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9.1   Introduction

The earliest written description of measles is classically attributed to the Persian born physician Abu Becr (Rhazes) in the 10th century. Rhazes was the first to differentiate measles from smallpox and considered the former to be more dreaded. Although he recognised both the cyclical and seasonal nature of the disease, it was not until the 17th century that Thomas Sydenham of London identified the infectious nature of measles. The studies of Peter Panum in the Faroe Islands in 1846 showed that the disease was acquired solely by direct transmission. Outbreaks of measles occurred for the first time in the South Pacific during the mid and late 19th century, with devastating results among the Fijians and New Zealand Māori. In 1954 Enders and Peebles in the USA reported the first successful isolation and propagation of the measles virus in human and monkey kidney cells. This led to the production of live attenuated measles vaccine, which was first licensed for use in the USA in 1963.

9.2   The illness

Measles is an acute, highly communicable viral illness usually transmitted via exposure to infected respiratory secretions. There is a prodromal phase of 2–4 days with fever, conjunctivitis, coryza and Koplik spots on the buccal mucosa. The characteristic maculopapular rash appears on the third to seventh day, spreads over three to four days from the head over the trunk to the extremities and lasts for up to one week. The patient is most unwell during the first day or two after the appearance of the rash.

The incubation period is usually 10 to 12 days, but may range up to 21 days and is prolonged in the immune suppressed. Measles is highly infectious from the beginning of the prodromal phase until four days after the appearance of the rash. Complications are common, in 10 percent of cases (see Table 9.1, section 9.6), and include otitis media, pneumonia, croup, or diarrhoea. Encephalitis has been reported in 1 in every 1000 cases, of whom some 15 percent die and a further 25 to 35 percent are left with permanent neurological damage. Other complications of measles include bronchiolitis, sinusitis, myocarditis, corneal ulceration, mesenteric adenitis, hepatitis and thrombocytopaenic purpura.

Subacute sclerosing panencephalitis (SSPE), a rare degenerative central nervous system disease resulting from persistent measles virus infection, is fatal. In the USA, where there is widespread measles immunisation, this complication has virtually disappeared. The case fatality rate for reported cases of measles in the USA is 1 in 1000. Measles is particularly severe in the malnourished and in patients with defective cell-mediated immunity, who may develop giant cell pneumonia or

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encephalitis without evidence of rash, and have a much higher case fatality rate. Measles is also serious in healthy children: over half of all the children who died from measles in the UK between 1970 and 1983 were previously healthy.[1] No other conditions were reported as contributing to death of the seven people who died from measles in the 1991 New Zealand epidemic.

In general vitamin A is not necessary for children with measles in industrialised countries. However, it may be considered for children under two years of age hospitalised with complications of measles, and other children with risk factors such as immune deficiency or malabsorption.
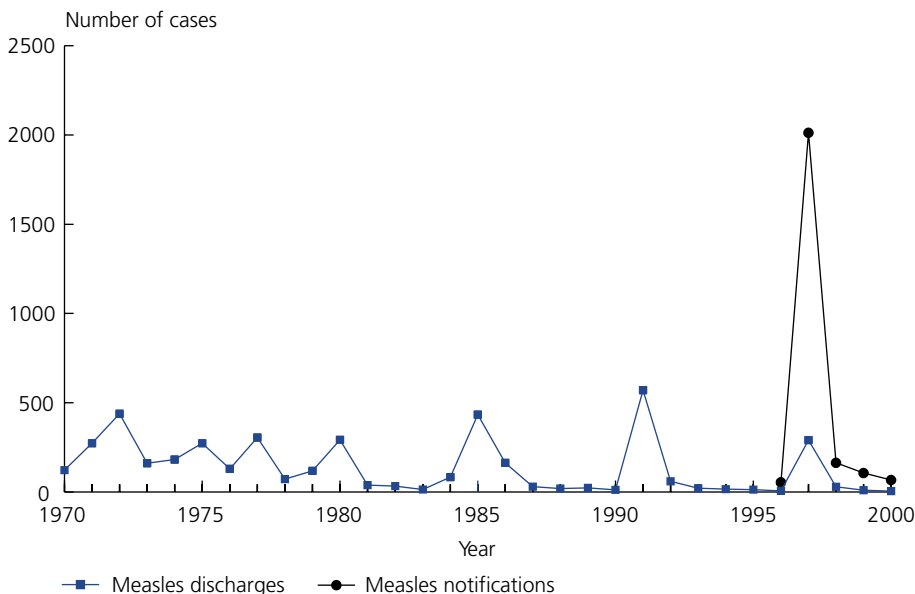
9.3 Epidemiology

Measles is the most common vaccine preventable cause of death among children throughout the world. The Global Burden of Disease Study ranked measles eighth, both as a cause of death and as a cause of disability adjusted life years (DALYs) lost, in the global population (all ages combined) in 1990.[2] Among children between zero and four years of age in non-industrialised countries, measles ranked fourth as a cause of DALYs lost, and was the infectious agent with the highest burden of disease. In 1989 the WHO Expanded Programme on Immunisation estimated that 1.5 million children died annually from measles or its complications. The disease is highly infectious in non-immune communities, with epidemics occurring approximately every second year. A 1951 outbreak of infection in southern Greenland, a country which had not previously experienced measles, resulted in an almost 100 percent infection rate of adults and children. Indigenous cases of measles, mumps and rubella have been eliminated from Finland over a 12 year period using a two dose measles, mumps and rubella vaccine (MMR) schedule given between 14 and 16 months and at six years of age.[3]

New Zealand epidemiology

Despite the introduction of the measles vaccine in 1969, measles occurred every year until 1980, with a pattern of 'low' years (an average of approximately 100 hospitalisations per year) alternating with 'high' or 'epidemic' years (an average of approximately 300 hospitalisations per year). Increased uptake of the measles vaccine, which is thought to have reached 70 percent or more by 1980, resulted in this epidemic cycle becoming more extreme. Measles virtually disappeared between epidemics, which occurred less frequently (in 1984/85, 1991 and 1997) but were of increased size, with 400 hospitalisations in 1984/85 (see Figure 9.1 for hospital discharges, and notifications of measles). A shift in the age distribution of cases towards older ages was also noted. This effect was most evident in the 1991 epidemic, and was seen more in European than in Māori or Pacific children.
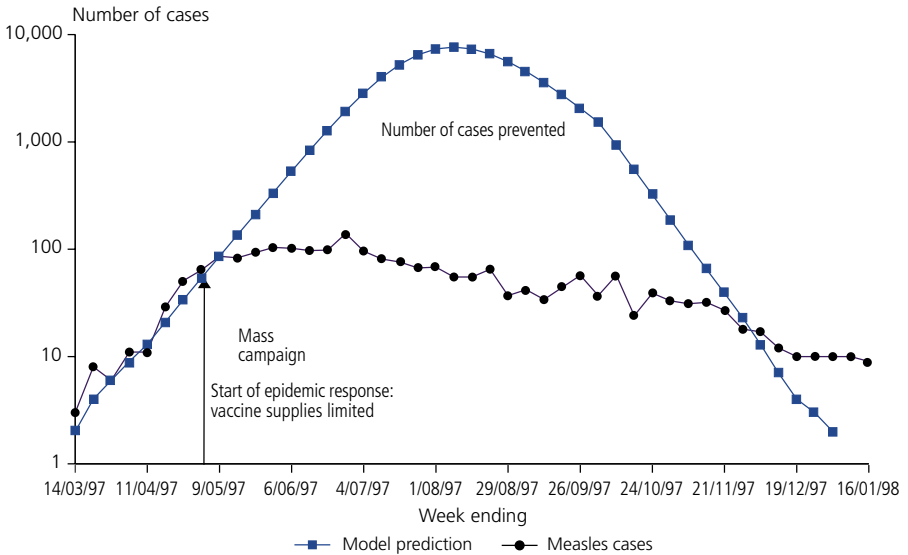
FIGURE 9.1: Hospital discharges from measles, 1970–2000, and notifications, 1996–2000

The 1991 epidemic involved increased hospitalisations from May 1991 to January 1992. During this period a total of 629 people were hospitalised with a principal or secondary diagnosis of measles; for 568, measles was the primary diagnosis. During the epidemic the deaths of four unimmunised children were reported, but mortality records revealed a total of seven deaths during the epidemic. Excluding the cases that died there were 10 hospitalised cases of measles encephalitis, 94 of pneumonia and 61 of otitis media. In the second half of the epidemic, reports of measles were requested and 10,000 were received; on this basis it was estimated that the epidemic involved 40,000 to 60,000 cases.

An epidemic was predicted in 1997,[4] and an immunisation campaign was planned to prevent it. However, the epidemic began in April 1997 three months before the planned start of the campaign. The campaign was brought forward so that 90–95 percent of cases were prevented[5] (see Figure 9.2). There were 2169 cases identified via notification, laboratory and hospitalisation data, including 314 hospitalisations. There was one case of disease related measles encephalitis and no deaths. The total number of cases in this epidemic is unknown as under-reporting was likely. Figure 9.2 shows the effect of the immunisation campaign in limiting the extent of the epidemic.

FIGURE 9.2: Actual number of notified cases of measles compared with predicted cases during the 1997 measles epidemic

Large scale measles epidemics occur when the number in the susceptible population increases and the immunisation coverage is low. It has been estimated that to prevent recurrent outbreaks of measles, 95 percent of the population must be immune. Since measles vaccine efficacy is 90–95 percent and not all children receive the first scheduled dose, the only way to achieve this level of immunity is by implementing a two dose immunisation strategy, as is now recommended.

A model has shown that there will continue to be measles epidemics if New Zealand continues the immunisation schedule of two doses of MMR at 15 months and 11 years of age, and the immunisation coverage remains at 82 percent at 15 months of age and achieves an overall coverage of 90 percent at 11 years of age. However, if the schedule is changed to give MMR at 15 months and at four years, before school entry, epidemics will be delayed and measles may be eliminated if coverage is raised to 95 percent coverage at 15 months and overall coverage of 90 percent at five years of age.

In 2000 the model developed for predicting the timing of the 1997 epidemic was extended to see when the next epidemic may occur. The model included MMR immunisation coverage since 1997, the numbers of notified cases of measles, and the number of children immunised in the MMR campaign during the 1997 epidemic.

The results suggest that if no change were made to the age at which MMR is given, the next measles epidemic would be between 2002 and 2004.[6]

Therefore from January 2001 the Immunisation Schedule was changed to give the second dose of MMR at four years of age prior to school entry, and the first dose continued to be given at 15 months. During 2001 there was an MMR catch-up programme throughout the country for all children between 5 and 10 years of age who would not receive MMR in Year 7 (Form 1) because of the 2001 schedule change.

History of the New Zealand Immunisation Schedule

The measles vaccine was introduced in 1969 for children between 10 months and five years of age who had not had measles, and for those under 10 years at special risk. In 1974 the recommended age for the measles vaccine changed from 10 months to 12 months, and in 1981 changed to 12–15 months of age. These changes attempted to find a balance between too early immunisation, where the vaccine is neutralised by maternally acquired antibody, and the requirement to protect the very young during an epidemic.

MMR vaccine was introduced in 1990 to be given at 12–15 months of age in place of the measles vaccine. The dose for 11 year old children was introduced in 1992. In 1996 the timing of the first dose was changed to 15 months of age to be given at the same time as the booster dose of diphtheria, tetanus, whole cell pertussis and *Haemophilus influenzae* type b (DTPH).

At the start of the 1997 epidemic the measles immunisation campaign targeted all children under 10 years of age. During the campaign the recommended time for the first dose was brought forward to 12 months of age, and in Auckland a dose was recommended for children 6–11 months of age repeated at 15 months of age.[7] The national coverage achieved in the campaign is not known, but estimates for the school-aged population range from 55 percent for Auckland to 85 percent for the Wellington region.

In 2001 the schedule continued to give the first dose of MMR at 15 months of age and changed the timing of the second dose to four years, with a catch-up programme for the second MMR dose for children between five and 10 years of age.

9.4   Vaccines

The measles vaccine is available in two forms:

- as one of the constituents of MMR vaccine, which is recommended for routine use
- as monovalent measles vaccine, which is recommended for use, and only available, in special circumstances. (See below for administration in infants under 12 months of age.)

The MMR II (MSD) vaccine used currently is a freeze-dried preparation containing live attenuated measles, mumps and rubella viruses. It must be stored in the dried

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state at 2° to 8°C and protected from light. It must be reconstituted only with the diluent supplied by the manufacturer and used within eight hours of preparation.

The measles, mumps and rubella vaccine viruses are regarded as being non-transmissible from vaccinees. There are two poorly documented case reports of transmission: one of rubella and one of a mumps vaccine strain that is no longer in production.[8] The measles and mumps vaccines are grown in chick embryo cell cultures and rubella vaccine in human diploid cell culture.

MMR vaccines licensed in New Zealand are:

- MMR II (MSD), which contains further attenuated Enders' Edmonston (Moraten) strain measles, RA 27/3 rubella, Jeryl Lynn mumps
- Priorix (GSK), is now available and contains Schwartz strain measles, RA 27/3 rubella, and RIT 4385 mumps strain derived from the Jeryl Lynn.

Efficacy

Seroconversion to all three viruses of MMR vaccine occurs in 85–100 percent of recipients. Most studies show 90–95 percent efficacy against measles. Those who do not seroconvert after the initial MMR dose almost always seroconvert after the second.

Even though antibody levels decline over time, secondary vaccine failure (ie, vaccine failure due to waning of protective immunity) has only rarely been documented for any of the three components of the vaccine. A meta-analysis for measles vaccine found no evidence of secondary vaccine failure in the US manu-factured vaccine currently used in New Zealand.[9] (Primary vaccine failure refers to the lack of protective immunity despite vaccination due to failure of the vaccine to stimulate an immune response.)

Dosage

The correct dose is all of the reconstituted vaccine (about 0.5 ml) given by sub-cutaneous injection in the deltoid area to all age groups. (See section 2.2 for needle sites and sizes.)

9.5   Recommended immunisation schedule

Measles vaccine is recommended as MMR at 15 months and four years of age, before school entry. Two doses of measles vaccine are recommended as the 5–10 percent who fail to be protected by the first dose will nearly all be protected by the second. The second dose of measles vaccine can be given as soon as four weeks after the first dose.

The MMR vaccine may be given to children of any age whose parents/caregivers request it and no opportunity should be missed to achieve immunity. It should be given to any adult who is known to be susceptible to one or more of the three diseases.

The MMR vaccine should be given irrespective of a history of measles, mumps or rubella infection or measles immunisation. A clinical history does not reliably indicate immunity unless confirmed by serology. Furthermore, there are no known ill effects from vaccinating children, even if they have had serologically confirmed measles.

After re-immunisation, reactions are expected to be clinically similar but much less frequent in occurrence since most vaccine recipients are already immune. No unusual reactions have been associated with measles or MMR re-immunisation.[10]

All health care workers with patient contact should be immune to measles, mumps and rubella, especially if they are working with immune compromised or pregnant individuals.

Children given measles vaccine in infancy

Children born in 1989 or earlier may have received the measles vaccine at 12 to 15 months of age, and MMR during the 1997 campaign. They will have therefore received the recommended two doses of measles, but only one of mumps and rubella. While the main reason for a two dose MMR schedule is to protect against measles, two doses of all three antigens are recommended. These children should receive a second dose of MMR (ie, a third dose of measles vaccine).

The anticipated adverse effects of re-immunisation are expected to be less frequent than with primary immunisation, as most vaccinees will be immune.

Administration

MMR can be given concurrently with other vaccines, as long as separate syringes are used and the injections are given at different sites. If not given concurrently, live vaccines should be given one month apart. MMR can be given to non-immune adults and should be considered for those in institutional care or whose occupation may expose them to a higher risk (eg, health professionals or those training as health professionals).

Immune suppression

MMR is contraindicated in children who are immune suppressed (eg, those suffering from leukaemia), but they may be partially protected from exposure to infection by ensuring that all contacts are fully immunised, including hospital staff and family members.

MMR vaccination is recommended for children with HIV infection at 12 months of age who are asymptomatic and children who are not severely immune compromised. MMR is contraindicated in children with severe immune suppression from HIV because vaccine related pneumonitis (from the measles component) has been reported.[11] Discuss vaccination of children with HIV infection with their specialist.

Tuberculosis and measles vaccine

There has been some concern that the measles vaccine could exacerbate tuberculosis. This concern is effectively addressed in the *2000 Red Book*, p. 394:

> *Tuberculin skin testing is not a prerequisite for measles immunisation, and measles vaccine does not exacerbate tuberculosis. If tuberculin skin testing is otherwise indicated, it can be done on the day of immunisation. Otherwise testing should be postponed for 4 to 6 weeks because measles immunisation may temporarily suppress tuberculin skin test reactivity.*

Single antigen measles vaccine and use under 12 months of age

A single antigen measles vaccine may be offered to infants between 4 and 12 months of age during measles outbreaks occurring in the very young (see section 9.8). These children will also need MMR at 15 months of age as their chance of protection from measles is lower and mumps and rubella protection is necessary. This will be recommended by the Medical Officer of Health and Ministry of Health based on the local epidemiology.

9.6   Adverse events following immunisation (AEFI)

Common events following MMR

It is commonly reported that 5–15 percent of children experience a fever of 39.5°C or over and 5 percent a rash 6–12 days post-immunisation. A placebo controlled study has shown that fever and/or rash in most cases are unrelated to immunisation, and only rash in 1.6 percent and high fever in 1.4 percent could be attributed to MMR; these fevers were most likely nine or 10 days after immunisation and the rash occurred in the second week.[12] The mumps vaccine may produce parotid and/or submaxillary swelling in about 1 percent of vaccinees, most often 10–14 days after immunisation. The rubella vaccine can cause a mild rash, fever and lymphaden-opathy, between two and four weeks after immunisation. There were no persisting sequelae associated with the administration of three million doses of MMR to 1.5 million children in Finland.[13,26]

Rarer more significant events

Febrile convulsions occur in 1 in 3000 children, 6–12 days after immunisation. Parents/caregivers should be advised to give the child paracetamol 15 mg/kg four hourly (up to a maximum of four doses in 24 hours) if a fever develops. Children with a history of convulsions should be given MMR but the parents/caregivers should be warned that there may be a febrile response.

   Thrombocytopaenia occurs in approximately 1 in 30,000 doses, 15 to 35 days after immunisation. The clinical course of these cases is usually transient and

benign.[14] The risk may be increased in those with a previous diagnosis of immune thrombocytopaenic purpura (ITP), especially if it occurred after an earlier dose of MMR vaccine. Therefore it is recommended that any child who developed ITP within six weeks of receiving the first dose of measles vaccine or MMR, undergo serological evaluation before receiving a second dose. The second dose is recommended for children who are not fully immune against measles, mumps and rubella.[15]

Central nervous system symptoms following measles vaccine are reported to occur in 1 in 1 million children. In most cases, this seems to be a chance occurrence which is not caused by the vaccine. An analysis of claims for encephalitis following measles vaccine in the USA found clustering of events at 8–9 days after immunisation.[16] This clustering supports, but does not prove, that vaccine causes encephalitis, albeit rarely and at a lower rate than the wild virus illness.

The MMR vaccine containing the Urabe strain of mumps was withdrawn in 1992 following a UK study that found a 1 in 11,000 risk of mumps vaccine meningitis. MMR containing the Urabe strain was used from 1991 until it was withdrawn in 1992 in New Zealand. Aseptic meningitis occurs in 1 in 800,000 doses following administration of the Jeryl Lynn strain of mumps vaccine,[17,18] which is used in New Zealand.

Arthritis or arthralgia occurs after both the rubella disease and vaccine, especially in adults. About 15 percent of adult women and less than 1 percent of children get joint symptoms about 2–4 weeks after immunisation. It was previously thought that rubella vaccine might lead to long term arthritis. However, two large controlled studies found no supporting evidence.[19,20] Another study did find a slight increase in arthritis risk from rubella vaccine, but this was of borderline statistical significance.[21] A review of the available evidence concluded that rubella vaccine does not cause chronic arthritis.[22]

Adverse outcomes not linked to MMR

In 1995 a group of researchers from the Royal Free Hospital in London published a study comparing children who took part in the 1964 UK Medical Research Council measles vaccine trial and received the measles vaccine at 10 to 24 months of age, with a cohort of their unvaccinated partners and with a longitudinal birth cohort from the National Child Development study born in 1958. The researchers looked at the history of inflammatory bowel disease (IBD), that is Crohn's disease and ulcerative colitis, in all three groups and found that the group receiving the measles vaccine had an increased risk of Crohn's disease (RR 3.01 95% CI 1.45-6.23) and of ulcerative colitis a relative risk of 2.53 (95% CI 1.15-5.58) compared with the birth cohort. The researchers suggested this indicated that the measles virus might play a part in the development of Crohn's disease and ulcerative colitis.[23]

In 1998[24] the researchers found that in a series of 12 children with chronic bowel

disease and a regressive developmental disorder, parents thought the onset of neurological symptoms was associated with MMR in eight of the 12 children, measles infection in one child and otitis media in one child. In nine of the children the neurological syndrome was classified as autism. All the children had intestinal abnormalities of chronic colitis and 11 children had lymphoid nodular hyperplasia. It was suggested by the researchers that there was an association between inflammatory bowel disease, autism and the MMR vaccine.

The methodology used in this study was criticised[25] because of the small number of cases in the series, and the selection bias as the report was based on cases referred to a group known to be interested in the relationship between MMR vaccine with IBD rather than based on a population based study. There were no controls to compare events following immunisation, and there was no clear case definition for cases. There are no other reports suggesting an association between IBD and behavioural syndromes or autism following MMR or measles vaccine in the millions of doses of vaccine used world wide since the 1960s.[13,26,27,28]

The hypothesis was also examined in studies by other researchers and in other countries. A study from Finland[26] followed up those children who developed gastrointestinal (GI) disease after MMR. At the end of 1996 three million doses of MMR vaccine had been delivered with 31 children reported with GI symptoms, none of whom developed either IBD or autism. A population based study from the UK, which examined the incidence of autism after the introduction of MMR,[27] also failed to find any association or increase in incidence of autism. In this study a community child health system was used to identify children diagnosed with autism born since 1979. The records show no increase in incidence following the introduction of MMR and no difference in the age at diagnosis of cases who had received MMR before or after 18 months, compared with those never vaccinated with MMR.

The Institute of Medicine in the USA reviewed evidence[28] and concluded in their report that the evidence does not support, at the population level, a link between MMR vaccine and autistic spectrum disorder (ASD). The Immunisation Safety Review Committee (ISR) did not exclude the possibility that MMR could contribute to ASD in a small number of children, because it is difficult to assess a rare occurrence and biological models have not been disproved. The ISR recommended no change or review of MMR licensure or change in the US MMR programme.

TABLE 9.1: Risks of measles, mumps, rubella and MMR vaccine

Measles complications	
Otitis media, pneumonia, diarrhoea	1/10–100
Encephalitis, probably resulting in brain damage	1/1000
Death	1/1000

Rubella complications	
Congenital rubella: cataracts, deafness, cardiac malformations, and brain damage. Some abnormality of the foetus will be detectable in 85 percent of women infected in the first eight weeks of pregnancy.	

Mumps complications	
Meningitis	1/7
Orchitis	1/5 post-pubertal males
Nerve deafness	1/15,000
Death	1.8/10,000

Vaccine complications	
Rashes, fever, local reactions, parotid swelling	1/7
Febrile convulsions	1/2500
Transient joint symptoms – children	1/35
Thrombocytopaenia	1/30,000
Encephalitis	1/1,000,000
Aseptic meningitis	< 1/100,000

Any severe or unexpected reactions should be reported to CARM, PO Box 913, Dunedin, using the prepaid postcard H1574 (see section 2.3). If the patient or parent/caregiver does not consent to being identified, the report should be made without personal identification.

9.7 Contraindications to MMR

The general contraindications that apply to all immunisations are relevant to the MMR and single antigen measles vaccines (eg, children with an acute febrile illness should have their immunisation deferred) (see section 1.9).

Anaphylaxis following a previous dose of measles vaccine or MMR is a contraindication to a further dose of MMR.

Children who have anaphylaxis after MMR should be serologically tested, and if non immune to rubella should be given a dose of single antigen rubella vaccine.

Other specific contraindications include:

• individuals with proven anaphylaxis (but not contact dermatitis) to neomycin

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- children with immune suppression (ie, children with significantly impaired cell-mediated immunity, including those with untreated malignancy, altered immunity as a result of drug therapy – including high dose steroids – or receiving high dose radiotherapy) (see section 1.8)
- children who have received another live vaccine, including BCG, within the previous month
- pregnant women
- women of childbearing age, who should be advised to avoid pregnancy for the next three months after the MMR or measles vaccines
- for individuals who have received immune globulin or a blood transfusion during the preceding 11 months (see Table 1.10 for the length of time to defer measles vaccine after specific blood products)
- children with HIV infection who are severely immune compromised.[29]

Egg allergy

Egg allergy is no longer considered a contraindication to the measles or MMR vaccines. Various studies have confirmed these children can be vaccinated safely.[29,30,31] Other components of the vaccine (eg, gelatine)[32] may be responsible for allergic reactions.

It is, however, recommended that any child who has a history of anaphylaxis with cardiorespiratory symptoms other than to MMR (see above) should be vaccinated under close supervision with adrenaline and age-appropriate resuscitation equipment available.

Vaccinators should be aware of the possibility that allergic reactions including anaphylaxis may occur. (See also section 1.8 for information on immunisation of a child on steroids.)

9.8   Control measures

Notify all cases of measles on suspicion to the local Medical Officer of Health. A single case of measles should be considered an outbreak and result in a suitable outbreak response.

When measles is suspected in a child presenting with respiratory symptoms, a rash and fever, a diagnostic serology test for measles should be done. This is because a single case of measles may herald an epidemic. Other viral illnesses present with fever, rash, conjunctivitis or cough and it is important to positively identify any case of measles and set in place further control measures. Cases should be notified on suspicion.

The recommended laboratory test for confirmation of a measles diagnosis is serum measles IgM (see Table 1.4). Although measles virus may be isolated very early in the illness or prodrome, the virus is quite delicate and often may not be

cultured. The diagnosis is usually made serologically, with a rise in serum IgG antibodies demonstrated on paired sera. A rapid diagnosis may be made if IgM can be demonstrated in the initial serum sample.

Serological or virological diagnosis of the early cases is essential, and outbreak control planning and response should not be delayed. All children who could be infected during the outbreak and have not received two doses of measles vaccine should be offered MMR, ideally within three days of diagnosis of the index case. The live measles vaccine if given within 72 hours of measles exposure will provide protection in some cases, so prompt immunisation may protect those susceptible. If there is doubt about the state of immunity, the vaccine should be given as there are no ill effects from vaccinating an individual who is already immune. Particular attention should be paid to individuals born during 1969–75. At that time the measles vaccine was given at 10 months of age. There is now good evidence that the vaccine is less effective at that age because of residual maternally acquired passive immunity, and so these people are less likely to be protected.

In an outbreak affecting infants, the use of monovalent measles vaccine for infants between four and 11 months of age or MMR vaccine for infants between 12 and 15 months of age should be considered. If the monovalent vaccine is not available, MMR may be used for infants under 12 months.

If the monovalent measles vaccine is given before the first birthday, MMR should still be given at 15 months and four years of age because of the lower seroconversion rate for those receiving the vaccine under 12 months, and the need to protect against mumps and rubella.

Immune globulin should be administered to protect measles exposed individuals in whom the vaccine is contraindicated (see section 9.7). Children with compromised immunity (eg, those with leukaemia) who come into contact with measles should be given normal human immune globulin (IG) (0.5 ml/kg to a maximum of 15 ml) as soon as possible after exposure. IG should also be considered for immune compromised adults who have no antibodies to measles. If immune competent individuals need IG prophylaxis the dosage should be 0.25 ml/kg to a maximum of 15 ml. IG is most effective if given within 72 hours of exposure, but can be effective even if given within six days. If a large dose is needed, an intravenous preparation of IG (IVIG) may be used.

Parents/caregivers should be advised that cases should be excluded from early childhood services, school or community gatherings until at least four days after the appearance of the rash. Immunised contacts (ie, in receipt of two doses after the first birthday) need not be excluded from early childhood services, school or community gatherings. Non-immune contacts (defined as those with no documentation of any immunisation or laboratory confirmed measles) should be excluded from school, early childhood services or community gatherings because of the risk of catching the disease themselves, and the risk of passing on the disease during the prodromal phase to other susceptible children.

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The recommended period during which absence from an early childhood service or school is advised extends from diagnosis of the first case until 14 days after the appearance of the rash in the last case. Non-immune contacts may return to school immediately after receiving the measles vaccine, although there is a small risk that some may be incubating the disease.

For more details on control measures, refer to *Control of Communicable Diseases Manual*.[33]

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