NCIRS National Centre for Immunisation Research and Surveillance

FactSheet

Measles vaccines for Australians

This fact sheet provides information for immunisation providers on measles disease and measles vaccination in Australia.

Disease and epidemiology

- Measles is a highly contagious vaccine-preventable disease spread via the respiratory route.
- Australia obtained measles elimination status from the World Health Organization (WHO) in 2014 (i.e. no ongoing circulation of measles). However, large outbreaks overseas and countries with endemic disease mean that travellers are at risk and can unknowingly bring the disease from overseas to Australia where smaller outbreaks and localised transmission may occur.
- Measles will infect about 90% of susceptible individuals if they are exposed to it. It causes an acute illness characterised by high fever, malaise and a characteristic rash.
- Measles has a high rate of complications which may result in hospitalisation and in some cases permanent disability and death. Infections are more severe in young children aged <5 years and adults.

Who should be vaccinated

- All individuals are recommended to receive 2 lifetime doses of measles-containing vaccine. Among adults, this recommendation is particularly relevant for travellers and those at occupational risk.
- Currently, the measles-mumps-rubella (MMR) vaccine is scheduled for all children at 12 months of age and the measles-mumps-rubella-varicella (MMRV) vaccine at 18 months of age.
- A sizeable number of Australians born from 1966 to the mid-1990s may be susceptible or under-protected due to being unvaccinated or having received only one lifetime dose (as was recommended before 1992). These people are recommended to receive catch-up vaccination for measles.

Vaccines

- MMR and MMRV vaccines are live-attenuated vaccines. These vaccines are safe, with the most common side effects being post-vaccination fever, rash or localised pain and swelling. They are safe for use in egg-allergic individuals.
- MMR and MMRV vaccines are contraindicated in people who are immunocompromised and in pregnant women.

The disease

Measles is a morbillivirus which is part of the *Paramyxoviridae* family. Measles is highly infectious and continues to cause a large burden of disease worldwide. Prior to the era of measles vaccination, it affected almost everyone by adolescence. Since the introduction of widespread vaccination, there have been encouraging reductions in measles-related deaths globally, from around 550,000 in 2000 to 89,780 in 2016.[1] It is targeted for elimination (requiring the absence of circulation of measles virus for ≥12 months) under the Global Vaccine Action Plan in five WHO Regions by 2020.[1]

Measles is highly contagious and so is well known for being able to 'seek out' susceptible people, even when most within the community are vaccinated. Vaccine coverage of up to 95% is required to prevent ongoing transmission during outbreaks and provide optimal herd immunity.[2] The measles virus is spread via respiratory droplets and aerosols, and it can remain infectious for up to 2 hours[3] in the air or on

surfaces after an infected person has been in an indoor environment. Up to 90% of those susceptible will become infected if exposed to the virus.[4]

Clinical features

Measles has a typical incubation period of 10–14 days (rarely as wide as 7–21 days) before non-specific symptoms commence which precede the appearance of the characteristic measles rash.[5] These symptoms last 2–4 days and consist of:

- high fever
- malaise
- runny nose and cough
- conjunctivitis
- Koplik spots: bluish-white plaques on the inner cheeks next to the molar teeth which, when present, are thought to be specific for measles infection.

Infected individuals look sick and miserable. The characteristic rash then appears 2–4 days after the onset of symptoms and is a widespread, confluent, blotchy maculopapular rash starting from the face and neck, spreading to the body and extremities over 3–4 days. It is initially blanching but evolves into a non-blanching brown rash.

Of concern, people with measles can be infectious for 4 days before the rash (sometimes before they feel unwell) through to 4 days after the rash has appeared. Once infected, immunity to future infection is thought to be life-long.

Complications of measles

Measles is well known for its relatively high rate of complications which can be severe, often lead to hospitalisation and which tend to occur most frequently in children aged <5 years and in adults aged >20 years old.[5] About 30% of measles cases will suffer one or more complications.[3]

Acute complications

Complication	Frequency or risk	Details
Middle ear infections	~9% of infections	
Diarrhoea leading to dehydration	~8%	
Pneumonia	~6%	Can be severe particularly in the young and is responsible for 60% of deaths.
Encephalitis	0.1–0.4% (1–4 per 1,000 infections)	Often more common in adults and frequently results in permanent brain damage.
Pregnancy complications[6]	Low birth weight (adjusted* relative risk 3.5, 95% CI: 1.5–8.2) Spontaneous abortion (aRR 5.9, 95% CI: 1.8–19.7) Intrauterine foetal death (aRR 9.0, 95% CI: 1.2–65.5) Maternal death (aRR 9.6, 95% CI: 1.3–70.0)	Measles is not associated with congenital malformation[5]
Death	0.1–0.3% (1–3 per 1,000 infections)	

*Adjusted for maternal age

Late complications

Subacute sclerosing panencephalitis (SSPE)

This is a rare but universally fatal complication which occurs on average about 7 years after infection, but occasionally much later.[4] A mutated form of the measles virus acquired during acute infection, having remained relatively dormant within the brain, starts a progressive degeneration of the central nervous system. This results in personality changes, seizures, loss of motor function, coma and then ultimately death. Because most cases occur in developing countries and were previously unrecorded, the incidence has been underestimated in the past. A German study has estimated SSPE to now occur in up to 1 in 1,700–3,300 cases.[7] Measles vaccine does not cause SSPE, and measles cases in vaccinated individuals have had evidence of wild-type infection.[4]

Epidemiology

Measles was declared eliminated from Australia in March 2014.[8] This means that outbreaks in Australia now start with a single non-immune individual contracting infection while overseas and coming/returning to Australia. As infected individuals are infectious even before they display signs or symptoms, it is easy for many people to be exposed to a measles case, and if susceptible, acquire infection (secondary cases).[4] This is of particular concern if an infected individual congregates in a community with other non-immune or unvaccinated individuals.

In 2018, 103 cases of measles were notified in Australia. Substantially higher numbers of measles notifications have been recorded in 2019 (n=128 by 27 June 2019)[9] because of larger numbers of imported cases and subsequent secondary cases. Outbreaks have affected numerous Australian states and territories. This mirrors the global trend which saw a 300% increase in cases in the first three months of 2019 compared with 2018.[10] This has been due to large outbreaks in sub-Saharan Africa, Eastern Europe and South East Asia, particularly Madagascar and Ukraine, but also countries such as Philippines and Thailand[11] where Australians frequently travel. These outbreaks have resulted in large numbers of deaths, particularly in young children. Mass vaccination programs have been undertaken in these countries to bring measles under control.

Vaccine

A highly effective live-attenuated vaccine against measles has been available since 1968. In the 1970s it was given through state-based programs in Australia and became nationally funded at 12 months of age in 1982. A 2nd dose of vaccine was only recommended and introduced into the National Immunisation Program (NIP) from November 1992.[12]

The measles vaccine is now administered along with vaccines against mumps and rubella as the combined MMR vaccine, scheduled at 12 months of age, and as the combined MMRV vaccine scheduled at 18 months of age. Monovalent measles vaccine is not available in Australia.

The measles vaccine virus strain is attenuated and so it causes a harmless infection, but elicits an immune response that then protects the vaccinated person against subsequent wild-type infection. It does not cause measles disease. Low rates of fever and rash can occur from the vaccine (refer to Vaccine safety section). It has been developed and produced using chick embryo cell cultures, not chicken eggs, and contains no egg protein. It is therefore safe in egg-allergic individuals,[13] even in those with a history of anaphylaxis (refer to Variations from product information in the Measles disease chapter of the Australian Immunisation Handbook).

MMR vaccines in Australia:

- M-M-R II (Merck Sharp & Dohme)
- Priorix (GlaxoSmithKline Australia)

MMRV vaccines in Australia:

- Priorix-tetra (GlaxoSmithKline Australia)
- ProQuad (Merck Sharp & Dohme)

Each of the two vaccines within the same category are considered interchangeable. Refer to the Measles disease chapter in the Australian Immunisation Handbook for more details about vaccine ingredients. MMR and MMRV can be co-administered with other live and inactivated vaccines provided a different syringe and injection site is used. If not co-administered, they should be separated from other live vaccines by a 4-week interval.

Immunogenicity and effectiveness

Measles vaccine is highly immunogenic even after a single dose. Protection is improved and is longer lasting after the 2nd dose. About 95% of people have evidence of protection after 1 dose and 99% after 2 doses. Clinical effectiveness studies in the community confirm this with 99% effectiveness of 2 doses in the Australian setting.[14]

Recommendations

People born in or after 1966

Children

All children are recommended to receive 2 lifetime doses of measles-containing vaccine.

MMR vaccine is recommended at 12 months of age as the 1st dose of measles-containing vaccine. A dose from 11 months is considered valid for this dose. If the vaccine is administered earlier than 11 months of age, the response to the vaccine may be reduced. This is due to interference from temporary maternally derived antibodies to measles that persist in the infant.

MMRV vaccine is recommended at 18 months of age as the 2nd dose of measles-containing vaccine. MMRV vaccine is not recommended to be used as the 1st dose of measles-containing vaccine in children aged <4 years as it may lead to a slightly higher frequency of adverse events following immunisation (refer to Vaccine safety section). MMRV vaccine is not recommended for adolescents aged ≥14 years; separate MMR and varicella vaccines should be used if required.

Adolescents and adults

All adolescents and adults born in or after 1966 should have documentation of having received 2 doses of measles-containing vaccine at ≥12 months of age or have had a measles serology test showing protection from previous vaccination or natural infection. As receiving a 2nd dose of measles vaccine was not recommended until 1992 and measles vaccine uptake before a national measles control campaign in 1998 was lower than it is presently, many people may be unprotected or under-protected, having received only a single dose. (Refer to Catch-up section for guidance on how to ensure optimal protection in individuals with an uncertain history of vaccination.)

Occupational risk groups

Healthcare workers, childhood educators, those working in long-term care facilities and correctional facility workers are recommended to have had 2 doses of measles-containing vaccine or have serological evidence of protection against measles.

Travellers

All travellers are recommended to have had 2 doses of measles-containing vaccine at ≥12 months of age or have serological evidence of protection against measles. This is particularly important when travelling to countries that have ongoing high rates of measles or have had recent outbreaks. Infants aged 6 to <12 months may receive an early dose of measles-containing vaccine from 6 months of age after an individual risk assessment taking into account the measles risk at the destination. However, they will still require 2 standard doses to be given from 12 months of age as per the usual schedule, regardless of any doses given prior to 11 months of age.

People born in or before 1965

People born in or before 1965 are likely to have had natural infection from measles, thereby acquiring immunity, and generally do not require vaccination. Serology may be considered in individuals who wish to

confirm immunity, such as travellers, or in individuals born overseas where measles epidemiology may have differed from that in Australia or introduction of routine vaccination may have occurred earlier than in Australia.

Catch-up

Many adults born in or after 1966 but prior to the mid-1990s may not have received 2 lifetime doses. This is because prior to 1992 people were recommended to receive only 1 dose of measles vaccine. Individuals should check any available vaccination records, including personal health records, GP records or the Australian Immunisation Register for documentation of having received 2 lifetime doses of measles-containing vaccine. A measles vaccination catch-up guide is available to assist immunisation providers in deciding the number of doses required and the role of serology testing for catch-up purposes. Further information is also available in the Catch-up section of the Australian Immunisation Handbook.

Where possible, for individuals requiring catch-up doses of measles-containing vaccine, it is preferable to vaccinate without serology testing, as this minimises missed opportunities to vaccinate and the need for follow-up visits. Further MMR vaccination in individuals who have previously been vaccinated or who are already immune is safe. Serology testing may be appropriate where the likelihood of previous immunity is high, for example, in people born in Australia prior to 1966 or born after the mid-1990s when 2-dose vaccine coverage was relatively high.

Catch-up vaccination for measles is funded under the NIP for all people aged ≤19 years. Catch-up immunisations are also funded for refugees and humanitarian entrants aged ≥20 years. In addition, some Australian states and the Northern Territory fund catch-up vaccination for people ≥aged 20 years. Check your local state or territory health department for details. For all other people, measles catch-up vaccination is available via private prescription from their GP.

Contraindications to vaccination

MMR and MMRV are live vaccines and are contraindicated in people who:

- have had anaphylaxis to MMR vaccine or one of its components
- are immunocompromised (low-dose corticosteroid therapy may be acceptable; refer to Precautions section)
- are pregnant. Pregnancy should also be avoided for 28 days after vaccination.

Egg allergy is NOT a contraindication as MMR vaccine has no egg protein.

Precautions

Measles vaccines and immunoglobulin/blood products

Antibodies present in immunoglobulins or blood products can inhibit the immune response to measles vaccines. There are no issues with **washed** red blood cell transfusions or giving anti-D immunoglobulin. However, other blood or immunoglobulin products should be given at least 3 weeks after measles vaccination, if possible, to allow development of an appropriate vaccine response.

If a blood or immunoglobulin product is necessary immediately or has been given before the individual received measles-containing vaccine, vaccination will then need to be delayed by 3-11 months after administration of the immunoglobulin-containing blood product, depending on the blood product and the dose given - refer to the Australian Immunisation Handbook.

People with HIV

Children with an age-specific CD4+ count of ≥15% and adults with a CD4+ cell count ≥200 cells per microliter (μL) can be vaccinated with MMR vaccine. Separate MMR vaccine and monovalent varicella vaccine should be used instead of combined MMRV vaccine because of a lack of safety data in this population.

Low-dose corticosteroid therapy

Vaccination may be appropriate in people undergoing low-dose corticosteroid therapy. Refer to 'Recommended timing of live vaccine doses in adults and children taking corticosteroids' table in the Australian Immunisation Handbook. Vaccination can occur 4 weeks after cessation of high-dose corticosteroid therapy.

Individuals with thrombocytopaenia

Thrombocytopaenia can be a rare complication of MMR vaccination. In those with immune thrombocytopaenic purpura (ITP), serology may be used to determine the need for a 2nd dose.

Household contacts of immunocompromised individuals

There is no risk of transmission of measles vaccine virus from vaccinated individuals to others and so it is safe to vaccinate these individuals.

Vaccine safety

Adverse events can occur after immunisation with measles-containing vaccine, many of which are similar to those that may occur after other routine childhood vaccines. These can include local reactions (redness, swelling, pain and tenderness) and systemic reactions (fever, irritability). Refer to adverse events after immunisation in the Australian Immunisation Handbook.

As MMR and MMRV vaccines are live vaccines, some adverse reactions can occur later than those with inactivated vaccines, corresponding to the peak period of live virus replication. Peak rates of high fever ≥39.4C (10–15% of recipients) and rash (~5%) occur between 7 and 10 days (range 5–12 days) after vaccination. An Australian study showed that febrile seizures occurred at a rate of 1 case per 4,000 doses in children aged 11–23 months after the 1st MMR vaccine dose.[15]

The rate of fever and febrile convulsion when MMRV vaccine was given as the 1st dose of measles-containing vaccine was twice the rate when MMR and varicella vaccines were given separately.[16] Therefore MMRV vaccine is recommended to be used only as the 2nd dose of measles-containing vaccine in Australia. A US study showed there was no increase in MMRV vaccine–related seizures compared with those when MMR and varicella vaccines were given separately at 4–6 years of age, which is the usual age in the US for giving the 2nd dose of measles-containing vaccine.[17] An Australian study has confirmed these findings in the 11–23-month age group, showing no increase in febrile seizures after administration of MMRV vaccine as the 2nd measles-containing vaccine dose.[18]

Thrombocytopenia can occur in 3–5 per 100,000 doses of MMR vaccine, and anaphylaxis is very rare (1 per 1.8–14.4 million doses).

Numerous well-designed studies have disproven a previously suggested link between MMR vaccines, inflammatory bowel disease and autism.[19] These have examined differences in MMR vaccine exposure in children with and without autism, both retrospectively[20] and prospectively,[21,22] comparing autism rates in large numbers of vaccinated and unvaccinated children. All studies have found no significant associations. In addition, ecological studies have found no relation between population MMR vaccination rates and autism rates, with one study instead finding autism rates increased even after a national MMR vaccination program was ceased[23] and vaccination coverage fell markedly. Further information on this topic is available from the NCIRS fact sheet on MMR vaccine, inflammatory bowel disease and autism.

Public health management of measles cases

Measles is a notifiable disease nationally. State or territory public health departments or local public health units should be contacted about each case to assist with the management. National guidelines are available to guide public health management. There is no specific treatment for cases. However, contacts of measles cases may benefit from post-exposure prophylaxis, receiving either vaccination **within 72 hours (3 days) of exposure** or normal human immunoglobulin (NHIG) **within 144 hours (6 days) of exposure.**

General principles

Measles-containing vaccine may prevent infection if given within 72 hours of exposure. This may be appropriate for individuals from 6 months of age. Infants receiving MMR vaccine between 6 and 11 months of age would still require their 2 standard doses from 12 months of age as per the usual schedule. A dose given from the age of 11 months can be accepted as the 1st standard dose and does not need to be repeated.

Early dosing of a 2nd dose of measles-containing vaccine can be considered in children aged >12 months if the interval from a previous dose is ≥4 weeks. This is considered a valid 2nd dose and does not need to be repeated.

NHIG via intramuscular injection may be appropriate for use within 144 hours of exposure for those in whom vaccination is not possible, including children aged 0 to <6 months, immunocompromised individuals and pregnant women. Refer to Post exposure prophylaxis for measles in the Australian Immunisation Handbook and the Communicable Diseases Network Australia national guidelines for measles for further details.

Useful links

- Australian Immunisation Handbook – Measles Disease chapter
- Measles vaccination catch-up guide
- MMR vaccination decision aid
- Talking about immunisation website
- Communicable Diseases Network Australia national guidelines for measles

References

1. World Health Organization. Measles. 2018. Available from: https://www.who.int/immunization/diseases/measles/en/ (Accessed 1 July 2019).

2. World Health Organization. Measles vaccines: WHO position paper – April 2017. 2017. Available from: http://apps.who.int/iris/bitstream/10665/255149/1/WER9217.pdf?ua=1 (Accessed 3/6/2019).

3. Centers for Disease Control and Prevention (CDC). Measles. In: Hamborsky J, Kroger A, Wolfe C (editors). *Epidemiology and prevention of vaccine-preventable diseases*. Washington DC: Public Health Foundation; 2015. Available from: https://www.cdc.gov/vaccines/pubs/pinkbook/meas.html.

4. McLean HQ, Fiebelkorn AP, Temte JL, et al. Prevention of measles, rubella, congenital rubella syndrome, and mumps, 2013: summary recommendations of the Advisory Committee on Immunization Practices (ACIP). *MMWR Recomm Rep* 2013;62:1-34.

5. Strebel PM, Papania MJ, Gastañaduy PA, Goodson JL. 37 - Measles Vaccines. In: Plotkin SA, Orenstein WA, Offit PA, Edwards KM (editors). *Plotkin's Vaccines (Seventh Edition)*: Elsevier; 2018. p. 579-618.e21. Available from: http://www.sciencedirect.com/science/article/pii/B9780323357616000377.

6. Ogbuanu IU, Zeko S, Chu SY, et al. Maternal, fetal, and neonatal outcomes associated with measles during pregnancy: Namibia, 2009-2010. *Clinical Infectious Diseases* 2014;58:1086-92.

7. Schonberger K, Ludwig MS, Wildner M, Weissbrich B. Epidemiology of subacute sclerosing panencephalitis (SSPE) in Germany from 2003 to 2009: a risk estimation. *PLoS One* 2013;8:e68909.

8. Gidding HF, Martin NV, Stambos V, et al. Verification of measles elimination in Australia: Application of World Health Organization regional guidelines. *J Epidemiol Glob Health* 2016;6:197-209.

9. National Notifiable Diseases Surveillance System (NNDSS). Summary tables for all diseases. 2019. Available from: http://www9.health.gov.au/cda/source/cda-index.cfm (Accessed 1 July 219).

10. World Health Organization (WHO). New measles surveillance data for 2019. 2019. Available from: https://www.who.int/immunization/newsroom/measles-data-2019/en/ (Accessed 1 July 2019).

11. World Health Organization (WHO). Global measles and rubella update May 2019. 2019. Available from: https://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/Global_MR_Update_May_2019.pptx (Accessed 1 July 2019).

12. National Centre for Immunisation Research and Surveillance (NCIRS). Significant events in measles, mumps and rubella vaccination practice in Australia. 2018. Available from: http://www.ncirs.org.au/sites/default/files/2018-12/Measles-mumps-rubella-history-Dec-2018.pdf (Accessed 1 July 2019).

13. Australasian Society of Clinical Immunology and Allergy Limited (ASCIA). Guidelines - Vaccination of the egg-allergic individual. 2017. Available from: https://www.allergy.org.au/hp/papers/vaccination-of-the-egg-allergic-individual (Accessed 1 July 2019).

14. Pillsbury A, Quinn H. An assessment of measles vaccine effectiveness, Australia, 2006-2012. *Western Pacific Surveillance and Response Journal: WPSAR* 2015;6:43-50.

15. Macartney KK, Gidding HF, Trinh L, et al. Febrile seizures following measles and varicella vaccines in young children in Australia. *Vaccine* 2015;33:1412-7.

16. Klein NP, Fireman B, Yih WK, et al. Measles-mumps-rubella-varicella combination vaccine and the risk of febrile seizures. *Pediatrics* 2010;126:e1-8.

17. Klein NP, Lewis E, Baxter R, et al. Measles-containing vaccines and febrile seizures in children age 4 to 6 years. *Pediatrics* 2012;129:809-14.

18. Macartney K, Gidding HF, Trinh L, et al. Evaluation of Combination Measles-Mumps-Rubella-Varicella Vaccine Introduction in Australia. *JAMA Pediatr* 2017;171:992-8.

19. Demicheli V, Rivetti A, Debalini MG, Di Pietrantonj C. Vaccines for measles, mumps and rubella in children. *Cochrane Database of Systematic Reviews* 2012:Cd004407.

20. Smeeth L, Cook C, Fombonne E, et al. MMR vaccination and pervasive developmental disorders: a case-control study. *The Lancet* 2004;364:963-9.

21. Madsen KM, Hviid A, Vestergaard M, et al. A population-based study of measles, mumps, and rubella vaccination and autism. *New England Journal of Medicine* 2002;347:1477-82.

22. Jain A, Marshall J, Buikema A, et al. Autism occurrence by MMR vaccine status among US children with older siblings with and without autism. *JAMA* 2015;313:1534-40.

23. Honda H, Shimizu Y, Rutter M. No effect of MMR withdrawal on the incidence of autism: a total population study. *Journal of Child Psychology and Psychiatry* 2005;46:572-9.