmed cases with active surveillance were reported.

There is no treatment available for ZIKV infection or its associated diseases. Transmission persists in several countries but generally the incidence and testing for ZIKV are low globally from 2018 to the present, which stalled many development efforts. The public health value for a Zika vaccine is to prevent prenatal ZIKV infection and congenital ZIKV syndrome, resulting in microcephaly, other nervous system malformations and pregnancy-related complications. Effective vaccine and monoclonal antibody treatment is still a public health priority, especially for persons who can become pregnant and who live or travel in ZIKV-endemic regions.

Vaccines

There are no registered vaccines currently available for Zika. Several investigational vaccines have entered preclinical and early clinical trials. None has advanced to clinical efficacy trials.



Table 29.13 Advanced ZIKV vaccine candidates

Vaccines	Developer	Type
mRNA-1893	Moderna	mRNA vaccine containing E and PrM proteins
Progress: - Completed Phase 1 trial successfully. - Vaccine induced strong neutralising antibody response comparable to levels observed during acute phase of a ZIKV infection. - Phase 2 clinical trial (NCT04917861) in USA & Puerto Rico - Involved 809 participants - Evaluates two administrations of mRNA vaccines at day 1 and day 29 at two dose levels (30 µg or 100 µg) compared to a single 100 µg dose administration and placebo.		
TAK-426	Takeda, Japan	Purified inactivated Zika vaccine (PIZV)
Progress: - Successfully completed Phase 1 clinical trial - evaluated safety, tolerability & immunogenicity of three doses of PIZV. - Well tolerated and immunogenic in both flavivirus-naïve and flavivirus-primed adults. 10 µg dose selected for further clinical development.		



Vaccines	Manufacturer	Type
VRC5283	NIAID Vaccine Research Centre	Contains DNA plasmid encoding the E and PrM proteins
Progress: • Phase 1 clinical trials (VRC 319 & VRC 320) » demonstrated superior immunogenicity. • A Phase 2/2b clinical trial (VRC 705) was initiated in 2017 » assessed safety, immunogenicity, and efficacy in endemic populations, • ZIKV incidence waned and there were not enough cases to assess vaccine efficacy. • Trial was stopped early due low possibility of documenting additional ZIKV infections. • Overall, only 3 out of 2338 subjects had virologically confirmed ZIKV infection by PCR. • Assessment of the immunogenicity results from this trial are still ongoing		

The current low ZIKV incidence and unpredictability of future outbreaks complicate prospects for further development of candidate vaccines beyond Phase II, licensure, and commercial viability of vaccines. This is due to the difficulty to evaluate efficacy in the absence of a sustained outbreak or reliable prevalence data. Vaccines have not yet been approved by regulatory authorities and would not be available for rapid mobilisation in an outbreak scenario. In addition, more immunological, epidemiological and regulatory questions also need to be addressed.



References

1. Bollman, B., Nunna, N., Bahl, K., et al. (2023). An optimized messenger RNA vaccine candidate protects non-human primates from Zika virus infection. *NPJ Vaccines*, 8, 58. <https://doi.org/10.1038/s41541-023-00656-4>
2. Brasil, P., Pereira, J.P., Moreira, M.E., et al. (2016). Zika virus infection in pregnant women in Rio de Janeiro. *The New England Journal of Medicine*, 375, 2321–2334. DOI: 10.1056/NEJMoa1602412
3. Buitrago-Pabón, A. L., Ruiz-Sáenz, S., Jiménez-Alberto, A., Aparicio-Ozores, G., Castelán-Vega, J. A., & Ribas-Aparicio, R. M. (2024). An update on Zika virus vaccine development and new research approaches. *Microbiology Research*, 15(2), 667–692 <https://doi.org/10.3390/microbiolres15020044>
4. Duong, V., Dussart, P., and Buchy, P. (2016) Zika virus in Asia. Review. *International Journal of Infectious Diseases*; 54:121-128. <http://dx.doi.org/10.1016/j.ijid.2016.11.420>
5. Dutta, S. K., & Langenburg, T. (2023). A perspective on current flavivirus vaccine development: A brief review. *Viruses*, 15, 860. <https://doi.org/10.3390/v15040860>
6. Gaudinski, M.R., Houser, K.V., Morabito, K.M., et al. (2018). Safety, tolerability, and immunogenicity of a purified inactivated Zika virus vaccine candidate in healthy adults: Randomised, open-label, phase 1 clinical trials. *The Lancet*, 391, 552–562. [https://doi.org/10.1016/S0140-6736\(17\)33105-7](https://doi.org/10.1016/S0140-6736(17)33105-7)
7. Han, H. H., Diaz, C., Acosta, C. J., Liu, M., & Borkowski, A. (2021). Safety and immunogenicity of a purified inactivated Zika virus vaccine candidate in healthy adults: An observer-blind, randomised, phase 1 trial. *The Lancet Infectious Diseases*, 21, 1282–1292. [https://doi.org/10.1016/s1473-3099\(20\)30733-7](https://doi.org/10.1016/s1473-3099(20)30733-7)
8. Morabito, K. M., Milutinovic, P., Graham, B. S., & Pierson, T. C. (2023). Zika Virus Vaccines. In Plotkin's Vaccines (8th ed., pp. 1322–1333.e1327). Elsevier.
9. Ostrowsky, J. T., Katzelnick, L. C., Bourne, N., et al., & Zika Expert Workgroup. (2025). Zika virus vaccines and monoclonal antibodies: A priority agenda for research and development. *The Lancet Infectious Diseases*, 25(7), e402–e415. [https://doi.org/10.1016/s1473-3099\(24\)00750-3](https://doi.org/10.1016/s1473-3099(24)00750-3)
10. Thomas, S. J., & Barrett, A. (2020). Zika vaccine pre-clinical and clinical data review with perspectives on future development. *Human Vaccines & Immunotherapeutics*, 16, 2524–2536. <https://doi.org/10.1080/21645515.2020.1730657>
11. Vannice, K.S., Giersing, B.K., Koslow, D.C., et al. (2019). Meeting report: WHO consultation on considerations for regulatory expectations of Zika virus vaccines for use during an emergency. *Vaccine*, 37, 7443–7450. <https://doi.org/10.1016/j.vaccine.2016.10.034>
12. Wang, Y., Ling, L., Zhang, Z., & Marin-Lopez, A. (2022). Current advances in Zika vaccine development. *Vaccines*, 10(11), 1816. <https://doi.org/10.3390/vaccines10111816>
13. World Health Organisation. (2024). Zika epidemiology update – May 2024. <https://www.who.int/publications/m/item/zika-epidemiology-update-may-2024>
14. WHO/UNICEF. (2017). Zika Virus (ZIKV) Vaccine Target Product Profile (TPP): Vaccine to protect against congenital Zika syndrome for use during an emergency.
15. Woodson, S. E., & Morabito, K. M. (2024). Continuing development of vaccines and monoclonal antibodies against Zika virus. *NPJ Vaccines*, 9, 91. <https://doi.org/10.1038/s41541-024-00889-x>
16. Woon, Y., Lim, M., Tg Abd Rashid, T., et al. (2019). Zika virus infection in Malaysia: An epidemiological, clinical and virological analysis. *BMC Infectious Diseases*, 19, 152. <https://doi.org/10.1186/s12879-019-3786-9>



Adults Who Missed Childhood Immunisation

Table 30.1 Recommended Vaccines for Adults Who Missed Childhood Immunisation

All adults should complete a primary series of the following vaccines and toxoids as quickly as possible if they have not done so during childhood.

Adults: Age group	Vaccine Recommended	Schedule
All Adults	Tetanus, Diphtheria & Pertussis	Combined tetanus, diphtheria and pertussis (Tdap): 1st dose of Tdap is followed by 2nd dose of Td given 4 weeks later, and 3rd dose of Td 6–12 months after 2nd dose Booster (Td/Tdap): every 10 years
		Doses need not be repeated when the vaccine schedule is delayed
		Individuals with unknown or uncertain diphtheria, tetanus, and pertussis vaccination history should receive a full primary series followed by appropriate boosters.



Adults: Age group	Vaccine Recommended	Schedule
All Adults	Poliomyelitis	For unvaccinated adults: 3-dose IPV series: 1, 1-2 months, 6-12 months. • If an accelerated schedule is necessary, each dose should be spaced 4 weeks apart. • A single booster dose of IPV vaccine should be given every 10 years if the person remains at increased risk.
	There have been ongoing cases of wild poliovirus type 1 reported in areas of conflict in Afghanistan and Pakistan since 2021	
Adults aged 18–64 years	Measles, Mumps, Rubella	2 doses of measles-mumps-rubella (MMR) live attenuated vaccine, given at least 1 month apart
	Indicated if there is no documented history of infection by a healthcare provider or serological evidence of immunity.	
All Adults	Hepatitis B	Three-dose series: 0, 1, 6 months.



Older Adults and Patients with Chronic Illnesses

Table 30.2 Immunisations for Older Adults

Vaccine recommended	Category	Schedule	Comments
Pneumococcal	All adults 50 years and older who are previously unvaccinated or of unknown vaccination status	PCV20: 1 dose Or PCV13 or PCV15: 1 dose, followed by PCV20 1 year later	The sequential approach is recommended for those who have received PCV13 or PCV15, while only a single dose is needed for PCV20
Influenza	All adults >50 years	1 dose administered annually	-
Shingles	All adults >50 years regardless of report of prior zoster infection	2 doses, 2–6 months apart	With or without a history of chickenpox or chickenpox vaccination. Five years after receiving Zostavax



Vaccine recommended	Category	Schedule	Comments
Tetanus, diphtheria and pertussis (Tdap) Or Tetanus and diphtheria (Td)	Complete vaccine series is indicated for individuals with uncertain vaccine history or with fewer than three recorded doses.	Primary vaccination: 3 doses with 1st dose of Tdap and 2nd dose with Td; at least 4 weeks apart; 3rd of Td doses 6–12 months later. Booster with Td at 10-years intervals.	Regardless of interval since last tetanus or diphtheria toxoid-containing vaccine.
RSV	All adults >60 years, particularly those at high risk of severe disease Women at 32–36 weeks of pregnancy to protect infants at birth	Single dose	



Table 30.3 Immunisations for Patients with Chronic Disease

Category	Vaccines Recommended	Schedule	Comments
Residents of nursing homes and other chronic care facilities	Influenza*	Annual vaccination	Vaccination can be given throughout the year Use the most recent formulation
	Pneumococcal	See schedule in Table 20.2 on page 115	
	Shingles	2 doses, 2–6 months apart	
	RSV	1 dose	
Patients with chronic illnesses (e.g., chronic pulmonary, cardiac, renal, and liver disease, diabetes mellitus)	Pneumococcal (see page 116), Influenza (see page 80), Hepatitis B (see page 70) for end-stage renal disease	Please refer to relevant sections	

*The influenza vaccination is strongly recommended for all adults 50 years and older.



Healthcare Workers

On the basis of documented nosocomial transmission, healthcare workers (HCWs) are considered to be at significant risk of acquiring and transmitting the following vaccine-preventable infections. The following vaccinations (Table 30.4) are strongly recommended for HCWs:

Table 30.4 : Immunisation for Healthcare Workers

Vaccines	Category	Recommendation
Chickenpox (varicella)	HCWs	Two doses 4–8 weeks apart for HCWs who do not have a reliable history of chickenpox infection or serologic evidence of immunity. Booster doses are not necessary.
COVID-19	All HCWs	Unvaccinated adults are recommended to receive one dose (or two doses of inactivated vaccine) of mRNA vaccine. Revaccination is not routinely recommended for healthy adults without direct patient contact
	HCWs with direct patient contact	This category is recommended for revaccination after 12 months from recent dose.



Vaccines	Category	Recommendation
Hepatitis B (HepB)	All HCWs including students directly involved in patient care or the handling of human samples	The primary HepB vaccination series should be administered at the start of employment for staff without documented proof of a complete vaccine series or serologic evidence of immunity Pre-vaccination serologic screening is not required, unless deemed cost-effective by the employer. Post-vaccination serologic testing 1-2 months after completing the 3-dose series is advised.
Influenza	All HCWs	Annual vaccination Use the most recent available formulation
Measles, mumps and rubella (MMR)	All HCWs including students directly involved in patient care or handling of human samples.	Primary vaccination (2 doses at least 28 days apart) before the start of employment for HCWs who do not have documented vaccination, physician-diagnosed infection or serologic evidence of immunity No recommendation on booster dose
Meningococcus	All laboratory personnel and HCWs with ongoing occupational exposure to <i>Neisseria meningitidis</i>	A primary vaccine followed by one booster dose every 5 years



Vaccines	Category	Recommendation
Polio	All HCWs	Should have completed a full course of primary vaccination.
	Laboratory staff and HCWs who handle specimens or have contact that might have polioviruses	Besides primary vaccination, this category may receive one lifetime IPV booster.
Tetanus, Diphtheria and Pertussis (Tdap)	All HCWs	A single dose of Tdap as soon as feasible if HCWs have not previously received Tdap. Td or Tdap boosters are advocated every 10 years thereafter.

References

1. World Health Organization (WHO). (6 December 2024). *Summary of WHO position papers – Immunization of health care workers*. <https://www.who.int/publications/m/item/table-4-summary-of-who-position-papers-immunization-of-health-care-workers>
2. World Health Organization (WHO). (1 December 2025). *Summary of WHO position papers – Recommendations for routine immunization*. <https://www.who.int/publications/m/item/table1-summary-of-who-position-papers-recommendations-for-routine-immunization>
3. Advisory Committee on Immunization Practices, & Centers for Disease Control and Prevention (CDC). (November 25, 2011). *Immunization of health-care personnel: Recommendations of the Advisory Committee on Immunization Practices (ACIP)*. *MMWR Recommendations and Reports*, 60(RR-7), 1–45. <https://www.cdc.gov/mmwr/preview/mmwrhtml/rr6007a1.htm>
4. World Health Organization (WHO). (October 8, 2024). *COVID-19 advice for the public: Getting vaccinated*. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines/advice>
5. Centers for Disease Control and Prevention (CDC). (September 6, 2024). *Polio vaccine recommendations*. <https://www.cdc.gov/polio/hcp/vaccine-considerations/index.html>



Human Immunodeficiency Virus (HIV)

Table 30.5 Immunisation for HIV Adult Patients

Vaccines	CD4 T lymphocyte count ≤ 200 cells/mm ³	CD4 T lymphocyte count > 200 cells/mm ³
Hepatitis A	R	R
	For non-immune, 2-dose series at 0 and 6–12 months	
Hepatitis B	R	R
	- For non-immune (anti-HBs <10mIU/ml): » Recombivax: 40 mcg/mL as a 3-dose series at 0, 1, and 6 months, or » Engerix B: 2 doses of 20mcg/mL as a 4-dose series at 0, 1, 2, and 6 months - Better immune response is observed in those with suppressed HIV viral load	
Hib	UI	UI
HPV	R	R
	Males and females through age 26 years: 3-dose series at 0, 1-2, and 6 months	
Influenza (inactivated)	R	R
	Single dose, given annually	
MMR	C	UI
	Tested seronegative and with CD4 count >200: single dose	
Meningococcus	R	R
	2 doses of MenACWY: ≥ 2 months apart and booster every 5 years	



Vaccines	CD4 T lymphocyte count ≤ 200 cells/mm ³	CD4 T lymphocyte count > 200 cells/mm ³
Pneumococcus (PCV13 & PPSV23 or PCV20)	R	R
	- If previously unvaccinated, 1 dose of PCV13 followed by 1 dose of PPSV23 >8 weeks later (preferably when CD4 count >200 cells/mm³). Repeat the PPSV23 dose five years later - If previously vaccinated with PPSV23, give PCV13 >1 year later, followed by PPSV23 five years after the previous dose. - PCV13 can be given at any CD4 cell count - For PPSV23, it is preferable to wait until CD4 count is >200 cells/mm³ - PCV20 only can be given at any CD4 cell count	
Rabies	UI	UI
RSV	UI	UI
	- For those aged ≥ 60 years: 1 dose is adequate - If CD4 <200, may choose to wait for immune reconstitution prior to vaccination.	
Tetanus-Diphtheria (Td)	UI	UI
	Booster dose to be given every 10 years.	
Chickenpox (Varicella) (live, attenuated)	C	UI
	- VZV seronegative and CD4 count >200: 2 doses, 4–8 weeks apart - Discontinue antiherpetic medications (e.g., acyclovir) at the time of vaccination and for the next 4 weeks	



Vaccines	CD4 T lymphocyte count ≤ 200 cells/mm ³	CD4 T lymphocyte count > 200 cells/mm ³
Yellow Fever	C	UI
	• In those with CD4 count >200 cells/ mm³, better immune response is shown in those with HIV viral load suppression • May consider a booster dose after 10 years following successful combination antiretroviral therapy (CART)	
Shingles (Zoster) (recombinant, adjuvant)	C	UI
	• For individuals age ≥ 18 years, regardless of CD4 count: 2 doses, 2–6 months apart • Do not administer RZV (Shingrix) during an acute episode of herpes zoster	
R – recommended; C – contraindicated; UI – Usual indication		

References

1. Crum-Cianflone, NF., & Wallace, MR. (2014). Vaccination in HIV-infected Adults. *AIDS PATIENT CARE and STDs*. 28(8): 397-410. DOI:10.1089/apc.2014.0121

2. *Immunizations for Preventable Diseases in Adults and Adolescents with HIV*. (Updated July 14, 2025). Accessed from: <https://clinicalinfo.hiv.gov/en/guidelines/hiv-clinical-guidelines-adult-and-adolescent-opportunistic-infections/immunizations#figure>

3. Veit, O, Domingo, C, Niedrig, M, et al, for the Swiss HIV Cohort Study. (2018). Long-term Immune Response to Yellow Fever Vaccination in Human Immunodeficiency Virus (HIV)-Infected Individuals Depends on HIV RNA Suppression Status: Implications for Vaccination Schedule. *Clinical Infectious Diseases*; 66(7):1099–1108. DOI:10.1093/cid/cix960



Immunocompromised patients

Immunisation for Adults with Cancer

Target population: adults and children with acute leukaemia, lymphoma, multiple myeloma, and patients with solid tumours who are scheduled to receive, are receiving, or have recently completed systemic anti-cancer therapy (chemotherapy, immunotherapy, targeted therapy, radiotherapy). The recommendations below apply to non-HSCT patients (HSCT-specific schedules are outside this table).

Timing of vaccination in general: ideally **2–4 weeks before** chemotherapy; if this is not possible, give 3 months after chemotherapy when immune response improves. Patients who received anti-B-cell therapy (e.g., rituximab) have poor response—delay vaccination **≥6 months** after rituximab for better response, when feasible.

Table 30.6 Recommended Immunisations for Adults with Cancer

Vaccines	Recommended Age	Schedule
Tdap or Td	19 years and older	One dose of Tdap, followed by Td or Tdap booster every 10 years
	Tdap has lower amounts of diphtheria and pertussis toxoid and is only used for those 7 years and older.	
	It is strongly recommended that individuals diagnosed with cancer receive the Tdap vaccine if they have not been vaccinated as adults.	



Vaccines	Recommended Age	Schedule
Hepatitis B	19–59 years: eligible 60 years and older: immunise those with other risk factors (HIV, chronic liver diseases, intravenous drug use, sexual risk factors, incarcerated individuals)	For adults 20 years and older, use high antigen dose (40 µg) & administer HBV vaccine series as: • Recombivax HB (0, 1, 6 months), or • Engerix-B (0, 1-2, 6 months)
	Check anti-HBs titre 1-2 months after the last dose. Repeat vaccine series, if titre level of >10 mIU/mL is not achieved.	
Influenza	All ages	Annually. Household contacts should be vaccinated annually as well.
	Avoid intranasal live attenuated influenza vaccine in cancer patients; use inactivated influenza virus vaccine (IIV) only. Evidence remains limited regarding the immunogenicity and clinical benefit of a high-dose versus a standard-dose of inactivated influenza virus vaccine (IIV). There are limited studies regarding the optimal timing for administering this vaccine during cancer treatment.	
Respiratory syncytial virus (RSV)	60 years and older	Once
	There are no data to guide the use of RSV vaccines in patients with cancer who are younger than 60 years.	
COVID-19	All ages	As per the latest CDC schedule for immunocompromised individuals. Revaccination should be considered at least 6–12 months after completion of B-cell-depleting treatments.
	COVID-19 vaccine can be co-administered with the influenza vaccine. It is safe to vaccinate concurrently with cytotoxic chemotherapy or during the cytopenic period.	



Vaccines	Recommended Age	Schedule
Pneumococcal vaccine (First PCV, then PPSV)	19 years and older	One dose of conjugate vaccine first (PCV13/PCV15) followed by PPSV23, 8 weeks later; OR, one dose PCV20. For most cancer patients, one dose of PCV20 is sufficient. No repeat PCV20 and no PPSV23 is needed after PCV20.
	PCV15 and PPSV23 should be separated by at least 8 weeks as noted in the table. Patients who have previously received PCV13 can only receive one dose of PCV20 after an interval of one year. Since conjugate vaccines (PCV) induce better immunogenicity in these populations, choose PCV where available.	
Recombinant zoster vaccine (non-live)	19 years and older	2 doses at least 4 weeks apart
	Patients who have experienced herpes zoster should receive the vaccine to prevent future episodes. There is no specific waiting period before immunization as long as the acute episode has resolved. The duration of clinical protection from RZV is unclear at this time and vaccination should not influence the duration of antiviral prophylaxis with certain therapies (e.g., proteasome inhibitors) Zoster live vaccine (ZVL) should not be administered to immunocompromised adults due to the risk of disseminated vaccine-related infection.	



Vaccines	Recommended Age	Schedule
Human Papillomavirus (HPV)	19–26 years: eligible 27–45 years: shared decision making	3 doses, 0, 1–2, 6 months
	Young cancer survivors have a higher incidence of secondary HPV-associated malignancies when compared to the general population. A significant factor contributing to this, is under immunisation. Studies have revealed that HPV vaccines are as immunogenic in young cancer survivors as they are in the general population. When to administer the vaccine should be based on individual risks. It is important to note that HPV testing or cytology screening is not required before vaccination.	

Adapted from CDC Adult Immunization Schedule By Medical Condition and Other Indication.

Coadministration of two or more of the recommended non-live vaccines is acceptable per CDC guidelines. When given on separate days, there is no recommended waiting period.

Table 30.7 Recommendations for Other Vaccines That May Be Indicated for Adults with Cancer and Coexisting Health Conditions

Vaccine	Type	Other Risk Factor	Recommendation
Haemophilus influenzae type b (Hib)	Non-live	Anatomic asplenia	For elective splenectomy: one dose at least 14 days before splenectomy (preferred)
		Functional asplenia	1 dose if the patient has not previously received Hib



Vaccine	Type	Other Risk Factor	Recommendation
Hepatitis A	Non-live	Chronic liver disease, HIV, MSM, homelessness, injection or non-injection drug use, occupational exposure, travel	2-dose HAV series or 3-dose HAV/HBV series
Meningococcal^a	MenACWY (non-live)	Anatomic or functional asplenia, complement component deficiency, complement inhibitor (e.g., eculizumab, ravulizumab), travel, occupational, military recruits, residential living for college students	• Two-dose series MenACWY-D • Frequency: 8 weeks apart • Revaccinate every 5 years if risk remains



Vaccine	Type	Other Risk Factor	Recommendation
Meningococcal^a	Men B (non-live)	Anatomic or functional asplenia (including sickle cell disease), persistent complement component deficiency, complement inhibitor (e.g., eculizumab, ravulizumab) use, occupational (microbiologists), pregnancy, MSM outbreak setting	- Two-dose primary series MenB-4C at least 1 month apart 3-dose primary series MenB-FHbp at 0, 1-2, 6 months - Revaccinate every 2-3 years if risk remains
Inactivated poliovirus (IPV)	Non-live	- Travel - Community risk (e.g., wastewater detection of vDPV)	Single booster
MMR	Live	No evidence of immunity: HIV (CD4 >200 for 6 months), HCP, outbreak setting, travel	Contraindicated with cancer treatment and other immunocompromising conditions
Chickenpox (Varicella)	Live	Post-exposure	Contraindicated with cancer treatment and other immunocompromising conditions



Vaccine	Type	Other Risk Factor	Recommendation
MVA (mpox)	Live (replication-deficient)	Post-exposure, Occupational exposure (laboratory worker), high risk	Safe to administer in persons with HIV or those on immunosuppressive therapies
Mpox and smallpox (ACAM2000)	Live		Contraindicated with cancer treatment and other immunocompromising conditions

Adapted from CDC. Adult Immunization Schedule by Medical Condition and Other Indication

Table 30.8 Timing Of Vaccination

Timing in relation to chemotherapy	Administration of vaccines
At diagnosis (before commencement of chemotherapy)	- review vaccine history - give indicated inactivated vaccines ≥ 2-4 weeks before therapy if possible
During chemotherapy	- give inactivated vaccines if indicated but counsel patient to expect reduced responsiveness (low immunogenicity) avoid live vaccines
After chemotherapy	- re-assess vaccine status ≥ 3 months after completion of chemotherapy - for anti-B-cell therapy, wait ≥ 6 months (often 6-12 months) before routine revaccination or live vaccines



Special Situations / Practical Points

1. **Anti-B-cell therapies (e.g., rituximab, obinutuzumab):** vaccines given during the period of B-cell depletion have poor immunogenicity. Defer non-urgent vaccination until **≥6 months** (often 6–12 months) after completion of therapy when feasible; check serology before revaccination/boosting.
2. **Timing relative to chemotherapy/immune recovery:** when vaccinating during or after therapy, many authorities use **≥3 months after completion of cytotoxic chemotherapy** as a pragmatic point for revaccination/primary vaccination, with longer intervals for intensive therapies or biologics. For planned immunosuppression, aim to vaccinate **≥2–4 weeks** before starting.
3. **Household contacts and healthcare workers:** should be current with routine vaccines (including annual IIV); live attenuated vaccines in contacts are usually allowed (except rare exceptions).
4. **Serologic testing:** consider post-vaccination serology for hepatitis B, chickenpox (when clinically relevant), and pneumococcus in select high-risk patients to confirm response and plan revaccination.
5. **COVID-19 vaccination:** immunocompromised cancer patients are a priority for COVID-19 vaccination and boosters per national guidance; multiple additional doses may be recommended (see specific COVID guidance).
6. **High-risk conditions (asplenia, cGvHD, multiple myeloma, chronic lymphoid/ myeloid malignancy):** favour conjugate pneumococcal vaccine and early revaccination schedules; consult ECIL/ASCO guidance.
7. Live vaccines are not given during chemotherapy and if patients remain immunosuppressed
8. Refer to each disease section for a particular vaccine for further information on the individual vaccines (safety, efficacy, availability, etc.)



References

1. Kamboj, M., Bohlke, K., Baptiste, D. M., et al. (2024). Vaccination of Adults with Cancer: ASCO Guideline. *Journal of Clinical Oncology: official Journal of the American Society of Clinical Oncology*, 42(14), 1699–1721. <https://doi.org/10.1200/JCO.24.00032>
2. Mikulska, M., Cesaro, S., de Lavallade, H., et al. European Conference on Infections in Leukaemia group (2019). Vaccination of patients with haematological malignancies who did not have transplantations: guidelines from the 2017 European Conference on Infections in Leukaemia (ECIL 7). *The Lancet. Infectious diseases*, 19(6), e188–e199. [https://doi.org/10.1016/S1473-3099\(18\)30601-7](https://doi.org/10.1016/S1473-3099(18)30601-7)
3. Rubin, L. G., Levin, M. J., Ljungman, P., et al. Infectious Diseases Society of America (2014). 2013 IDSA Clinical Practice Guideline for Vaccination of the Immunocompromised Host. *Clinical infectious Diseases : an official publication of the Infectious Diseases Society of America*, 58(3), 309–318. <https://doi.org/10.1093/cid/cit816>
4. Centers for Disease Control and Prevention (CDC). General Best Practice Guidelines for Immunization: *Altered Immunocompetence (Immunocompromised persons)*. *CDC Vaccines & Immunizations*. Updated online (2023–2024). Available from: <https://www.cdc.gov/vaccines/hcp/imz-best-practices/altered-immunocompetence.html>
5. European Society for Medical Oncology (2023). *ESMO Open and other oncology society guidance on vaccination of cancer patients (seasonal influenza, COVID-19 and pneumococcal vaccines)* — see: "Vaccination for seasonal influenza, pneumococcal infection and herpes zoster in patients with cancer" (ESMO Open review) and society statements. ESMO Open. 2023. Available from: <https://www.esmo.org>.



Table 30.9 Vaccination after Haematopoietic Stem Cell Transplant (HSCT) (Allogeneic and Autologous)

Vaccine	No. of doses ^a	Time after HSCT			
		Visit 1	Visit 2	Visit 3	Booster 12 months after first vaccination
Inactivated vaccine or toxoid					
Diphtheria, Tetanus, Pertussis	3 ^{a,b,c}	DTaP	DTaP	DTaP	DTaP
	From 6 months after HSCT: 3 doses of DTaP at 1–2-month intervals are recommended, followed by a booster 18 months after HSCT. Full dose (D) and full dose acellular vaccine (aP) are preferred. It is recommended that post-transplant patients receive DTaP due to its higher response rate as compared with Tdap.				
Polio (Inactivated vaccine only)	3 ^{b,c}	IPV	IPV	IPV	IPV
	From 6 months after HSCT: 3 doses at 1–2-month intervals are recommended; booster doses should be administered. Inactivated vaccine only. Live attenuated OPV is not recommended				
Haemophilus influenza type b (Conjugate type preferred)	3 ^{b,c}	Hib	Hib	Hib	-
	From 6 months after HSCT: 3 doses at a minimum of 1-month intervals are recommended				
Hepatitis B	3 ^c	Hep B	Hep B	Hep B	Booster ^d
	From 6 months after HSCT for: (i) seronegative patients before HSCT with a donor with positive anti-HBc, (ii) previously infected and anti-HBS <10 mIU/ml. Vaccine before HSCT for seronegative patients. One to two months between dose 1 and 2, 2 months between dose 2 and 3. If titres are less than 10 IU/mL, repeat the vaccination course.				



Vaccine	No. of doses ^a	Time after HSCT			
		Visit 1	Visit 2	Visit 3	Booster 12 months after first vaccination
Pneumococcal	3 x PCV13, 1x PPSV23	PCV13	PCV13	PCV13	PPSV23 2 months after 3rd dose of PCV, then one PPSV23 booster dose 5 years later
Starting 6 months after HSCT three doses of PCV13 at a 2 monthly interval are recommended. The PCV13 is more immunogenic and preferred but the spectrum of protection is narrower. HSCT recipients obtain a better response to PCV13 than PPSV23. PPSV23 may be given at 18 months to broaden the coverage if the patient has no chronic graft versus host disease (cGVHD) that requires immunosuppression					
Influenza	2 doses, first year after HSCT	Influenza	Influenza	-	Booster annually
Start 3–6 months after HSCT 2 doses in the 1st year after HSCT, then 1 seasonal dose should be given in each subsequent year. The 2nd dose 4 weeks after the 1st dose					



Vaccine	No. of doses ^a	Time after HSCT			
		Visit 1	Visit 2	Visit 3	Booster 12 months after first vaccination
COVID-19	2–3	COVID	COVID	Optional	Additional dose yearly, based on risk
	Start 3–6 months after HSCT. 2 primary doses, a 3rd dose can be considered. Minimal dose interval: 4 weeks				
HPV	3	HPV	HPV (2 month after first dose)	HPV (4 months after 2nd dose)	
	Administer first dose from 6–12 months after HSCT based on guidelines for the general population. It is recommended for people aged above 25 years to prevent HPV-related malignancies.				
Meningococcal ^e (Conjugate vaccine preferred)	2	8 weeks between the primary doses		Single Booster dose every 5 years after completing the primary series	
	Only for patients at risk of invasive meningococcal disease including those with asplenia, who travel to high-risk areas (Hajj).				
From 6 months after HSCT at least 2 doses of either a monovalent or tetravalent C vaccine and meningococcal B vaccine					



Vaccine	No. of doses ^a	Time after HSCT			
		Visit 1	Visit 2	Visit 3	Booster 12 months after first vaccination
Shingles (recombinant, adjuvanted, Shingrix)	2	Aged ≥18 years: a 2-dose series (2 months apart) if unvaccinated, or catch up on missed doses after antiviral prophylaxis has been completed		Further doses are not indicated	
Shingrix is registered for people aged ≥18 years. It is given 2–6 months apart in immunocompetent people or 1–2 months apart in immunocompromised people. Do not give vaccines during acute episodes of HZV infection. Refer to page 142					

Live-Attenuated Vaccines

Vaccine	No. of doses ^a	Time after HSCT
MMR	2–4 weeks apart	≥24 months after HSCT in patients with immune recovery, no GVHD and off immunosuppression.
Contraindicated immediately after HSCT. Consider 24 months after HSCT in a seronegative patient who is not receiving immunosuppressive therapy and has no chronic graft versus host disease. If MMR immunity has not been confirmed before vaccination, check serology after the 2nd dose to confirm seroconversion		



Vaccine	No. of doses ^a	Time after HSCT
Chickenpox (Varicella)	2 doses (2 months apart)	≥ 24 months after HSCT in patients with immune recovery, no GVHD and off immunosuppression
	Check serology (IgG) for varicella 24 months after HSCT in a seronegative patient and after more than 1 year of stopping immunosuppression. Consider in seronegative patients.	
Shingles, oral OPV, BCG, oral typhoid	-	Not recommended
	The live virus in the vaccine could lead to serious, potentially life-threatening infection	

a DTPa for children less than 10 years of age; dTpa for those 10 years and above

b If not specified, otherwise, the interval between doses is 1-2 month and the minimum interval between doses is 1 month

c May be given as combined vaccines. Hexaxim (DTaP-IPV-HB-Hib) is a 6-in-1 combination vaccine

d Check titres 4–8 weeks after the last dose of post-transplant vaccine; if anti-HBs is <10 IU/mL, an additional 3 doses should be considered, but the benefit of this second series of vaccination is uncertain. A high dose formulation is preferred for these booster doses.

e Meningococcal serogroups A, C, W, Y vaccine (MenACWY)



NOTES

1. Vaccination schedules are similar for allogeneic and autologous HCT recipients but grading of recommendations changes for some vaccines.
2. For autologous transplant recipients, many inactivated vaccines may be started **3 months** post-autologous with primary series resumed as if vaccine-naïve in many programmes. Live attenuated vaccines should be deferred until **≥24 months** after transplantation, and only when the patient is off immunosuppressive therapy and clinically recovered.
3. For some centres, influenza and COVID-19 can be started as early as **3 months** post-transplant to allow seasonal protection, while pneumococcal/meningococcal/Hib vaccines are often initiated at 3–6 months
4. For CAR-T recipients, CDC recommends revaccination starting **≥3 months** post-cellular therapy. (www2.cdc.gov, PMC)
5. **General rule:** Live attenuated vaccines (MMR, chickenpox) should not be given within the first 2 years after HSCT, or in patients with active GVHD or those receiving immunosuppressive therapy. Limited data are available regarding safety and efficacy.
6. **Exceptional/conditional use:** Some guidelines allow MMR and chickenpox vaccination ≥24 months post-HSCT in patients who have achieved immune recovery, have no GVHD and are off immunosuppressive therapy.
7. Inactivated vaccines can be given if the patient has cGVHD.
8. Inactivated Polio (IPV) and oral Polio vaccine (OPV) are not interchangeable.
9. In patients receiving prednisone ≥0.5 mg/kg bodyweight per day as part of a combination therapy or if a three-agent immunosuppressive treatment is given, vaccination may be postponed until immunosuppressive therapy is reduced to a double combination or prednisone < 0.5 mg/kg bodyweight daily in order to achieve a better vaccine response.



10. Following a complete revaccination program, regular assessment of seroprotection against diphtheria, poliomyelitis, tetanus, measles and HBV every 4–5 years is recommended in patients after HSCT.
11. Influenza and COVID-19 vaccines may be initiated as early as 3 months post-transplant during an outbreak.
12. Pneumococcal vaccine: There are two types of pneumococcal vaccine—conjugate vaccine (PCV13) and polysaccharide vaccine (PPSV23). PCV13 is used for the primary series because the immune response to conjugate vaccines is generally more immunogenic than polysaccharide vaccines; however, its spectrum of protection is narrower. Therefore, a subsequent dose of PPSV23 is given to broaden the immune response. PPSV23 protects against 23 strains but is less immunogenic and may elicit an inadequate response. It may be beneficial to use PPSV23 as the fourth dose to broaden the immune response. Adjunctive antibiotic prophylaxis may be given for patients with cGVHD. A multidose series is required due to loss of pre-transplant immunity. When PCV20 is used, administer a 3-dose series at intervals of at least 4 weeks. PPSV23 is not required when PCV20 is used.
13. For post-HSCT patients who wish to travel abroad, immunisation may be necessary. Patients should seek advice from their respective transplantation teams. Vaccines that should be safe for blood and marrow transplant patients intending to travel include:

- Typhoid: The oral form is contraindicated
- Cholera: Not recommended because of low protective efficacy
- Hepatitis A: Both active and passive are safe

Live attenuated vaccines that are contraindicated include Yellow fever, Japanese encephalitis, and oral polio live vaccines

14. Hepatitis B virus (HBV)

Before allogeneic HSCT, patients who are negative for all HBV markers that are transplanted with a graft from an anti-HBc positive donor should be vaccinated if possible and could additionally receive anti-HBV immunoglobulins;

6 months after allogeneic and autologous HSCT, patients who were negative for HBV before transplantation and patients who were



vaccinated before transplant but lost their immunity at 6 months should be vaccinated according to country recommendation (6–12 months after transplantation 3 doses should be administered; patients infected with HBV before HSCT (HBsAg negative and anti-HBc positive) should be assessed regularly for anti-HBs antibody titres and should be vaccinated if they have unprotective titres; if anti-HBs titres are < 10 IU/l, –8 weeks after the initial series of 3 vaccine doses, a second series of 3 doses should be considered. For further details on individual vaccines (including safety, efficacy, and availability), please see the respective subsections.

The vaccination recommendations for close contacts of patients undergoing hematopoietic stem cell transplantation are as follows:

1. Review compliance with the national vaccination plan indicated for the age of family members.
2. Annual influenza and COVID-19 vaccine while the patient is considered immunocompromised.
3. Chickenpox and MMR vaccines for seronegative family members:
 - a. For those receiving the chickenpox vaccine, contact with the patient should be avoided for 6 weeks after vaccination.
 - b. For MMR, close contacts who have been recently vaccinated should avoid direct contact with the patient for 4 weeks after administration to minimise the risk of transmission.
4. If there are children in the household who have received the rotavirus vaccine, the patient should avoid contact with the child's faeces (diaper handling; hygiene care) for 4 weeks after vaccination.



References

1. Australian Government Department of Health. (August 26, 2025). *Table. Recommendations for vaccination after haematopoietic stem cell transplant in children and adults*. In The Australian Immunisation Handbook. Retrieved October 30, 2025, from <https://immunisationhandbook.health.gov.au/resources/tables/table-recommendations-for-vaccination-after-haematopoietic-stem-cell-transplant-in-children-and-adults>
2. Cordonnier, C., Einarsdottir, S., Cesaro, S., et al. European Conference on Infections in Leukaemia group (2019). Vaccination of haemopoietic stem cell transplant recipients: Guidelines of the 2017 European Conference on Infections in Leukaemia (ECIL 7). *The Lancet. Infectious Diseases*, 19(6), e200–e212. [https://doi.org/10.1016/S1473-3099\(18\)30600-5](https://doi.org/10.1016/S1473-3099(18)30600-5)
3. Ullmann, A. J., Schmidt-Hieber, M., Bertz, H., et al. Infectious Diseases Working Party of the German Society for Hematology and Medical Oncology (AGIHO/DGHO) and the DAG-KBT (German Working Group for Blood and Marrow Transplantation) (2016). Infectious diseases in allogeneic haematopoietic stem cell transplantation: Prevention and Prophylaxis Strategy Guidelines 2016. *Annals of Hematology*, 95(9), 1435–1455. <https://doi.org/10.1007/s00277-016-2711-1>
4. Rieger, C. T., Liss, B., Mellinghoff, S., et al. German Society of Hematology and Medical Oncology Infectious Diseases Working Group (AGIHO) (2018). Anti-infective vaccination strategies in patients with hematologic malignancies or solid tumors-Guideline of the Infectious Diseases Working Party (AGIHO) of the German Society for Hematology and Medical Oncology (DGHO). *Annals of oncology: official journal of the European Society for Medical Oncology*, 29(6), 1354–1365. <https://doi.org/10.1093/annonc/mdy117>
5. Ljungman, P., Cordonnier, C., Einsele, H., et al. Center for International Blood and Marrow Transplant Research, National Marrow Donor Program, European Blood and Marrow Transplant Group, American Society of Blood and Marrow Transplantation, Canadian Blood and Marrow Transplant Group, Infectious Disease Society of America, Society for Healthcare Epidemiology of America, Association of Medical Microbiology and Infectious Diseases Canada, & Centers for Disease Control and Prevention (2009). Vaccination of hematopoietic cell transplant recipients. *Bone marrow transplantation*, 44(8), 521–526. <https://doi.org/10.1038/bmt.2009.263>
6. de la Carrera, R. (2019). Vaccinations. p 208-219. In: Carreras, E., Dufour, C., Mohty, M., Kroger, N, (eds) *the EBMT Handbook*, Springer, Cham. http://doi.org/10.1007/978-3-030-02278-5_29.
7. Centers for Disease Control and Prevention (June 26, 2024). General Best Practice Guidelines for Immunization: *Altered Immunocompetence*. CDC Vaccines & Immunizations. Updated 2023–2024. Available from: <https://www.cdc.gov/vaccines/hcp/imz-best-practices/alterd-immunocompetence.html>
8. European Society for Blood and Marrow Transplantation (EBMT) / EBMT Handbook (2024). Pavletic S, editor. Vaccinations. In: *The EBMT Handbook*. NCBI Bookshelf. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK608259/>.
9. Silva-Pinto, A., Abareu, I., Martins, A., Bastos, J., Araujo, A and Pinto, R. (December 23, 2024). Vaccination After Haematopoietic Stem Cell Transplant: A Review of the Literature and Proposed Vaccination Protocol. *Vaccines*,12(12):1449. doi: [10.3390/vaccines12121449](https://doi.org/10.3390/vaccines12121449)



Table 30.10 Recommendations for vaccination before and after solid organ transplant

These recommendations are based on the principle that, where possible, children and adults should complete an age-appropriate routine vaccination schedule before transplant. When needed, an accelerated or catch-up schedule may also be considered in the pre-transplant period. Immunogenicity is likely greater when vaccines are administered prior to transplant; if this has not been achieved, the transplant recipient should receive additional doses after transplant.

Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Non live vaccines			
COVID-19	Use if indicated following age-appropriate primary schedule (see comments)	Complete the 2-dose primary schedule and consider a 3rd dose	Aged ≥5 years: one additional dose or ongoing doses every 6–12 months, based on individual risk benefit assessment (see comments)
	The number of primary and additional doses are based on the person's age and presence of other risk factors for severe illness from COVID-19.		



Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Diphtheria-tetanus-pertussis^{a,b}	Complete the routine primary schedule or catch-up on missed doses	Aged ≥10 years: complete a 3-dose schedule of dTpa-containing vaccine if unvaccinated, or catch-up on missed doses	One additional dose of dTpa if previous doses were >10 years ago.
<i>Haemophilus influenzae</i> type b^b	Complete the routine primary schedule or catch-up on missed doses	Aged ≥18 years: complete the routine schedule or catch-up on missed doses	Further doses are not indicated
Hepatitis A^b	Recommended for seronegative people who have: • chronic liver disease • chronic infection with either hepatitis B or hepatitis C	Two doses are recommended for people who have: • had a liver transplant • chronic liver disease • chronic infection with either hepatitis B or hepatitis C	Further doses are not indicated if seropositive
	• Confirm immunity by serological testing before vaccination. • If the person is also at risk of acquiring hepatitis B, they can receive a combination hepatitis A-hepatitis B vaccine. • See also https://immunisationhandbook.health.gov.au/contents/vaccination-for-special-risk-groups/vaccination-for-international-travellers		





Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Hepatitis B^b	Recommended for all seronegative people, an accelerated schedule may be followed.	3 doses are recommended for all seronegative people	Further doses are not indicated if seropositive
	• Confirm immunity by serological testing before and after vaccination. • The combination hepA-hepB vaccine may be appropriate for people who are about to receive a liver transplant if they are not immune to either disease. • Types of combination vaccine: Twinrix (720/20) for recipients aged 16 years and older.		
Human Papillomavirus	Aged ≥9 years if immunocompromised before transplant: a 3-dose schedule	Aged ≥9 years: complete a 3-dose primary schedule (at 0, 2 and 6 months) if unvaccinated, or catch up on missed doses	Further doses are not indicated
	• Gardasil 9 vaccine is registered for people aged 9–45 years. • For people >25 years, conduct a risk assessment to determine their need for vaccination.		



Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Influenza	Aged >9 years (1st vaccination season): One dose every year	Aged >9 years: 2 doses in the 1st year after transplant, then 1 dose every year	2 doses in the 1st year after transplant, then 1 dose every year
Use an age-appropriate vaccine option.			
Meningococcal (MenACWY)	Complete age-appropriate routine primary schedule	- Complete age-appropriate routine primary schedule or catch-up on missed doses - Age ≥12 months, 2 doses (8 weeks between doses)	Booster recommendation for people with ongoing increased risk of invasive meningococcal disease who completed the primary series at: ≥7 years of age: every 5 years after completing the primary schedule
The number of doses needed depends on the vaccine brand used and the person's age when they start the vaccination course.			



Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Pneumococcal (conjugate and polysaccharide vaccines)	Complete routine or catch-up on missed doses	Aged <18 years: 1 dose of 20vPCV at least 2 months after any previous dose of PCV Aged ≥18 years: • 1 additional dose of PCV • 1 dose of PPV 2–12 months after PCV, and • a 2nd dose of PPV 5 years later	Aged <18 years: 1 dose of 20vPCV at least 2 months after any previous dose of PCV Aged ≥18 years: • 1 additional dose of PCV • 1 dose of PPV 2–12 months after PCV, and • a 2nd dose of PPV 5 years later
	• Children who have received either a routine course of 3 doses of any PCV, or 4 doses of 13vPCV or 15vPCV, or 4 doses of any PCV plus 1 dose of PPV, are recommended to receive 1 dose of 20vPCV at least 2 months after any previous doses of PCV. • Children who received either a routine course of 4 doses of 20vPCV or 4 doses of any PCV plus 2 doses of PPV (i.e., Aboriginal and Torres Strait Islander children) have already received the recommended number of doses of pneumococcal vaccine and do not require any additional doses.		



Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Polio^b	Complete the routine or catch-up on missed doses	- Aged <10 years: complete the routine or catch-up on missed doses - Aged ≥10 years: complete a 3-dose schedule if unvaccinated, or catch-up on missed doses	Aged ≥18 years: a 10-yearly booster is recommended if there is an ongoing risk of polio exposure
See also https://immunisationhandbook.health.gov.au/contents/vaccination-for-special-risk-groups/vaccination-for-people-who-are-immunocompromised/travellers-who-are-immunocompromised 			
Rabies	Use if indicated	Use if indicated	Use if indicated
Give a 5-dose schedule intramuscularly if immunocompromised. See also: https://immunisationhandbook.health.gov.au/contents/vaccination-for-special-risk-groups/vaccination-for-people-who-are-immunocompromised/travellers-who-are-immunocompromised 			



Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Respiratory syncytial virus (RSV)	Aged ≥60 years: 1 primary dose of RSV vaccine	Aged ≥60 years: one primary dose of RSV vaccine if unvaccinated	Further doses are not indicated
Shingles (herpes zoster), recombinant	Aged ≥18 years if immunocompromised: a 2-dose schedule	Aged ≥18 years: a 2-dose schedule (1–2 months apart) if unvaccinated, or catch up on missed doses after antiviral prophylaxis has been completed	Further doses are not indicated
Shingrix is registered for people aged ≥18 years			
Live vaccines			
BCG	Only use if the benefits outweigh the risks. Give ≥4 weeks before transplantation.	Contraindicated when immunocompromised. Consult a specialist for the timing of vaccination if indicated	Further doses are not indicated
See also https://immunisationhandbook.health.gov.au/contents/vaccination-for-special-risk-groups/vaccination-for-people-who-are-immunocompromised/travellers-who-are-immunocompromised			



Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Cholera (live)	Contraindicated	Choose non-live vaccine option if indicated	Further doses are not indicated
	See also https://immunisationhandbook.health.gov.au/contents/vaccination-for-special-risk-groups/vaccination-for-people-who-are-immunocompromised/travellers-who-are-immunocompromised 		
Japanese encephalitis (live)	Contraindicated	Choose non-live vaccine option if indicated	Follow booster recommendation if indicated
	See also https://immunisationhandbook.health.gov.au/contents/vaccination-for-special-risk-groups/vaccination-for-people-who-are-immunocompromised/travellers-who-are-immunocompromised 		
Measles-mumps-rubella^c	Complete a 2-dose schedule ≥4 weeks before transplantation if seronegative	Complete a 2-dose schedule at least 12 months after transplantation if seronegative following an assessment of degree of immunocompromise	Further doses not indicated if seropositive
	Confirm immunity by serological testing before vaccination.		



Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Typhoid (live)	Contraindicated	Choose non-live vaccine option if indicated	Further doses are not indicated
See also https://immunisationhandbook.health.gov.au/contents/vaccination-for-special-risk-groups/vaccination-for-people-who-are-immunocompromised/travellers-who-are-immunocompromised			
Chickenpox (Varicella) -monovalent)	Complete a 2-dose schedule ≥4 weeks before transplantation if seronegative	Complete a 2-dose schedule at least 12 months after transplantation if seronegative following an assessment on degree of immunocompromise	Further doses are not indicated if seropositive
Confirm immunity by serological testing before vaccination.			



Vaccine	Before solid organ transplant: if never previously vaccinated OR partly vaccinated	After solid organ transplant: if never vaccinated OR partly vaccinated before transplant	After solid organ transplant: if fully vaccinated before transplant
Yellow fever	If the benefits outweigh the risks, give ≥4 weeks before transplantation	Contraindicated when immunocompromised. Consult a specialist for timing of vaccination if indicated	Further doses are not indicated
See also https://immunisationhandbook.health.gov.au/contents/vaccination-for-special-risk-groups/vaccination-for-people-who-are-immunocompromised/travellers-who-are-immunocompromised			

Adapted from Australian Technical Advisory Group on Immunisation (ATAGI). Recommendations for vaccination before and after solid organ transplant in children and adults (2025)

NOTE

^a DTPa for children <10 years; dTpa for those ≥10 years

^b May be given as combined vaccines

^c Measles-mumps-rubella-varicella combination vaccines are not recommended.

References

1. Australian Technical Advisory Group on Immunisation (ATAGI). Recommendations for vaccination before and after solid organ transplant in children and adults. In: *The Australian Immunisation Handbook* Updated 26 August 2025 <https://immunisationhandbook.health.gov.au/resources/tables/table-recommendations-for-vaccination-before-and-after-solid-organ-transplant>

2. Danziger-Isakov, L., Kumar, D. On Behalf of the AST ID Community of Practice (April 19, 2019). Vaccination of solid organ transplant candidates and recipients: Guidelines from the American society of transplantation infectious diseases community of practice. *Clinical Transplantation*, 33(9), e13563. <https://doi.org/10.1111/ctr.13563>



Miscellaneous Groups

Table 30.11 Recommended Vaccinations

Category	Recommended Vaccines	Rationale and Schedule
Pregnant Women	- Tdap - RSV	To protect newborns via passive antibody transfer: Tdap at 16-36 weeks' gestation. RSV at 32-36 weeks' gestation.
	- Influenza - COVID-19	Reduces risk of severe complications in mothers and infants Can be given at any trimester.
Individuals working with children	- Influenza - Tdap - MMR (if not-immune) - Chickenpox (if not-immune)	See specific chapters
Caregivers - Carers for persons with developmental disabilities - Staff of nursing homes & long term care facilities for persons of any age	Caregivers are advised to follow vaccination recommendations for HCWs.	Reduces the risk of occupational exposure among caregivers and protects vulnerable populations. See specific chapters



Category	Recommended Vaccines	Rationale and Schedule
Emergency and essential service workers • Police • Emergency workers • Staff of correctional facilities, prisons or detention centres	• Hep B (potential blood/body fluid exposure) • Influenza (annually) • Td or Tdap • MMR (if not-immune) • Chickenpox (if not-immune) • COVID-19	Reduces the risk of occupational exposure. Upon hiring staff, screening of HIV, HBV, HCV and TB are recommended for correctional staff. See specific chapters
Military personnel	Military personnel are advised to receive all routine vaccines recommended for adults, unless contraindicated. Additional vaccines may be required depending on deployment location, disease outbreaks, and job-specific risks (e.g. Hep A, typhoid, polio booster, meningococcal, Japanese encephalitis, yellow fever, and rabies) See specific chapters and vaccines for travellers	
Prisoners and individuals in correctional/detention settings	• Hep B • Hep A • HPV (if not-immune) • COVID-19	Reduces the risk of exposure See specific chapters
	NOTE: Depending on facility intake procedures and healthcare capacity, it is recommended to screen for HIV, viral hepatitis, STIs, and TB among individuals who are incarcerated or detained.	



Category	Recommended Vaccines	Rationale and Schedule
Men who have sex with men (MSM)	• Hep A • Hep B • HPV	Reduces the risk of exposure See specific chapters
Injecting drug users (IDUs)	• Hep A • Hep B	Reduces the risk of exposure. Although hepatitis A is transmitted via the faecal-oral route, person-to-person transmission is common among IDUs therefore, HAV vaccination is recommended. See specific chapters

References

1. World Health Organizations (WHO). (2024). Vaccination before and during pregnancy. https://www.who.int/docs/librariesprovider2/default-document-library/factsheet_pregnancy.pdf?sfvrsn=89f4519b_2&download=true
2. Centers for Disease Control and Prevention (2024). Pregnancy and Vaccination. <https://www.cdc.gov/vaccines-pregnancy/about/index.html>
3. Australian Government, Department of Health and Aged Care (April 7, 2025). Immunisation for pregnancy. <https://www.health.gov.au/topics/immunisation/when-to-get-vaccinated/immunisation-for-pregnancy>
4. Centers for Disease Control and Prevention (June 5, 2024). Vaccines for Family and Caregivers <https://www.cdc.gov/vaccines-pregnancy/about/vaccines-family-caregivers.html#:~:text=Family%20and%20caregivers%20should%20be,%2C%20they%20should%20get%20vaccinated>
5. Centers for Disease Control and Prevention (June 14, 2024). Recommendations for Correctional Staff. <https://www.cdc.gov/correctional-health/recommendations/staff.html>
6. Centers for Disease Control and Prevention (April 18, 2022). Recommendations for Correctional and Detention Settings. <https://www.cdc.gov/nchhstp/director-letters/correctional-settings-recommendations.html> and <https://stacks.cdc.gov/view/cdc/120256>.



7. Government of Canada (October 2025). Immunization of workers: Canadian Immunization Guide. <https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-3-vaccination-specific-populations/page-11-immunization-workers.html>
8. Military Health System.(October 8, 2025) Vaccine Recommendations by AOR. <https://health.mil/Military-Health-Topics/Health-Readiness/Immunization-Healthcare/Vaccine-Recommendations/Vaccine-Recommendations-by-AOR>
9. Centers for Disease Control and Prevention (October 7, 2025). Recommended Adult Immunization Schedule for ages 19 years or older. <https://www.cdc.gov/vaccines/hcp/imz-schedules/downloads/adult/adult-combined-schedule.pdf>



Travellers



Introduction

Travellers are advised to consult a travel health specialist or doctor 4–8 weeks before departure to allow sufficient time for recommended vaccinations. However, if immediate travel is unavoidable, it is still important to seek medical advice to help prevent infections.

Vaccination for travellers will depend on:

- country of visit
- duration and place of stay
- accommodation
- intended activities
- presence of comorbid medical conditions

The following websites provide updated information on immunisation for travellers and should be referred to when offering advice on travel vaccination.

- WHO Travel Advice (<https://www.who.int/travel-advice>)
- Centres for Disease Control and Prevention (wwwnc.cdc.gov/travel/)
- International Association for Medical Assistance to Travellers (www.iamat.org)
- Travel Health Pro NaTHNaC (<https://travelhealthpro.org.uk/>)

Mandatory vaccines

Some countries require proof of vaccination for travellers entering or exiting their borders. Failure to obtain the necessary vaccines may result in denial of entry or quarantine at the destination or upon return. For details, refer to the country list on the WHO's International Travel and Health (ITH) webpage. The International Certificate of Vaccination or Prophylaxis



(ICVP), commonly known as the Yellow Card, is an official World Health Organization (WHO) document used to record vaccinations required for international travel.

Table 30.12 Mandatory vaccinations for Travellers.

	Vaccines	Regions where the Vaccine is Mandatory	Rationale and Schedule
A.	Meningococcal	The proof of meningococcal vaccination administered within the past 3–5 years is required by the Saudi authorities to obtain a Hajj or Umrah visa. (See next section for advice on Hajj and Umrah pilgrimage)	Single dose (2–55 years), 10 days prior to travel WHO advises all individuals planning to attend mass gatherings to receive the meningococcal vaccine at least 10 days before travel
B.	Polio	In some areas in Afghanistan & Pakistan, polio vaccination may be mandatory for all outgoing international travellers and incoming long-term visitors (i.e., those staying >4 weeks), regardless of age. The updated and current list of ‘currently polio exporting’ & ‘currently polio infected’ countries can be found at https://polioeradication.org/	Single booster dose of IPV, four weeks and 12 months prior to travel A valid Yellow Card is required as proof of vaccination for long-term visitors





	Vaccines	Regions where the Vaccine is Mandatory	Rationale and Schedule
C.	Yellow fever	Country requirements are subject to change at any time, can be verified on the WHO website travel advice page (https://www.who.int/travel-advice)  As of 2022, list of countries with risk of YF transmission are provided in: https://www.who.int/publications/m/item/countries-with-risk-of-yellow-fever-transmission-and-countries-requiring-yellow-fever-vaccination-(november-2022) 	Single dose (≥ 9 months age), 10 days prior to travel. No booster required. Yellow fever vaccination is required for travellers to and from countries or areas at risk of yellow fever transmission. Countries that mandate yellow fever vaccination for entry do so in accordance with International Health Regulations (IHR).



Recommended vaccines

Table 30.13 Recommended Vaccination for Travellers

	Vaccines	Regions/ Destinations	Recommendations
A.	Cholera	Some parts of Africa, Asia, and South America	Euvichol-Plus: 2 doses, 2 weeks apart, 10 days prior to travel. Poor sanitation & water hygiene places.
B.	Dengue	Parts of Africa & Asia, Central & South America, Caribbean & Pacific islands	2 doses, 3 months apart
C.	Hepatitis A	Most developing countries in Sub-Saharan & North Africa, Asia, Middle East, South & Central America & Eastern Europe	Single dose of vaccine followed by a booster injection preferably 6–12 months Where there's poor sanitation and water hygiene
D.	Japanese Encephalitis	Asia and parts of the Western Pacific	2 doses, 28 days apart. Mainly in rural areas
E.	Meningococcal	Sub-Saharan Africa (meningitis belt), Saudi Arabia (mandatory for Hajj and Umrah pilgrims)	Single dose (2–55 years), 10 days prior to travel



	Vaccines	Regions/ Destinations	Recommendations
F..	Rabies	Asia, Africa, Latin America, parts of Europe	Pre-exposure: 2 doses, 7 days prior to travel Especially for rural or animal exposure. Consider a third pre-exposure dose if expecting long-term rabies exposure risks
G.	Typhoid	South Asia, Southeast Asia, Africa, Central or South America.	Single dose parenteral vaccine, 2 weeks prior to travel Where there's poor sanitation & water hygiene

These vaccines are advised based on the risk of disease at your destination.

Routine vaccines

Although not specific to travel, all travellers are generally advised to ensure that they are up to date with routine vaccinations and boosters, because the diseases remain endemic in some countries. These vaccines include MMR (measles, mumps, rubella), Tdap (tetanus-diphtheria-pertussis), hepatitis B, influenza, pneumococcal, tuberculosis, chickenpox and COVID-19.

Hajj and Umrah Pilgrimage

While all routine and standard travel vaccines apply to Hajj pilgrims, the crowded conditions and physically demanding rituals of the pilgrimage make certain vaccines especially important. Mandatory vaccine regulations may change from one Hajj season to another. The most up-

to-date vaccination requirements are available on the Saudi Ministry of Health website (www.moh.gov.sa/en/) and the official health guidelines for Hajj pilgrimage (<https://hajj.nusuk.sa/nusuk/health/guidelines>).

For the Hajj season 1446H (2025), mandatory vaccinations include those against meningococcal disease (all pilgrims) and polio and yellow fever (for pilgrims from endemic countries). In addition, COVID-19 and seasonal influenza vaccines are required for pilgrims aged over 65 years or those at high risk of severe infection.

Umrah pilgrims that enter Saudi Arabia using an Umrah visa usually need to follow similar requirements as Hajj pilgrims. However, those requirements are not implemented for Umrah pilgrims entering Saudi Arabia with tourist visas, where they need to follow requirements for tourist visas by the Saudi Immigration Authority.

Mandatory and Recommended Vaccines for Hajj and Umrah pilgrimage

Table 30.14 Vaccinations for Hajj and Umrah Pilgrimage

	Vaccines	Recommendations
A.	COVID-19	For the Hajj season 1446H (2025): • Mandatory: All Hajj pilgrims >65 years or those with underlying health risks • Recommended: Pilgrims <65 years without risk factors for severe illness Vaccination 10 days prior to arrival
B.	Influenza (seasonal)	For the Hajj season 1446H (2025): • Mandatory: All pilgrims aged >65 years or those with underlying health conditions • Recommended: Pilgrims <65 years without risk factors of severe infection Vaccination 10 days prior to arrival



	Vaccines	Recommendations
C.	Meningococcal	Mandatory to All Hajj pilgrims (>2 years) For the Hajj season 1446H (2025): • Quadrivalent Polysaccharide Vaccine: Must be administered at least 10 days and no more than 3 years before arrival; or • Quadrivalent Conjugate Vaccine: Must be administered at least 10 days and no more than 5 years before arrival
D.	Pneumococcal	• Recommended: ≥50 years and immunocompetent persons <50 years with risk factors • Because of lack of evidence, it is not routinely recommended to provide pneumococcal vaccines to healthy persons aged <50 years Please see specific recommendations for pneumococcal vaccine
E.	Polio	Mandatory for all pilgrims from countries where polio is endemic or has recently circulated IPV or bOPV vaccine, 4 weeks–12 months prior to arrival
F.	Yellow Fever	Mandatory for all pilgrims (>9 months) from regions where yellow fever is endemic. Vaccination 10 days prior to arrival



Additional vaccinations and measures during Hajj



Pre-travel advice on Hajj rituals and associated health challenges is essential for all pilgrims. A general health assessment should evaluate existing medical conditions and overall physical fitness. Pilgrims should be encouraged to bring an adequate supply of their regular medications, including portable respiratory inhalers, if applicable.



Travel vaccines for diseases such as typhoid, hepatitis A and cholera are also important because the risk of food- and water-borne infections during Hajj is rather high, due to mass food preparation, overcrowding, limited toilet facilities, and difficulties in maintaining personal hygiene. Vaccination against blood-borne diseases, such as hepatitis B, is also encouraged, particularly because part of the Hajj and Umrah rituals involve head shaving that can pose a transmission risk if proper aseptic technique is not maintained.



References

1. Centers for Disease Control and Prevention. (2025). Think travel vaccine guide. <https://wwwnc.cdc.gov/travel/page/vaccine-guide>
2. Centers for Disease Control and Prevention. (April 23, 2025). Yellow Book. <https://www.cdc.gov/yellow-book/hcp/contents/index.html>
3. World Health Organization. (June 1, 2024). International Health Regulations (3rd ed.) https://apps.who.int/gb/ebwha/pdf_files/WHA77/A77_ACONF14-en.pdf
4. World Health Organization. (2025). Vaccines and travel. <https://www.who.int/travel-advice/vaccines>
5. World Health Organization (2005). International certificate of vaccination or prophylaxis. <https://www.medbox.org/document/international-certificate-of-vaccination-or-prophylaxis>
6. World Health Organization. (2019). International travel and health: Chapter 6 – Vaccine-preventable diseases and vaccines. <https://www.who.int/publications/m/item/international-travel-and-health-chapter-6--vaccine-preventable-diseases-and-vaccines>
7. World Health Organization. (November 18, 2022). Countries with risk of yellow fever transmission and countries requiring yellow fever vaccination. [https://www.who.int/publications/m/item/countries-with-risk-of-yellow-fever-transmission-and-countries-requiring-yellow-fever-vaccination-\(november-2022\)](https://www.who.int/publications/m/item/countries-with-risk-of-yellow-fever-transmission-and-countries-requiring-yellow-fever-vaccination-(november-2022))
8. World Health Organization. (September 27, 2021). Following a successful mass vaccination campaign, the polio outbreak ends in Malaysia. <https://www.who.int/malaysia/news/detail/27-09-2021-following-a-successful-mass-vaccination-campaign-the-polio-outbreak-ends-in-malaysia>
9. World Health Organization (April 10, 2025). Statement of the forty-first meeting of the Polio IHR Emergency Committee. <https://www.who.int/news/item/10-04-2025-statement-of-the-forty-first-meeting-of-the-polio-ih-er-emergency-committee>
10. National Health Service (March 2023). Available travel vaccines. <https://www.nhs.uk/vaccinations/travel-vaccinations/available-travel-vaccines/>
11. Ministry of Health, Kingdom of Saudi Arabia. (2025). Hajj vaccinations 1446. https://www.moh.gov.sa/en/HealthAwareness/Pilgrims_Health/Approved-Vaccines/Pages/default.aspx
12. Ministry of Hajj and Umrah, Kingdom of Saudi Arabia. (2025). Nusuk Hajj – Your gateway to a journey of a lifetime. <https://hajj.nusuk.sa/nusuk/health/guidelines>
13. Centers for Disease Control and Prevention (April 23, 2025). Saudi Arabia: Hajj and Umrah pilgrimages. <https://www.cdc.gov/yellow-book/hcp/africa-middle-east/saudi-arabia-hajj-and-umrah-pilgrimages.html>



Vet and Animal Handlers

Table 30.15 Immunisation For Veterinarians and Animal Handlers

Category	Vaccines Recommended	When to Give	Why it's recommended
Personnel working exclusively with non-feral rodents and rabbits from approved sources, as well as cold-blooded vertebrates	Tetanus	Tdap vaccination at time of employment A tetanus booster is recommended every 10 years	Risk of severe infections from animal bites, scratches, or contaminated wounds.
Personnel working or exposed to feral animals and purpose bred laboratory animals from non-approved sources, as well as farm animals	BCG	If Mantoux negative	BCG offers partial protection, but it should not be relied upon as the sole preventive measure against zoonotic TB in occupational settings
	Tetanus	Tdap vaccination at time of employment A tetanus booster is recommended every 10 yrs	Risk of severe infections from animal bites, scratches, or contaminated wounds.



Category	Vaccines Recommended	When to Give	Why it's recommended
Personnel exposed to cats, dogs, and feral animals from populations known to be potential carriers of rabies	Tetanus	Tdap vaccination at time of employment A tetanus booster is recommended every 10 yrs	Risk of severe infections from animal bites, scratches, or contaminated wounds.
	Rabies	2-dose schedule (pre-exposure): Administer the first dose on Day 0 and the second dose on Day 7 A booster may be recommended after 1–3 years for individuals with continued high-risk exposure	Rabies has a nearly 100% case-fatality rate once symptoms develop. Vaccination is the only effective prevention method, either before or immediately after exposure



Category	Vaccines Recommended	When to Give	Why it's recommended
Personnel working with nonhuman primates (NHP)	Tetanus	Tdap vaccination at time of employment A tetanus booster is recommended every 10 yrs	Risk of severe infections from animal bites, scratches, or contaminated wounds
	Hepatitis B	3-dose series (0, 1, and 6 months)	Risk of exposure via bites, scratches, or needle sticks
	Rabies	2-dose schedule (pre-exposure): Administer the first dose on Day 0 and the second dose on Day 7. A booster may be recommended after 1–3 years for individuals with continued high-risk exposure	Rabies has a nearly 100% case-fatality rate once symptoms develop. Vaccination is the only effective prevention method, either before or immediately after exposure.
	Measles, mumps, rubella	Normally taken in the form of MMR vaccine. 2 doses if not previously immunised.	Humans can transmit measles to susceptible NHPs, especially macaques. Important for animal welfare and biosecurity
	BCG	If Mantoux negative	TB can be transmitted between humans and NHPs



Category	Vaccines Recommended	When to Give	Why it's recommended
Personnel working with nonhuman primates (NHP)	Hepatitis A	2-dose schedule (0, 6–12 months)	At risk of exposure to hepatitis A virus (HAV) particularly when handling HAV-infected primates or related materials.
	Influenza	Annual immunisation	Humans can transmit influenza to NHPs, potentially causing outbreaks that affect both animal welfare and research integrity.
Personnel with exposure to poultry, as well as domestic and non-domestic birds or pigs.	Influenza	Annual immunisation	These animals are known reservoirs for influenza viruses , and humans working closely with them are at risk of zoonotic transmission and even pandemic influenza emergence.
	Tetanus	Tdap vaccination at time of employment. A tetanus booster is recommended every 10 yrs	Risk of severe infections from animal bites, scratches, or contaminated wounds



Category	Vaccines Recommended	When to Give	Why it's recommended
Personnel with exposure to poultry, as well as domestic and non-domestic birds or pigs.	Japanese encephalitis	<i>(Check the dose schedule in the JE section)</i>	Farm workers or veterinarians working with pigs could be at risk if there are nearby mosquito vectors



Abbreviations	Definition
A	
AI	Avian influenza
Anti-HBs	Antibody to Hepatitis B Surface Antigen
AEFI	Adverse Event Following Immunisation
aP	Acellular pertussis
B	
BCG	Bacille Calmette–Guérin
bNAb	Broadly Neutralizing Antibody
bOPV	Bivalent oral poliovirus vaccine
C	
cAD3-EBOZ	Chimpanzee Adenovirus Type 3–Vectored Ebola Vaccine
CCEEV	Cell culture- or embryonated egg-based vaccine
CDC	Centers for Disease Control and Prevention
CDI	<i>Clostridioides difficile</i> Infection
CDT	Binary Toxin (<i>C. difficile</i> transferase)
CFR	Case fatality rate
cGvHD	Chronic graft-versus-host disease
CHIKV	Chikungunya virus
COPD	Chronic Obstructive Pulmonary Disease
CRS	Congenital rubella syndrome
CSP	Circumsporozoite protein
cVDPV	Circulating vaccine-derived poliovirus
D	
DCA	Drug Control Authority
DENV	Dengue virus
DHF	Dengue haemorrhagic fever
DSS	Dengue shock syndrome
DTPa/dTpa	Diphtheria-tetanus-pertussis

Abbreviations



Abbreviations	Definition
E	
EBOV	Ebola virus
EPI	Expanded Programme of Immunisation
eRIG	Equine rabies immunoglobulin
EVD	Ebola virus disease
G	
GBS	Guillain-Barré syndrome
H	
HA	Haemagglutinin
HAART	Highly Active Antiretroviral Therapy
HAV	Hepatitis A Virus
HBIG	Hepatitis B immunoglobulin
HBV	Hepatitis B virus
HBsAg	Hepatitis B Surface Antigen
HCW	Healthcare worker
Hib	<i>Haemophilus influenzae</i> type b
HIV	Human immunodeficiency virus
hRIG	Human rabies immunoglobulin
HPV	Human papilloma virus
HPAI	Highly pathogenic avian influenza
HSCT	Hematopoietic stem cell transplantation
I	
ICH	Immunocompromised Hosts
ICVP	International Certificate of Vaccination or Prophylaxis
ID	Intradermal
IDU	Injecting drug users
Ig	Immunoglobulin
IgG	Immunoglobulin G



Abbreviations	Definition
IHR	International Health Regulations
IIV	Inactivated influenza vaccine
IM	Intramuscular
IM NHlg	Intramuscular normal human immunoglobulin
IPV	Inactivated poliovirus vaccine
IPD	Invasive pneumococcal disease
ITH	International Travel and Health
IV	Intravenous
J	
JE	Japanese encephalitis
M	
MADRAC	Malaysian Adverse Drug Reaction Advisory Committee
MCV	Measles containing vaccine
MenACWY	Meningococcal ACWY
MMR	Measles-mumps-rubella
MSM	Men who have sex with men
mAb	Monoclonal antibody
N	
NA	Neuraminidase
NHlg	Normal human immunoglobulin
NHP	Nonhuman Primates
NK	Natural killer cells
nOPV2	Novel oral poliovirus type 2 vaccine
NPRA	National Pharmaceutical Regulatory Agency
O	
OCV	Oral Cholera Vaccine
OPV	Oral poliovirus vaccine

Abbreviations



Abbreviations	Definition
P	
PCV	Pneumococcal conjugate vaccine
PfCSP	<i>Plasmodium falciparum</i> Circumsporozoite Protein
PEP	Post-exposure prophylaxis
PIZV	Purified Inactivated Zika Vaccine
PLHIV	People living with HIV
PPSV	Pneumococcal polysaccharide vaccine
PrEP	Pre-exposure prophylaxis
PRH	Product Registration Holder
prM	Pre-membrane protein
R	
RABV	Rabies virus
RCV	Rubella-containing vaccine
Rlg	Rabies Immunoglobulin
RNA	Ribonucleic acid
RSV	Respiratory syncytial virus
RSVPreF3	Respiratory Syncytial Virus Pre-fusion F protein
rVSV	Recombinant vesicular stomatitis virus
RZV	Recombinant zoster vaccine
S	
SC	Subcutaneous
SOT	Solid organ transplant
STD	Sexually Transmitted Disease
STI	Sexually transmissible infection
T	
TcdA	<i>Clostridioides difficile</i> Toxin A
TcdB	<i>Clostridioides difficile</i> Toxin B



Abbreviations	Definition
Tdap	Tetanus, diphtheria and pertussis vaccine [A booster vaccine for older children (1-12 years and adults) containing reduced diphtheria toxoid and pertussis antigens]
Td	Tetanus and diphtheria vaccine
TB	Tuberculosis
TIG	Tetanus Immunoglobulin (Human Tetanus Immunoglobulin)
TIV	Trivalent Inactivated Influenza Vaccine
TST	Tuberculin Skin Test
Ty21a	Live attenuated oral <i>Salmonella Typhi</i> vaccine strain Ty21a
V	
VAPP	Vaccine associated paralytic poliomyelitis
VCD	Virologically confirmed dengue
VE	Vaccine efficacy
VLP	Virus-like particle
VZIg	Varicella Zoster Immunoglobulin
VZV	Varicella-zoster virus
W	
WHO	World Health Organization
WPV	Wild poliovirus
Y	
YF	Yellow Fever







Malaysian Society of Infectious Diseases & Chemotherapy

For further information or enquiry, please contact:

Malaysian Society of Infectious Diseases and Chemotherapy

c/o

Department of Medical Microbiology,
Faculty of Medicine, Universiti Kebangsaan Malaysia,
Hospital University Kebangsaan Malaysia,
Jalan Yaacob Latif,
Bandar Tun Razak, Cheras,
56000, Kuala Lumpur, Malaysia.

ISBN 978-967-13054-4-7



9 789671 305447