Guidance for the Control of Measles Incidents and Outbreaks in Scotland.

Scottish Health Protection Network

Revised September 2018
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The Scottish Health Protection Network (SHPN) is an obligate (jointly owned) network of existing professionals, organisations and groups in the health protection community across Scotland. The aims of the network are:

- To ensure Scotland has a Health Protection service of the highest quality and effectiveness that is able to respond to short term pressures and to long term challenges.
- To oversee the co-ordination of Scotland’s health protection services under a network that promotes joint ownership and equitable access to a sustainable and consistent service.
- To minimise the risk and impact of communicable diseases and other (non-communicable) hazards on the population of Scotland and to derive long term public health benefits (outcomes) through the concerted efforts of health protection practitioners across Scotland.

In line with the above, SHPN supports the development, appraisal and adaptation of health protection guidance, seeking excellence in health protection practice.

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Professionals involved in the implementation of recommendations proposed in this document are expected to take them fully into account when exercising their professional judgment. The document does not, however, override the individual responsibility of professionals to make decisions appropriate to the circumstances of the individual cases, in consultation with partner agencies and stakeholders. Professionals are also reminded that it is their responsibility to interpret and implement these recommendations in their local context, in light of their duties to avoid unlawful discrimination and to have regard to promoting equality of opportunity. Nothing in this document should be interpreted in a way which would be inconsistent with compliance with those duties.

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<td>CD/EH</td>
<td>Communicable Disease/Environmental Health</td>
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<td>ECDC</td>
<td>European Centre for Disease Prevention and Control</td>
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<td>GDG</td>
<td>Guidance Development Group</td>
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<td>GP</td>
<td>General Practitioner</td>
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<td>Guidance Review Group</td>
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<td>HCW</td>
<td>Healthcare worker</td>
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<td>HNIG</td>
<td>Human normal immunoglobulin</td>
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<td>HPN</td>
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<td>IMT</td>
<td>Incident Management Team</td>
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<td>Infection Prevention and Control Teams</td>
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<td>IVIG</td>
<td>Intravenous Immunoglobulin</td>
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<td>MMR</td>
<td>Measles, Mumps and Rubella</td>
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<td>NHS</td>
<td>National Health Service</td>
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<td>NICE</td>
<td>National Institute for Health and Care Excellence</td>
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<td>OH</td>
<td>Occupational Health</td>
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<td>OHSAS</td>
<td>Occupational Health &amp; Safety Advisory Services</td>
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<td>PAG</td>
<td>Problem Assessment Group</td>
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<td>PCR</td>
<td>Polymerase Chain Reaction</td>
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<td>Public Health England</td>
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<td>RPE</td>
<td>Respiratory protective equipment</td>
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<td>Scottish Health Protection Network</td>
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<td>SICP</td>
<td>Standard Infection Control Precautions</td>
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<td>SIGN</td>
<td>Scottish Intercollegiate Guidelines Network</td>
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<td>SIRS</td>
<td>Scottish Immunisation and Recall System</td>
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<td>SSPE</td>
<td>Subacute sclerosing panencephalitis</td>
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<td>TEG</td>
<td>Technical and Editorial Group</td>
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<td>TBP</td>
<td>Transmission Based Precautions</td>
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<td>UK</td>
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<td>vCJD</td>
<td>Variant Creutzfeldt-Jakob Disease</td>
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1. About this document and the guidance development process

This guidance is the outcome of a review process undertaken to update the January 2014 ‘Guideline for the Control of Measles Incidents and Outbreaks in Scotland’. It also includes the additional November 2014 proposed pre- and post-exposure to measles algorithms for management of healthcare workers.

Some recommendations have changed since 2014, in the light of new evidence and expert consensus.

This guidance represents the view of the Scottish Immunisation Programme, working under the auspices of the Scottish Health Protection Network (SHPN).

This guidance document will be reviewed and updated after 3 years unless significant developments relating to the topic arise in the interim.

Aim and scope of the guidance

This document aims to provide up-to-date, user-friendly recommendations that:

- are based on best available published evidence and expert consensus;
- offer best practice advice for measles incidents and outbreaks;
- define the major components of care provision for measles cases and contacts in measles incidents/outbreaks and measures for their prevention and control; and
- detail areas of uncertainty that may be important for research purposes.

Who is the guidance intended for?

This guidance is relevant to all healthcare professionals who deal with patients with measles or suspected measles, as well as with contacts of infected patients. It is also expected that the guidance will be of value to those involved in clinical governance in primary, secondary care and public health to help ensure that arrangements are in place to deliver appropriate care for the population covered by this guidance.

Development Process

The development of this guidance in 2010 was based upon the method outlined by the HPN- in the light of current reviews of the SIGN 50,1 NICE Guidelines manual2 and the ECDC methodologies.3 A team of health professionals and technical experts known as the Guidance Review Group (GRG) – membership in Appendix 1 – followed the systematic framework referred to above.1

Recommendations given in the original guidance are as a result of careful review and consideration of the evidence available, existing guidance and principles of best practice. The evidence base for this guidance was synthesised from that collated using
an explicit search strategy devised by the guidance technical and editorial group (TEG) and members of the GRG. During the initial development of the guidance the search covered MEDLINE, EMBASE, CINAHL and various meta-search engines from 2008 to Dec 2011. The scope of the search strategy did not include recommendations covering every detail of the recognition and initial management of measles infections. Instead this review focussed on those areas of clinical and public health practice that were identified as relevant. Evidence was updated in 2017 based on consideration of revised PHE and ECDC guidance and more in-depth review was performed when required, for example, a review of the literature around transmission of measles between vaccinated individuals.

**Professional judgement and compliance with the guidance**

Professionals involved in the investigation and management of measles incidents and outbreaks in Scotland are expected to take this guidance fully into account when exercising their professional judgment. The guidance does not, however, override the individual responsibility of professionals to make decisions appropriate to the circumstances of the individual incidents and cases, in consultation with partner agencies and stakeholders. Implementation of this guidance is the responsibility of the health protection community across Scotland. Professionals are reminded that it is their responsibility to implement the guidance, in their local context, in light of their duties to avoid unlawful discrimination and to have regard to promoting equality of opportunity. Nothing in this guidance should therefore be interpreted in a way which would be inconsistent with compliance with those duties.

**Acknowledgements:**

Health Protection Scotland (HPS) wish to express their appreciation to all whose efforts made this guidance possible. In particular, to the members of the Guidance Development Groups and their constituencies, the Scottish Immunisation Programme, HPS Graphics, stakeholders and external reviewers, who contributed and reviewed the content of this guidance.

**Comments on the published guidance:**

Comments on this guidance should be sent to the SHPN Guidance Group by emailing NSS.SHPN@nhs.net.
2. Introduction

Prior to the introduction of measles vaccination in 1968, measles was a common illness in Scotland and the vast majority of children were exposed to the virus. Since the introduction of measles vaccination into the childhood immunisation programme the number of measles cases seen in the UK has fallen dramatically.¹

There is now a low incidence of measles in Scotland and it is rare for people to catch the disease in Scotland. Cases are most often seen among people who have recently travelled to areas where measles is endemic or where there are ongoing outbreaks.

In 2010 and 2011 a large increase in cases of measles occurred in many European countries including Bulgaria, France, Germany, Italy, Ireland, Romania and Spain². There have also been localised outbreaks in parts of England: such as in Merseyside³ and Sussex in 2012 and the North of England and South of Wales in 2013. In 2016, an increase in measles cases occurred throughout the UK and a number of European countries reported large increases in measles cases from the end of 2016 throughout 2017.⁴

The potential for measles outbreaks in Scotland is therefore significant. The original guidance was produced in response to concerns raised by public health professionals managing clusters of measles cases and has now been updated. Public health efforts to control one or two cases of measles demand considerable time and coordination.⁵,⁶
3. Background

3.1 Epidemiology in Scotland

Measles is a notifiable disease under the Public Health Scotland (2008) Act. Registered medical practitioners should inform their local Health Protection Team (HPT) of any suspected cases even on clinical grounds alone. In addition, clinicians are requested to submit a sample (see section 5) from the notified case to establish whether it is a true case of measles, as distinguishing measles from other rash illnesses through clinical diagnosis alone is difficult.

Figure 1 shows the trend in measles notifications in Scotland between 1976 and 2014, with a marked reduction in the number of measles notifications in Scotland since the late 1980s, when measles-mumps-rubella (MMR) vaccine was introduced. Historical data on measles cases and measles containing vaccine uptake and the latest vaccine uptake figures can be found on the Health Protection Scotland (HPS) and Information Services Division (ISD) websites.


Source: Information Services Division (ISD) and Health Protection Scotland.
In recent years, the number of laboratory confirmed measles cases in Scotland has been small (Figure 2). A number of clusters have been identified in at risk populations, very few of which have spread into the wider community. The majority of laboratory confirmed cases have been in under-vaccinated individuals (individuals who are unvaccinated or those who have only received one dose of MMR vaccine).

FIGURE 2: Laboratory confirmed measles cases in Scotland, 2001-2017.

In the last ten years, the annual number of measles cases has been variable as has the case demographics. A number of clusters and outbreaks occurred in different settings, including within families, higher education establishments, further education establishments, within the community and within healthcare settings. In 2008, 2013 and 2014 a high proportion of cases were from the Traveller community. There were no cases of measles in 2015 but following measles importations, one of which started a university-based outbreak, the number of cases increased to 26 in 2016. In 2017, the number of cases decreased to five, with one of three importations leading to limited further transmission within Scotland.

In 2010 and 2011 there was an extensive European outbreak of measles which also affected England. Following risk assessment by HPS in the summer of 2011, the Chief Medical Officer for Scotland recommended that MMR vaccination history should be reviewed for all children at their teenage booster appointment and MMR vaccine offered if a child was not fully vaccinated with two doses of MMR vaccine. This was implemented...
in each NHS board during the 2011-12 school year.

The number and rate per 100,000 population of laboratory confirmed measles cases in Scotland compared to England and Wales between 2001 and 2015 are shown in Figure 3. In 2007 to 2009, high numbers of confirmed cases were reported to Public Health England (PHE) (formally the Health Protection Agency (HPA)) in England & Wales. In 2011 and 2012 the number of measles cases reflects a number of localised outbreaks. High numbers of cases were also seen in 2013. Following large local outbreaks in England and Wales in 2013, the Chief Medical Officer for Scotland recommended a short MMR catch-up campaign for 10-17 year olds (the age group most affected by the outbreaks in England and Wales at this time). In 2014 and 2015, the number of laboratory confirmed measles cases decreased in England and Wales.

FIGURE 3: Comparison of laboratory confirmed measles cases in Scotland and in England and Wales, 2001-2016.

3.2 The disease

Measles virus

Measles virus is a single stranded, enveloped RNA virus of the genus *Morbillivirus*, family *Paramyxoviridae*. Humans are the natural host for this virus, no animal reservoirs are known. There are eight measles virus clades and 24 genotypes currently recognised. Genotypes differ between countries.

Clinical Presentation

The clinical symptoms of measles begin with a prodromal fever that can be accompanied by conjunctivitis, coryza, cough and Koplik spots (which are found in the mouth and have a whitish centre and red coloured base). Typically, the measles rash develops after about three or four days. It is a blotchy red (maculopapular) rash that begins on the face, and then spreads downwards over the rest of the body. The rash usually lasts for 4-7 days and may end with the skin peeling, as the rash fades.

Complications

Complications can occur. These include otitis media, pneumonia and encephalitis. In the developing world, where children are more likely to be malnourished, measles is more likely to cause severe complications or even death. Death occurs in one in 5000 cases in the UK. A rare, late complication of measles is subacute sclerosing panencephalitis (SSPE). This occurs in one in every 25,000 cases of measles, with a higher rate of around one case in every 8,000 in children aged less than two years.

Diagnosis and differential diagnosis

As measles has become a rare infection in Scotland, it is important to acknowledge that it can be clinically misdiagnosed; approximately only 10% to 30% of measles notifications are confirmed to be true measles cases. Other rash causing illnesses mistaken for measles include rubella, erythrovirus B19 (formerly parvovirus), adenovirus, enteroviruses, Kawasaki Disease or drug rashes. It is therefore important that samples are taken from all clinically suspected cases of measles for laboratory testing including an oral fluid sample to be sent for testing at PHE Colindale, England (see section 5). Oral fluid testing is an essential requirement of measles and rubella surveillance and is part of the World Health Organisation’s (WHO) Global Measles and Rubella Strategic Plan.

Communicability

Guidance around the number of days in which a case is infectious before the onset of rash varies internationally. Scottish guidance takes a precautionary approach and considers cases to be infectious from **five days before the onset of rash until four days after the rash develops** (see Appendix 2). However, immunosuppressed patients...
may have prolonged excretion of the virus in respiratory tract secretions and can be contagious for the duration of the illness. Patients who are immunosuppressed may present with an atypical rash or no rash at all. They may also present directly with pneumonia or encephalitis and this can make diagnosis difficult. After a susceptible person is exposed to the virus the normal incubation period (to onset of fever) is ten days (range 7-18 days). The typical measles rash usually appears 14 days after exposure. However, in some cases it may take as long as 21 days before the rash develops.

### Transmission

Measles is one of the most highly communicable viral illnesses with a single case having the potential to lead to a further 15 cases in a susceptible population. It can be transmitted through airborne spread as well as through direct contact with nasal or throat secretions of those infected. Natural infection results in lifelong immunity. Anyone who has not been fully immunised nor had the illness previously is susceptible. Although infants of naturally immune mothers are likely to have protective levels of antibody until at least six months of age, a proportion of infants born to vaccinated mothers may not have protective titres even from birth (see section 8.1). Rarely, individuals who have received two doses of a measles containing vaccine can develop symptoms following exposure to a measles case. However, symptoms are usually attenuated and the individuals are unlikely to be as infectious as an unvaccinated case.
4. Definitions

4.1 Outbreaks and incidents

In line with the definitions given in the ‘Management of the Public Health Incidents: Guidance on the Roles and Responsibilities of NHS Led Incident Management Teams’ (2017), it is accepted that a public health incident may arise in the following situations, applicable to measles:

- a single case of a serious illness with major public health implications where action is necessary to investigate and prevent ongoing exposure to the hazardous agent;
- two or more linked cases of unexplained illness that could indicate the possibility that they may both be caused by the same exposure i.e. an outbreak;
- higher than expected number of cases or geographic clustering of a serious pathogen.

4.2 Notification of measles

Measles is a notifiable disease under the Public Health Scotland (2008) Act. All suspected cases of measles should be notified to the local Health Protection Team. Notifications should be made on the basis of clinical suspicion only. All suspected cases should undergo testing to ascertain if they are a true case of measles (see section 5).

Suspected measles should be notified by a phone call to the local Health Protection Team as soon as possible and certainly on the same working day, with written notification following within three days. Method of written notification varies between NHS boards; this may be done electronically or may involve returning a standard paper form.

4.3 Measles case definitions

Since the introduction of measles vaccination into the childhood immunisation programme, measles has become a rare infection in Scotland. Health Protection Teams are often advised of clinically suspected cases, most of whom will turn out to have illnesses other than measles. If a patient has already received two doses of MMR vaccine, at least one month apart, it is very unlikely that they have measles, even in an outbreak situation. However, on rare occasions, measles cases can arise in fully vaccinated individuals. This is to be expected in the presence of an effective vaccination programme in which the overall number of measles cases will decrease, but the potential for measles cases in fully vaccinated individuals, since they represent almost all of the exposed population, will increase. The case definitions below are taken from ECDC, who provide case definitions for infectious diseases for all countries within Europe to use. The definitions below should be used during investigation of a suspected measles related incident or outbreak in Scotland. These definitions may be adapted for outbreaks, by including time and place descriptions.
In circumstances where no outbreaks are ongoing, measles should be considered if the patient has:

- fever (temperature 38°C or higher); AND
- a generalised maculopapular rash; AND
- either cough, coryza OR conjunctivitis.\(^\text{5-10}\)

Clinically suspected cases should be investigated using either polymerase chain reaction (PCR) or serology and an oral fluid sample should be taken (see section 5). PCR is the preferred method for rapid diagnosis.

Possible cases can be further divided into likely and unlikely categories based on PHE criteria (section 2.1.1) if required. The categorisation is a qualitative decision based on the overall current epidemiological picture and clinical presentation of the case, together with factors such as recent travel to an area of increased measles incidence. This distinction may be useful in non-outbreak situations.\(^\text{11}\) See Box 1 below which can aid in classification.

BOX 1: Factors to consider in the risk assessment.

### Factors increasing the risk of exposure

- Membership of a community known to be more susceptible e.g. traveller community, Charedi Orthodox Jewish community, anthroposophic (Steiner) communities, local community with low MMR vaccination coverage\(^\text{12, 13}\).
- Visited an area (local or international) where measles is known to be circulating, during the incubation period.
- Attendance at large international mass gathering events, where substantial mixing occurs between individuals potentially travelling from areas where measles is circulating. This would include events such as music festivals etc\(^\text{14}\).

### Factors favouring the diagnosis of primary measles infection

- **Age:** the likelihood of a suspected case being confirmed as measles is higher among adolescents and young adults. In infants and toddlers, measles like clinical presentations due to other illnesses, such as roseola or scarlet fever, are common.
- **A lack of immunity or incomplete vaccination:** the diagnosis is more likely if cases are unvaccinated or partially vaccinated, and have no prior history of measles infection.
During an outbreak, it is more likely that clinically suspected cases will turn out to be true cases of measles. In this situation, the following case definitions should be used.

**Possible case:**
- fever (temperature 38°C or higher); **AND**
- a generalised maculopapular rash; **AND**
- either cough, coryza or conjunctivitis.

Possible cases can be further divided into likely and unlikely categories as described above.

**Probable case:**
- fever (temperature 38°C or higher); **AND**
- a generalised maculopapular rash; **AND**
- either cough, coryza or conjunctivitis; **AND**
- an epidemiological link to a laboratory confirmed case.

**Confirmed case:**
- a laboratory confirmed case; **AND**
- fever (temperature 38°C or higher); **AND**
- a generalised maculopapular rash; **AND**
- either cough, coryza or conjunctivitis; **AND**
- who has not been recently vaccinated (most commonly rash occurs about a week after immunisation).  

Care should be taken to investigate a laboratory confirmed case that does not meet the clinical case criteria.

**Discarded case (not measles):** A suspected measles case that has been completely investigated, including negative laboratory testing, can be classified as discarded. A case of vaccine-associated measles is a discarded case.

### 4.4 Sporadic measles

A sporadic case of measles is one for which there is no known exposure and for which no onwards transmission is identified.
4.5 Epidemiological linkage

A measles case is epidemiologically linked if:

- there was exposure to a laboratory-confirmed case during their infectious period (five days before to four days after rash onset); **AND**
- this exposure occurred within the expected 7-21 days incubation period of the case under investigation before rash onset.

Epidemiological linkage can provide additional evidence for measles infection in instances where laboratory confirmation is unavailable, or is equivocal (e.g. following vaccination).\(^\text{10,15}\)

4.6 Imported measles

An imported case has its source outside the UK, rash onset within 21 days after entering the UK, and illness not linked to prior local transmission.\(^\text{15}\) Cases in Scotland that have travelled to another part of the UK within the previous 21 days, can be considered to be imported into Scotland from elsewhere in the UK. However, for ECDC and WHO purposes, only cases imported from outwith the UK can formally be considered to be imported.

4.7 Endemic measles

An endemic case is any case in Scotland that cannot be proven to be imported from elsewhere.\(^\text{15}\)

4.8 Vaccine-associated measles

Vaccine-associated measles is any case of measles that has received vaccine close to onset of illness, typically around one week before illness,\(^\text{6}\) and has no known measles exposure. Vaccine-associated illness is more likely to occur after the first dose of MMR vaccine.\(^\text{6}\) Measles virus typing should be used to distinguish between vaccine-associated and wild-type measles (see section 5). A case of vaccine-associated measles is a discarded case.
4.9 Preventable case of measles

A preventable case of measles is confirmed measles in a person who was eligible for vaccination at the appropriate age. Those who were eligible for vaccination are:

- born during or after 1968\(^6\) (year in which measles vaccine was introduced into the UK); **AND**
- lack documented evidence of age-appropriate vaccination against measles; **AND**
- have no medical contraindication to receiving the vaccine; **AND**
- have not had confirmed measles previously.

A case is classified as non-preventable if the person does not meet these criteria.

4.10 Contact of measles

A contact of measles is a person who has been exposed to a person with measles, from five days before the onset, until four days after the onset of the rash or has been in contact with an immunosuppressed person with measles at any point during their illness (see section 7.2.2 for explanation of significant contact).

4.11 Person susceptible to measles

A person is considered to be susceptible to measles if they cannot provide presumptive evidence of immunity to the infection. A person can be considered to have presumptive evidence of immunity if any of the following criteria are met:

- Persons aged over three years and four months who have documented evidence of receiving two doses of measles-containing vaccine at least one month apart. (It should be noted that there is potential for fully vaccinated individuals to develop symptoms following exposure to a case of measles, although this is very rare).
- Persons with documented evidence of laboratory confirmed measles in the past.
5. Laboratory diagnosis and confirmation of measles (see Appendix 3 and Appendix 4)

5.1 Background

Laboratory confirmation of suspected measles cases is essential because measles is a rare disease in Scotland and clinical diagnosis can be unreliable. Most sporadic or index cases are identified after the appearance of the rash, but during an outbreak, cases may be diagnosed during the prodromal phase. The timing of sampling must be taken into account when making a diagnosis. Where suspected cases occur in young children and there is understandable reluctance to obtain a blood sample, particularly at the beginning of an outbreak, diagnosis using non-invasive samples is advisable.

There are three basic laboratory techniques for measles diagnosis and surveillance in general use in Scotland and the rest of the UK:

1. PCR;
2. serology; and
3. oral fluid testing (performed at PHE Colindale).

Other methods such as virus isolation and immunofluorescence are rarely performed. Although PCR and IgM testing (serology or oral fluid testing) can both be performed on a variety of specimens, the timing of sampling with respect to the appearance of the rash affects their predictive values (see Appendix 3), as does the prevalence of the infection (i.e. within or outwith an outbreak).

5.1.1 Detection of virus by PCR

Direct detection of the virus using PCR on throat swabs is the preferred method of confirming measles in Scotland. It offers the advantage of confirming the infection earlier on in the illness and the sample is relatively non-invasive making it a suitable choice for children (see Appendix 3). PCR testing is also the most rapid method of measles diagnosis and is therefore the preferred method for local investigation. PCR tests used within Scottish virology laboratories are the same as those developed and used at PHE Colindale. Quoted sensitivity and specificity for these tests are both greater than 95%. Alternative specimen types include blood, oral fluid and urine, however measles PCR on urine has been shown to be less sensitive than on throat swabs.

All PCR positive samples should be referred to PHE Colindale for genotyping to provide additional information about the potential source of the virus.
5.1.2 Detection of IgM in blood or oral fluid

The presence of measles specific IgM indicates acute infection, but its reliability only approaches 100% three days after appearance of rash and levels may decline as early as day fifteen after onset of rash. False positives with other infections such as erythrovirus B19 and rubella may also occur.

Oral fluid samples provide a non invasive alternative to blood, with a quoted sensitivity and specificity approaching that of serum (100% and 96% respectively). The optimum time for collection is between three days and six weeks after onset of rash. In the UK this test has been used for surveillance for many years at the PHE Colindale, Virus Reference Department. This laboratory is the reference laboratory for measles for the whole of the UK and is recognised by WHO as the European Reference Centre. Samples should be taken using a specific kit which is held by each NHS board Health Protection Team and returned by post to Colindale. Results are usually available within three weeks and returned to the requesting clinician and public health department.

IgM testing can also be performed on blood and has similar sensitivity to oral fluid. However, when compared with oral fluid, IgM tests on blood are less dependent on the quality of the sample.

IgM testing on serum or oral fluid, is the WHO approved criteria for diagnosis of measles infection, not PCR. This is why all notified cases should undergo IgM testing, usually testing on an oral fluid sample, to meet WHO criteria for measles testing which is part of the wider WHO elimination criteria.

5.1.3 Detection of IgG in oral fluid or blood

IgG seroconversion may also be used to make a retrospective diagnosis but it is not widely utilised. Oral fluid and blood are suitable samples for detection of IgG. For oral fluid quoted sensitivity and specificity are 93% and 98% respectively.

IgG detection or immunity testing, is also used for high-risk susceptible contacts of a suspected or confirmed case of measles, when determining if immunoglobulin should be administered (see section 8.2 and section 8.3).
5.1.4 Genotyping

It is important for public health to identify the dynamics of any outbreak. In order to fully investigate the epidemiology of an outbreak, genotyping of measles virus is required from epidemiologically linked cases. This test is only carried out in PHE Colindale, the WHO UK reference centre. The laboratory can use any PCR positive samples to carry out genotyping, although a further sample may be requested by PHE Colindale if there is insufficient material. It is the responsibility of the laboratory performing the initial tests to store the samples appropriately and refer them onto PHE Colindale.

5.2 Laboratory testing

The availability of measles testing in Scottish virology laboratories is shown in Table 1. Those microbiology laboratories without access to measles testing should be able to refer samples onto their local virology service as soon as possible. With prior warning, test results should be available within one working day of receipt of sample. If samples are urgent, clinicians should telephone their local virology laboratory to advise of the sample.

TABLE 1: Availability of measles testing in Scottish virology laboratories (as at August 2017).

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Molecular detection (PCR)</th>
<th>Serology (IgM and IgG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aberdeen</td>
<td>Available</td>
<td>IgM and IgG available</td>
</tr>
<tr>
<td>Dundee</td>
<td>Available</td>
<td>IgG only</td>
</tr>
<tr>
<td>Edinburgh</td>
<td>Available</td>
<td>IgG only</td>
</tr>
<tr>
<td>Glasgow</td>
<td>Available</td>
<td>IgG only</td>
</tr>
<tr>
<td>Inverness</td>
<td>Not available (samples sent to Edinburgh)</td>
<td>IgG only</td>
</tr>
</tbody>
</table>

During an outbreak, local laboratories should be the first point of contact when arranging to have samples tested. A standard throat swab in either viral transport medium or lysis buffer should be sufficient. For further advice please contact your local laboratory.

Oral fluid kits are available from the local Health Protection Team. All notified cases of measles should be tested in this way for IgM to meet WHO requirements of measles investigation to satisfy elimination criteria, even if previous PCR testing is negative. Oral fluid samples are returned directly to PHE Colindale for testing, using the packaging supplied with the kit.
5.3 Recommended tests and interpretation of test results

A throat swab for PCR testing is the preferred sample for diagnosis of all suspected measles cases (both sporadic and in an outbreak situation), as this offers the greatest sensitivity overall and the results are rapidly available. Other samples can be used depending on the stage of the infection. A diagram summarising which measles tests are most suitable during different stages of the illness is available in Appendix 3.

- From prodromal phase to around six days after appearance of rash – send a throat swab to the local virology laboratory for PCR testing.
- From prodromal phase to 6 weeks after rash – send oral fluid or blood sample for IgM and IgG testing (blood samples taken within 3-4 days after onset or rash may be negative and a repeat sample may be required after 10-14 days).
- Contact local Health Protection Team for an oral fluid kit (for IgM and IgG testing) for all notified cases.
- Always discuss the interpretation of results with laboratory staff if the patient has received MMR vaccination within the last three months.

Repeat samples should be taken if clinical suspicion of measles remains high and previous results have been negative or equivocal. It is also advisable to test for rubella if measles test results are negative, to both exclude rubella infection and to meet criteria as specified by the WHO. Oral fluid testing should be undertaken for all suspected measles cases that are PCR negative (and where no serum sample is taken) to confirm the result. An algorithm summarising measles tests, test results and interpretation for suspected cases is given in Appendix 4.

In the presence of clinical symptoms and the absence of recent vaccination (usually within two weeks, but may be up to three months), any of the following laboratory test results provide confirmation of measles infection in Scotland:

- Detection of measles virus nucleic acid in a clinical specimen (PCR);
- Measles virus specific antibody response in serum or saliva.
6. Roles and responsibilities

Guidance on the statutory responsibilities of health boards and their relationship with the Scottish Government can be found in the document ‘Management of Public Health Incidents – Guidance on the Roles and Responsibilities of NHS Led Incident Management Teams’.¹

Measles outbreaks and incidents are likely to impact on occupational health and infection control teams as well as the wider public health workforce. Each of these groups should communicate clearly with each other at an early stage to instigate control measures.

**Diagnosing clinicians (primary and secondary care)**
- Clinical management of suspected case
- Risk reduction for staff and other patients
- Notification to local Health Protection Team
- Taking suitable samples for virological testing

**Health Protection Teams**
- Assessment of exposure and vaccination history of cases
- Contacts risk assessment (including liaison with occupational health colleagues)
- Assess the need for a Problem Assessment Group (PAG) / Incident Management Team (IMT)
- Advising on control measures
- Advice on exclusion (inform workplace, school, nursery etc.)
- Liaison with laboratory staff
- Liaison with immunisers (primary care or occupational health) for follow up doses of vaccine
- Communications to healthcare staff, affected communities, Health Protection Scotland, Scottish Government and media
- Liaison with Infection Prevention and Control Teams

**Infection Prevention and Control Teams (IPCT)**
- Ensuring all other patients and visitors potentially exposed in wards and hospital waiting rooms have been identified (this will largely be undertaken by clinical teams, receptionists etc who need to be advised by IPCT based on exact attendance and exposure time)
- Request that the clinical team assesses which patients are likely to be at higher risk - immunocompromised, pregnant and infants
- Establish if there has been significant contact
- Liaise with clinicians and HPT for hospital related cases to ensure appropriate follow up
- Advise on infection prevention precautions when a suspected case of measles is in hospital.
Role of Occupational Health

- Ensure up to date immunisation of healthcare workers and support staff, especially those in high risk settings (including paediatrics, maternity, neonatal, oncology wards and accident & emergency) to avoid transmission and exclusion of staff which may affect key areas
- Experience shows that maintaining data on measles immunity of healthcare workers which can be readily assessed if required for incident management has been vital in prompt management and avoiding unnecessary exclusion
- Review evidence of immunity for healthcare workers
- Prompt follow up of healthcare workers exposed to measles including vaccination and exclusion
- Provide regular reports and updates to the IMT on above

Health Protection Scotland

- Expert advice on risk assessment
- Expert advice on control measures
- Incident management if outbreak extends beyond NHS Board level
- Scotland-wide, national and international communications
- Scottish guidance (together with the Scottish Health Protection Network)
7. Case investigation and control measures (see Appendix 5 and Appendix 6)

7.1 Actions in the event of notification of suspected measles

Due to the highly infectious nature of measles and the potential poor outcomes associated with disease, especially in those who are vulnerable, every notified case of suspected measles requires assessment. The algorithm below (Figure 4) highlights initial actions in response to notification of suspected measles. Further details are found throughout this chapter.
FIGURE 4: Algorithm describing initial actions for health protection teams in response to notification of suspected measles.

Receive report of suspected measles:
- Notification from primary or secondary care [Maculopapular rash; temperature ≥38°C, cough, conjunctivitis or coryza],
- Local diagnostic laboratory result

Obtain history from the case including:
- Contact with a case of measles?
- Travel to endemic areas or areas with ongoing outbreaks?
- Case attends childcare/school/work?
- Living in close community?
- Part of Travelling Community?
- Date of onset and clinical condition of case / hospitalised
- Significant contacts

Risk assessment
- Check for linked cases
- Check immunisation status
- High-risk contacts? (e.g. HCW, vulnerable groups) – check immunisation status or previous clinical history
- Is prophylaxis indicated? – organise MMR or HNIG
- Advise on exclusion (inform school/nursery/work)

Call a PAG/IMT if part of cluster or outbreak. It may be necessary to call a PAG/IMT for a single case.

Complete enhanced measles surveillance form and send to HPS

See Appendix 3 and Appendix 4 for advice on testing

The enhanced surveillance form can be found at: http://www.hps.scot.nhs.uk/pubs/detail.aspx?id=3504

See Appendix 6, Appendix 7, Appendix 8, Appendix 9 and Appendix 10 for advice on management of high risk / vulnerable groups
7.2 Case investigation

7.2.1 Data collection

It is important to collect information about the case and those who may have been exposed in order to determine the period of infectivity, as well as offer appropriate post exposure prophylaxis to contacts. Most existing measles guidelines include information recording forms developed from expert opinion.\(^1\)\(^9\)

The following information should be collected for suspected cases during a measles incident or outbreak:

- demographic details of case, including GP and workplace/school/childcare of case;
- type of laboratory testing;
- clinical details, including rash onset and any complications or hospitalisation;
- vaccination history;
- contact with known measles case(s);
- travel history;
- details of household and other contacts.

The enhanced measles surveillance form should be used to collect this information and can be found at [http://www.hps.scot.nhs.uk/pubs/detail.aspx?id=3504](http://www.hps.scot.nhs.uk/pubs/detail.aspx?id=3504).

Epidemiological information should be collected in order to allow descriptive and analytical epidemiology of measles outbreaks to be carried out. Public health professionals are encouraged to complete outbreak reports for all measles outbreaks (see section 10).

7.2.2 Risk assessment

All individuals who have had significant contact with a confirmed or probable case of measles should undergo risk assessment. They should be asked to provide presumptive evidence of immunity. For example, either a history of receiving two doses of measles-containing vaccine (through the Scottish Immunisation & Recall System (SIRS) or GP notes where readily available), a history of laboratory confirmed measles or probable measles with epidemiological link to a confirmed case (see section 4.3).

It is not possible to definitively describe what constitutes ‘significant contact’ with a measles case, as there is currently insufficient evidence to answer this question. It is agreed, however, that any contact lasting 15 minutes or more is sufficient for transmission. If any close contact (e.g. face to face contact) occurred or if the contact is immunosuppressed it is likely that less than 15 minutes of contact is sufficient for transmission. If it is difficult to establish whether a significant contact
has occurred or if the person exposed is thought to be at particularly high risk (e.g. immunosuppressed) the case should be discussed with the local Health Protection Team (see section 8.3).

7.2.3 Risk assessment for measles on an aircraft

In the situation where a case of measles has travelled on an aircraft whilst infectious, a risk assessment needs to be undertaken. A number of criteria should be considered before contact tracing is initiated and to allow assessment of the required response.

In summary, contact tracing should primarily be considered when interventions are likely to be effective or will contribute to maintaining measles elimination/control in Scotland and wider in the UK.

Specifically, contact tracing should be considered:

- if the index case is confirmed, probable or is assessed as being a likely case based on clinical symptoms, country of likely acquisition, immunisation status or belonging to a high-risk group; \textbf{AND}
- if the index case travelled during his/her infectious period; \textbf{AND}
- if the flight occurred within the previous five days (based on the window of opportunity to administer post-exposure prophylaxis minus one day to organise intervention).

\textbf{Contact tracing may still be an option after five days if the first two aforementioned criteria are met and:}

- the incubation period of potential secondary cases has not elapsed; \textbf{AND}
- information of the fellow passengers is still or readily available; \textbf{AND}
- there is evidence of transmission in the country of likely acquisition; \textbf{AND}
- resources are available.

The rationale of undertaking contact tracing after five days and up to 12 days after the flight has elapsed is to identify secondary cases and ensure appropriate interventions to limit further spread. The time period of 12 days is based on median incubation period minus time for organisation of intervention.

When it has been decided that contact tracing should be undertaken, the HPT should contact HPS with details of the flight and HPS will make contact with the airline to ask them to circulate ‘warn and inform’ letters by electronic means in the first instance, emphasising the urgency and importance to passengers (template in Appendix 5). If the airline will not agree to this, efforts will be made by HPS to acquire the passenger manifest.

In this circumstance, HPS will try to identify those passengers that are resident outside of Scotland and the UK National Focal Point will be contacted for advice. HPS in
conjunction with the National Focal Point will ensure that, where possible, details of passengers resident outwith Scotland are passed on to the appropriate authorities, elsewhere in the UK, or internationally.

For those passengers who appear to be residents of Scotland, if the Health Board of residence is able to be determined by HPS, a decision will be made, following discussion between HPS and the HPTs of the Health Boards in which the passengers are resident, as to whether contact tracing should be undertaken by HPS or the HPTs. This will be dependent on a number of practicalities, including the timeframe available to apply interventions, the number of passengers, mode of communication to passengers agreed on and available resources.

As each airline is likely to have a different approach in how they deal with these incidents, practitioners should be aware that proposed plans may have to change in response to the airline’s approach.

### 7.3 Control measures

#### 7.3.1 Standard infection control precautions and respiratory protection

**Standard Infection Control Precautions (SICPs) must be used by all healthcare workers at all times and in all care settings, including the patient's home.** Comprehensivé guidance and advice for healthcare workers is available in the National Infection Prevention and Control Manual (NIPCM).

Transmission Based Precautions (TBPs) should be followed in addition to SICPs when caring for laboratory confirmed or suspected cases of measles while they are considered to be infectious. Respiratory Protective Equipment (RPE) should be worn as it is considered that a very small proportion of individuals may become infected despite having received two doses of MMR vaccine and is a means of protecting from the risk that remains. For those staff who are unaware of their IgG immunity or vaccination history, a Filtering Face Piece level 3 Respirator (FFP3 respirator) must be worn at all times during contact with the patient while they are considered to be infectious (see section 7.4.1). More information can be found in appendix 11 of the NIPCM.

#### 7.3.2 Vaccination

Vaccination against measles is part of the routine childhood schedule against infectious diseases in the UK. Measles vaccination was introduced to the UK in 1968 and in 1988 the single vaccine was replaced with the combined MMR vaccine. Since 1996, it has been recommended that all children should routinely receive two doses of MMR, the first dose at around 12 months of age and a second dose is recommended from three years four months of age. Further details about the administration of MMR vaccine, its contraindications as a live attenuated vaccine and the routine immunisation schedule in the UK can be obtained from Immunisation against Infectious Disease - The Green Book.
Vaccination of contacts following exposure to measles

As vaccine-induced measles antibody develops more rapidly than antibody following natural infection, MMR should be given to eligible susceptible contacts as soon as possible after exposure, ideally within three days.¹ This is post-exposure prophylaxis. Even where it is too late to provide effective post-exposure prophylaxis, the vaccine can provide protection against future exposure to all three infections covered by the vaccine. If an individual is already incubating measles, MMR will not exacerbate the symptoms. People who are immunised following exposure to a confirmed or probable case of measles should be told that any symptoms they develop in the following 10 days are likely to be due to natural infection¹ and should be managed as a true case of measles. If there is doubt about an individual’s vaccination status, MMR should still be given as there are no adverse effects from vaccinating those who are already immune provided they are not contraindicated.¹

Clear guidance about the use of vaccination to protect contacts following exposure is available in the Green Book and PHE’s Guidance for Measles Post-Exposure prophylaxis.¹,¹⁵ This is summarised in Table 2.
TABLE 2: Recommendations for use of MMR for post-exposure prophylaxis for eligible susceptible contacts.

<table>
<thead>
<tr>
<th>Age of proposed recipient</th>
<th>Unvaccinated (or unknown vaccination status)</th>
<th>Having already received one documented dose of measles containing vaccine</th>
<th>Having already received two documented doses of measles containing vaccine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 6 months</td>
<td>Do not offer MMR. See section 8.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6 – 11 months</td>
<td>Offer MMR*; two further doses required after 12 months of age; offer at scheduled appointments * HNIG may be indicated in some cases, see section 8.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12 months to 18 months</td>
<td>Offer MMR1. Receive MMR2 as per routine schedule. No need for third dose.</td>
<td>Offer MMR2. If offer is less than three months after MMR1 received, offer a third dose of MMR at the scheduled MMR2 appointment.</td>
<td>-</td>
</tr>
<tr>
<td>18 months to 3 years 4 months</td>
<td>Offer MMR1. Offer MMR2 as scheduled or if within one month of scheduled MMR1, delay until one month gap between doses. No need for third dose.</td>
<td>Offer MMR2, ensuring at least 1 month interval between MMR1 and MMR2. No need for third dose.</td>
<td>No action</td>
</tr>
<tr>
<td>3 years 4 months to adults</td>
<td>Offer MMR1 and MMR2, ensure one month gap between doses. No need for third dose.</td>
<td>Offer MMR2, ensuring at least 1 month interval between MMR1 and MMR2. No need for third dose.</td>
<td>No action</td>
</tr>
<tr>
<td>Adults born before 1970</td>
<td>Adults of this age are likely to have been exposed to measles as children and be naturally immune. MMR can still be offered based on risk assessment.</td>
<td>Adults of this age are likely to have been exposed to measles as children and be naturally immune. MMR can still be offered based on risk assessment.</td>
<td>Adults of this age are likely to have been exposed to measles as children and be naturally immune. MMR can still be offered based on risk assessment.</td>
</tr>
</tbody>
</table>
Contraindications to vaccination

Most people can receive MMR vaccination without any difficulties. However, the vaccine should not be given to some groups of patients.

The Green Book states that the following groups should not receive MMR vaccination:

- those who are immunosuppressed (see section 8.3);
- those who have had a confirmed anaphylactic reaction to a previous dose of a measles, mumps or rubella containing vaccine;
- those who have had a confirmed anaphylactic reaction to neomycin or gelatin;
- pregnant women.

The Green Book advises that all children with egg allergy may receive MMR vaccine if it is not otherwise contraindicated. Further written information about contraindications to MMR vaccination is available in the Green Book. If there is any doubt about whether a contact can safely receive MMR, further advice should be sought from either a consultant paediatrician or immunisation co-ordinator, rather than withholding vaccination.

Contacts of measles cases who are unable to receive MMR can be given human normal immunoglobulin (HNIG) or intravenous immunoglobulin (IVIG) as post-exposure prophylaxis (see section 7.3.4).

7.3.3 Vaccination campaigns

Routine MMR vaccination should continue during an outbreak. Outbreaks provide an opportunity to encourage routine vaccine uptake. Efforts should be focussed on the most vulnerable, including children, healthcare workers and young adults.

International guidelines differ in their advice about whether to carry out additional vaccination campaigns in an attempt to attenuate an outbreak. Researchers suggest that more evidence should be collected following immunisation campaigns to assess their effectiveness.

Outbreaks in closed communities such as schools, further education establishments and prisons may require targeted vaccination campaigns within the facility.

7.3.4 Immunoglobulin

Immunoglobulin provides passive protection against measles infection for those who cannot receive MMR. Human normal immunoglobulin (HNIG) is a preparation of human plasma proteins, derived from blood donations. It contains antibodies to measles virus and by administering it to individuals who have been exposed to measles the disease can be prevented or modified. All HNIG used in the UK is now prepared from plasma acquired outside of the country. This is because of a theoretical risk of transmitting vCJD from plasma products.
Subcutaneous and intramuscular infusions are not considered practical for immunosuppressed individuals and so intravenous immunoglobulin (IVIG) is the recommended product to be used for post-exposure treatment to ensure the appropriate dose is administered rapidly in these individuals.

Indications for use of HNIG or IVIG

In Scotland, the following three documents provide guidance about when to use HNIG or IVIG as post-exposure prophylaxis:

- the PHE Immunoglobulin Handbook;¹⁹
- the Green Book;¹
- the PHE Guidelines on Post-Exposure Prophylaxis for measles.¹⁵

HNIG or IVIG should be offered to susceptible contacts who have been exposed to a confirmed case of measles and who fall into one of the groups listed below:

- anyone with a contraindication to MMR vaccine;¹
- immunosuppressed adults or children;¹ (see section 8.3);
- children less than 6 months of age (see section 8.1);
- children aged 6-8 months exposed in the household setting (see section 8.1); and
- some Pregnant women²⁰ (see section 8.2).

People who are exposed to measles and who fall into one of the groups listed above should receive HNIG or IVIG as soon as possible after exposure. **HNIG or IVIG is most effective if given within 72 hours** but can be effective if given within 6 days of exposure.

To access HNIG or IVIG, contact your local hospital pharmacy department.

7.3.5 Exclusion (see Appendix 6)

Confirmed Measles

People with confirmed measles should be excluded from their usual place of work or study or from shared childcare facilities or any other shared space until at least four days after the rash has developed.³ If possible, advise case to self isolate and to avoid contact with vulnerable groups during this time.

Exposure to Measles

Consider excluding non-immune individuals exposed to measles or those with possible/probable measles before laboratory confirmation from their usual occupation, place of study or childcare facility if they attend settings where large numbers of potentially non-immune or vulnerable individuals gather (e.g healthcare facilities, prisons, schools, nurseries etc).²¹ This is important where contacts may be particularly vulnerable
to infection, are at greater risk of complications or there is a greater potential of transmission. The rationale behind exclusion is to prevent further spread of infection from exposed individuals who may be incubating measles. People who work in one of these settings and who have had significant contact with a confirmed measles case should be risk assessed (see section 7.2.2). Those who have received two doses of a measles-containing vaccine or who have a laboratory confirmed history of measles infection, should be reassured, and continue to work as normal, but nevertheless be made aware of signs and symptoms, and report any occurring, as cases have occurred among individuals who have received two doses of vaccine.

In some circumstances where non-immune individuals are very likely to have been exposed to measles (e.g. household contact, face to face contact) it may be appropriate to consider quarantine to prevent likely further transmission, invoking the Public Health Act if necessary.

When healthcare workers are exposed to suspected measles, they should be risk assessed using the algorithm in Appendix 7 (see section 7.2.2).

In a school setting, a letter to the school to identify vulnerable groups may be helpful in the first instance. MMR should be recommended to all exposed children who have not received two doses of MMR if there is no contraindication. Local risk assessment will indicate whether exclusion is recommended. Non-immune contacts should be excluded until 21 days after the appearance of rash in the last case at the school. 3, 22

7.4 Control measures in special settings

In settings where large numbers of people live and work together additional control measures should be considered. These settings include hospitals, prisons and schools.

General key infection control issues are identified in the NIPCM, available on the HPS website. 12

7.4.1 Prevention

Healthcare workers have an increased risk of being exposed to measles compared to the general population. 22, 23 Healthcare workers should be asked to provide written evidence at pre-placement health screening that they have:

- documented administration of two doses of a live measles virus vaccine; OR
- pre-existing laboratory evidence of immunity (laboratory confirmed measles or measles IgG positive). 1, 24

These recommendations are in line with the General Medical Council’s Good medical practice and the Nursing and Midwifery Council’s Code. 25, 26
Healthcare workers can be presumed immune to measles if they meet the criteria above. Demonstration of measles immunity by IgG testing is not necessary or desirable. However, if the HCW has previously had a measles IgG test and this was positive, then this will be taken as the HCW having some degree of protection if exposed to measles.

Those not meeting these criteria should receive two doses of MMR at least one month apart if there is no contraindication, prior to starting work.¹

FIGURE 5: Algorithm for the assessment of immunity to measles in HCW.
The following key points should be noted.

- Two doses of MMR does not guarantee immunity to measles, but is taken as indicative of protection.
- Laboratories in Scotland use a measles IgG titre cut-off as specified by the test manufacturers.
- If someone has had laboratory confirmed measles infection in the past, and measles IgG is no longer detectable, this is still taken as indicative of protection.
- Immunisation status of all HCW should be ascertained and assessed in case of a future exposure incident.

Year of birth may be used as a convenient predictor of immunity in some circumstances. However, particular attention may be required in certain settings, for example, within healthcare settings as work undertaken by HPS, detailed in Appendix 8 has suggested higher than expected susceptibility for those born prior to 1970, albeit in unrepresentative populations.

### 7.4.2 Risk assessment and exclusion

All individuals who are exposed to measles should be risk assessed, as described in section 7.2.2. Any non-immune individuals should be excluded as outlined in section 7.3.5 and offered appropriate post exposure prophylaxis. Management of hospitalised patients with measles should follow the local infection control policy. Normally, patients are considered infectious from five days before rash until four days after it. However, immunosuppressed individuals may remain infectious for longer periods and an individual risk assessment should be undertaken.\(^{22}\) It is important to note that measles may have an atypical presentation when immunosuppressed individuals are infected. They may not have a rash and may present with pneumonia or encephalitis.\(^{15,27}\) Atypical presentations may also occur in those who have previously been vaccinated, most likely as an attenuation of symptoms.

### Healthcare Workers

#### Exposure to a confirmed or probable case

The number of healthcare workers exposed to a confirmed or probable case of measles in Scotland should be very small and occupational health departments should hold a record of immunity to measles for all healthcare workers.

If this evidence is lacking, then MMR should be administered if within six days of exposure (preferably within three days of exposure) and assurance of immunity should be gained by urgent immunity testing for measles IgG.
If immunity testing shows presence of measles IgG within seven days of exposure, the HCW should be assumed to have some level of immunity and can return to work (as this is too early to be due to infection from the recent exposure). If immunity testing is negative, the HCW should be excluded from the workplace from day 5 following first exposure to day 21 following final exposure. If the HCW received MMR within 72 hours of exposure and is symptom-free for at least 14 days after MMR was given, they can return at that stage.

HCWs who are pregnant or immunocompromised and are themselves classed as ‘high-risk’, should be managed using the appropriate tables in Appendix 9 and Appendix 10.

**Exposure to a possible case**

No action by the HPT or OH departments is required until results of testing on the suspected case are available. If testing on suspected case is positive, proceed as for exposure to a confirmed case. If testing on suspected case is negative, no further action is required.
8. Management of high risk groups (see Appendix 9 and Appendix 10)

8.1 Protecting infants under 12 months of age

Infants under 12 months of age are too young to have routinely been offered MMR and are therefore at high risk of developing measles if they are exposed. The case-fatality ratio for measles is age-related and is high in children under one year of age.

A number of studies\(^1,2\) have shown that maternally derived antibody wanes more rapidly in infants of vaccinated mothers than in infants of naturally immune mothers; therefore, a significant proportion of those born to vaccinated mothers may not have protective titres from birth.\(^3\) Almost all expectant mothers born in the UK have now been eligible for measles-containing vaccine (introduced in 1968); vaccine coverage has exceeded 75% in all cohorts born after 1985. Measles control has also improved since the late 1980s,\(^4,5\) meaning that the opportunity for natural boosting of antibody levels\(^6\) is not present amongst younger UK born women. Therefore the use of post-exposure prophylaxis in infants now no longer depends on a range of maternal factors and is based on the age of the infant and the setting of exposure (Table 3).

If there is a particular concern with the level of protection, advice should be sought from the local HPT. Additional information is also available from the PHE Post-Exposure Prophylaxis for Measles.\(^7\)

Contact with measles

Children who have significant contact (see section 7.2.3) with an individual with confirmed measles during the infectious period from up to five days prior to, to four days after the onset of the rash should be assessed using table 3 below, and offered immunoglobulin (see section 7.3.4) or MMR. Every effort should be made to confirm the diagnosis of measles in the index case, but this may not always be possible. Local availability will determine which investigations are used to confirm the diagnosis. In the event of contact with clinically diagnosed but virologically unproven measles, further action may be warranted if the clinical diagnosis seems likely (see section 4.3).

For infants aged 6-8 months, a clinical decision to use either HNIG or MMR is required (see Table 3). HNIG is preferred where there may be particular reasons to avoid measles (such as underlying lung disease or recent severe illness) or those who are exposed in the household setting where disease may be more severe.\(^8\) Outside of the household, when ongoing exposure from further waves of infection are likely, MMR may be preferred as it should also provide longer lasting protection against subsequent exposures. This latter benefit is suggested by a study that investigated the effectiveness of a measles-containing vaccine during an outbreak, where the estimated vaccine effectiveness for infants aged 6-11 months was 73%.\(^9\)
TABLE 3: Post exposure prophylaxis in infants of UK born mothers.

<table>
<thead>
<tr>
<th>Infants</th>
<th>Household exposure</th>
<th>Exposure outside of household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants &lt;6 months</td>
<td>Assume susceptible and issue HNIG regardless of maternal status within six days of exposure</td>
<td>Assume susceptible and issue HNIG regardless of maternal status within six days of exposure</td>
</tr>
<tr>
<td>Infants aged 6-8 months</td>
<td>Offer HNIG within six days</td>
<td>Offer MMR ideally within 72 hours if not contraindicated</td>
</tr>
<tr>
<td>Infants ≥9 months</td>
<td>Offer MMR vaccine, ideally within 72 hours of exposure if not contraindicated</td>
<td>Offer MMR vaccine, ideally within 72 hours of exposure if not contraindicated</td>
</tr>
</tbody>
</table>

Following HNIG, MMR vaccination should be delayed until 3 months after administration. When MMR is given within three months of receiving blood products such as HNIG, the response to the measles component may be reduced. This is because such blood products may contain significant levels of measles specific antibody, which could then prevent vaccine virus replication.

As the pattern of maternal antibody waning in infants shows significant geographical variation and as vaccination programmes were introduced at different times, this advice may not be applicable to infants of mothers born outside the UK. In such cases an individual risk assessment is required. Information about disease incidence and immunisation rates by country is available from WHO.

Please refer to the British National Formulary for up to date information about HNIG. Additional information is also available in the PHE guidance.

8.2 Protecting pregnant women (see Appendix 9)

Measles illness during pregnancy results in a higher risk of premature labour, spontaneous abortion, and low-birth weight infants. It is not associated with congenital infection or damage. HNIG may attenuate the infection in the mother, but there is no evidence that it prevents foetal loss.

It is recommended in PHE’s Guidance on the management of, and exposure to, rash illness in pregnancy, that all pregnant women who are in contact with a non-vesicular rash illness should be risk assessed and investigated for erythrovirus B19 infection (previously parvovirus) and for rubella infection (unless there is satisfactory evidence of past rubella immunity due to vaccine or natural infection). Significant contact with a rash illness is defined as being in the same room (e.g. house, classroom or 2-4 bed hospital bay) for 15 minutes or more or any face to face contact.

A very high proportion of pregnant women will be immune and therefore HNIG is only offered to women who are likely to be susceptible based upon a combination of age,
history of measles infection or vaccination and/or measles IgG antibody screening. A table detailing how to manage non-immunosuppressed pregnant women exposed to measles is detailed in Appendix 9.

Further information about the investigation and management of rash in pregnancy is available from Guidance on the management of, and exposure to, rash illness in pregnancy. MMR vaccine is contraindicated in pregnancy.

8.3 Protecting the immunosuppressed (see Appendix 10)

Both children and adults who are immunosuppressed require a detailed epidemiological and clinical risk assessment to establish how likely it is they have been in contact with a case of measles. In a non-outbreak situation the index case should be tested for measles infection, see section 5. This may aid management of those who have been in contact with that individual.

If any immunosuppressed person (e.g. patients with leukaemia or on high dose immunosuppressants) is exposed there is a very low threshold for follow-up: even a very short exposure (minutes) should trigger investigation. In a highly immunosuppressed child who is unlikely to be immune, it may be worth considering prophylaxis where the possibility of exposure has occurred e.g. by entering a room within a short period after a case has been present.

A table detailing management of immunosuppressed contacts of probable or laboratory confirmed cases of measles is detailed in Appendix 10 and further guidance and information is available in PHE Guidelines on Post-Exposure Prophylaxis for measles.

All immunosuppressed individuals should be considered for treatment with IVIG as soon as possible after the exposure occurred (preferably within 3 days, but treatment may be effective within 6 days).

People with severe defects of cell mediated immunity who are on regular IVIG replacement therapy do not require additional IVIG if the most recent dose was administered ≤3 weeks before exposure. Such individuals should be under the management of specialists in immunology and their need for replacement immunoglobulin therapy will have already been assessed by their immunologist (in line with advice to be disseminated through the UK Primary Immunodeficiency Network – UK PIN).

All other individuals with immunosuppression who are not already on IVIG replacement therapy will require assessment at the time of an exposure. These individuals can be divided into two groups A and B depending on the degree of immunosuppression see Appendix 10 for assessing for details of Group A and B and prophylaxis.

See PHE Guidelines on Post-Exposure Prophylaxis for measles for further information on immunosuppression.
**Live vaccines contraindicated**

Live vaccines such as MMR can, in some situations, cause severe or fatal infections in immunosuppressed individuals due to extensive replication of the vaccine strain. For this reason, severely immunosuppressed individuals should not be given MMR and vaccination in immunosuppressed individuals should only be given in consultation with an appropriate specialist.\(^\text{10}\)


**8.4 Protecting unvaccinated groups**

Members of the Gypsy and Traveller community, some religious groups, migrants from other EU countries and many non-EU countries are more likely to have missed their routine doses of MMR vaccine. Communities who have previously declined vaccination may change their minds during an outbreak and they should be given the opportunity to access MMR.

In an outbreak situation, it is important to specifically target unvaccinated groups so that they can receive MMR or HNIG if indicated.

Members of the Traveller Community may have difficulty in accessing healthcare services. The Scottish Government report into Gypsies/Travellers and Care published in 2012 and the UNITING study highlight some of these issues.\(^\text{15, 16}\)
9. Communication

Detailed advice about the roles and responsibilities of an IMT during an outbreak is contained in the document ‘Management of Public Health Incidents – Guidance on Roles and Responsibilities of NHS led Incident Management Teams’.\(^1\) Health boards should use their locally developed communications plans during an outbreak or incident.

In any outbreak situation, clear communication is important. All information should be agreed by the IMT before it is sent to laboratory staff, general practitioners, occupational health, infection control staff, the public, media and key organisations involved in the management of the outbreak (e.g. schools). These key groups must be given information that will help to reinforce control measures agreed by the IMT.
10. After an outbreak

Outbreaks provide an opportunity for learning and every effort should be made to complete an outbreak report. The Scottish Government issued advice to IMTs recommending that a report should be completed at the end of each outbreak. Further information is available in the publication, ‘Management of Public Health Incidents – Guidance on the Roles and Responsibilities of NHS led Incident Management Teams’.¹
11. References

References section 1

1. SIGN 50 methodology. Available at http://www.sign.ac.uk/index.html
2. NICE guidelines manual: Available at http://www.nice.org.uk/guidelinesmanual

References in section 2


References in section 3

1. Public Health Act 2008 (Scotland), available at: http://www.scotland.gov.uk/Topics/Health/Policy/Public-Health-Act

References in section 4


References in section 5


3. Test kits are produced by MicrolImmune, for specifics see www.microimmune.co.uk


References in section 6

**References in section 7**


References in section 8


References in section 9


References in section 10

Appendix 1: Guidance review (and development) groups membership

2017 Guidance Review Group

Scottish Immunisation Programme
Members of the Scottish Immunisation Programme, as part of the Scottish Health Protection Network with representation from all Health Protection Teams (membership available on request).

Health Protection Scotland Immunisation Team
Claire Cameron, Kevin Pollock and Ross Cameron.

2013 Guidance Review Group (GRG) Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Role and affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>David Breen (Chair)</td>
<td>Consultant in Public Health Medicine (CD/EH), NHS Dumfries &amp; Galloway</td>
</tr>
<tr>
<td>Celia Aitken</td>
<td>Consultant Virologist, NHS Greater Glasgow &amp; Clyde</td>
</tr>
<tr>
<td>Esther Curnock</td>
<td>Public Health Speciality Registrar, NHS Ayrshire &amp; Arran</td>
</tr>
<tr>
<td>Lucy Denvir</td>
<td>Public Health Speciality Registrar, NHS Dumfries &amp; Galloway</td>
</tr>
<tr>
<td>Rosie Hague</td>
<td>Consultant Paediatrician, NHS Greater Glasgow &amp; Clyde</td>
</tr>
<tr>
<td>Alastair Leckie</td>
<td>Consultant in Occupational Health, OHSAS</td>
</tr>
<tr>
<td>Monica Maguire</td>
<td>Health Protection Nurse Specialist, NHS Greater Glasgow &amp; Clyde</td>
</tr>
<tr>
<td>Alison Potts</td>
<td>Epidemiologist, Health Protection Scotland</td>
</tr>
<tr>
<td>Alex Sánchez-Vivar</td>
<td>National Co-ordinator, Health Protection Network</td>
</tr>
<tr>
<td>Alison Smith-Palmer</td>
<td>Epidemiologist, Health Protection Scotland</td>
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</table>
### 2012 Technical and Editorial Group (TEG)

<table>
<thead>
<tr>
<th>Member</th>
<th>Role</th>
</tr>
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<tbody>
<tr>
<td>David Breen</td>
<td>Chair of GDG</td>
</tr>
<tr>
<td>Alison Potts</td>
<td>Guidance Coordinator</td>
</tr>
<tr>
<td>Alison Smith-Palmer</td>
<td>Guidance Coordinator</td>
</tr>
<tr>
<td>Alex Sánchez-Vivar</td>
<td>National Coordinator, Health Protection Network</td>
</tr>
<tr>
<td>Josephine Pravinkumar</td>
<td>(standing in for David Breen)</td>
</tr>
</tbody>
</table>

### 2010 Guidance Development Group (GDG) Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Title and affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>David Breen</td>
<td>Consultant in Public Health Medicine (CD/EH), NHS Dumfries &amp; Galloway</td>
</tr>
<tr>
<td>Trevor Gibbs</td>
<td>RCGP Scotland Deputy Chair (Policy)</td>
</tr>
<tr>
<td>David Haldane</td>
<td>Consultant in Occupational Health, NHS Greater Glasgow &amp; Clyde</td>
</tr>
<tr>
<td>Pamela Joannidis</td>
<td>Lead Nurse Infection Control, NHS Greater Glasgow &amp; Clyde</td>
</tr>
<tr>
<td>Monica Maguire</td>
<td>Health Protection Nurse Specialist, NHS Greater Glasgow &amp; Clyde</td>
</tr>
<tr>
<td>Katy Sinka</td>
<td>Epidemiologist, Health Protection Scotland</td>
</tr>
<tr>
<td>Joy Tomlinson</td>
<td>Consultant in Public Health Medicine, NHS Ayrshire &amp; Arran</td>
</tr>
<tr>
<td>Lorna Willocks</td>
<td>Consultant in Public Health Medicine (CD/EH), NHS Lothian</td>
</tr>
<tr>
<td>David Yirrell</td>
<td>Consultant Clinical Scientist, NHS Tayside</td>
</tr>
</tbody>
</table>
Appendix 2: Clinical course of typical measles infection

The diagram below is to aid in the interpretation of the infectious period of measles cases.

**Exposure to rash onset (10-21 days)**
Incubation period is typically between 7 and 18 days to onset of fever
Measles rash typically develops 14 days after exposure

Probable infectious period (10 days)

Five days before | Four days after
--- | ---
-14 | 0
-13 | 1
-12 | 2
-11 | 3
-10 | 4
-9 | -5
-8 | -4
-7 | -3
-6 | -2
-5 | -1
-4 | 0
-3 | 1
-2 | 2
-1 | 3
0 | 4

**RASH**
Appendix 3: Measles testing timings

This figure summarises which tests are most appropriate to use at different stages of measles illness.

Source: PHE. Reproduced with permission.

Solid line indicates detectable during the period indicated.

Dashed line indicates may be detectable during the period indicated, but this is not reliable.
Appendix 4: Interpretation of measles test results

Algorithm for interpretation of measles test results. PCR testing on throat swabs is the preferred method for rapid diagnosis of measles in Scotland.

**Suspected measles case**

- **Virus detection**
  - a) Throat swab in VTM or lysis buffer
  - b) Urine sample (optional)

- **PCR for measles**
  - Positive
  - Repeat sample if measles still suspected
  - Oral fluid testing for IgM and IgG
  - Confirmed measles case. Laboratory to send sample to PHE Colindale for typing
  - Negative

- **Antibody detection***
  - Oral fluid or blood sample
  - Test for IgM
    - Positive
    - No evidence recent measles
    - Exclude other causes (Erythrovirus B19, rubella)
    - Confirmed measles case. Laboratory to send sample to PHE Colindale for typing
  - Negative
  - Repeat sample

* IgG seroconversion is an alternative, but 2nd sample should be taken 10 – 14 days later. Oral fluid samples are taken with special kits held by the local HPT and should be returned directly to PHE Colindale for testing.
Appendix 5: Warn and Inform letter template for aircraft passengers

Warn and inform letter template. Ensure that the letter is sent out on appropriately headed paper, or if by email or text, ensure that the provenance is clear.


Dear Sir/Madam,

Passenger with measles on [name of airline] flight [flight number]

We have been informed that a person on [name of airline] flight [flight number] from [departure airport] to [arrival airport] on [date of flight] has been diagnosed as a [confirmed/probable] case of measles. Our records show that you were a passenger/crew member on this flight.

Why are we contacting you?
Health Protection Scotland is informing passengers who may have been exposed to help reduce the risk of spreading infection and help protect those at greatest risk of serious illness.

What is measles?
Measles is a disease which spreads very easily. The symptoms of measles are a cough, runny nose, conjunctivitis, rash and fever. Measles can be serious, particularly for people whose immune system is not working normally.

What is the risk of catching measles?
Most older children and adults are immune to measles – either because they had measles as a child or because they have been vaccinated with two MMR vaccines– and so are very unlikely to catch measles.

You should contact your doctor straight away if you have weakened immunity (due to illness or medication). If you are not immune and the exposure was within the past few days, your doctor may be able to organise treatment to prevent you becoming seriously ill.

If you are pregnant and not sure of your immunity or if you were travelling with a baby under six months of age, you should seek your doctor’s advice.

If you become unwell and think it could be measles within three weeks of the flight, you should see a doctor. You should ring the doctor or clinic beforehand so they can make sure you do not pass the disease to others in the waiting room.

Tell your doctor that you have been on the same flight as someone with measles and show them this letter if possible. Your doctor should seek advice from the local Health Protection Team.

If you are well and not in the groups listed above you do not need to take action. If you would like more information on measles visit https://www.nhsinform.scot/illnesses-and-conditions/infections-and-poisoning/measles.

Vaccination with two doses of MMR is the best protection against measles and if you have not been vaccinated against measles, or are unsure, you are advised to discuss this with your own GP. If you do have further questions, please get in touch with your GP or, if out of hours, call the NHS non-emergency number on 111.

Yours Sincerely,

[Title] [first name, surname], [Job title]

[Organisation]
Appendix 6: Algorithm for the management of measles contacts in special or high-risk settings

Special or high risk settings include healthcare facilities, prisons and schools, and other settings where potentially large numbers of non-immune or immunosuppressed individuals gather. If contact is immunosuppressed, refer to Appendix 10. If contact is a healthcare worker, refer to Appendix 7.

Contact with confirmed, probable or likely case of measles

Risk assessment
Has there been more than 15 minutes contact or direct contact (e.g. face to face) during the infectious period 5 days before and 4 days after rash onset?

Yes

No

Evidence of immunity?
Previously received two doses of measles containing vaccine or written evidence of previous infection

Yes

Fit for work/attendance
Advise contact of signs and symptoms

Is IgG testing appropriate or desirable?

No

No

Yes

Check measles antibodies (IgG)
Exclude from day five of first exposure until result known

Positive

Negative

Exclude from day 5 after first exposure to day 21 after last exposure.

Provide post-exposure prophylaxis: MMR for immunocompetent, non-pregnant adults ideally within 72 hours of exposure. MMR should still be considered after 72 hours to provide protection for future potential measles exposures.

If given MMR within 72 hours of exposure, can return to work earlier than 21 days if symptom-free for at least 14 days post-MMR.
Appendix 7: Algorithm for management of healthcare workers with contact to a laboratory confirmed or probable measles case.

HCW contact with laboratory confirmed, probable or likely measles case (not pregnant or immunocompromised*)

Yes

Two documented doses of MMR?

Yes

Fit for work
Keep under clinical review for 21 days post exposure

No

No

Pre-existing laboratory evidence of immunity

No

Yes

IgG Positive

IgG Negative

Exclude from day 5 after first exposure to day 21 after last exposure.

If given MMR within 72 hours of exposure, can return to work earlier than 21 days if symptom-free for at least 14 days post MMR.

Provide post-exposure prophylaxis 1xMMR for immunocompetent, non-pregnant adults, ideally within 72 hours of exposure and follow up with second MMR after one month.

AND

Urgent measles IgG testing - exclude from day 5 after first exposure until test result known.

*If contact is immunosuppressed, refer to Appendix 10.
Appendix 8: Estimated measles susceptibility by year of birth

This work took available measles IgG test results from laboratories across Scotland and calculated percentage testing negative for measles IgG in different birth cohorts.

The work undertaken in this analysis suggests that a significant proportion of the adult population in Scotland is still susceptible to measles. Our analysis suggests that this could be more than 25% susceptible for those born after 1980; 17-20% susceptible for those born 1970-80; 5-10% susceptible for those born 1960-70; but very low susceptibility for those born before 1960 (see table, below).

This data was based on test results from almost 5000 individuals in 2011-2014 for those who submitted a serology sample for measles IgG testing. This is unlikely to be a representative population and over-represent:

- healthcare workers and those involved in measles exposure incidents;
- healthcare workers who have requested measles IgG testing in place of vaccination;
- members of the general population who are immunocompromised and have been hospitalised and/or have been exposed to a case of measles.

Whilst this population is far from ideal, it does provide evidence to suggest that the proportion of adults born before 1970 who test negative for measles IgG is higher than expected. Therefore, year of birth may not be an effective predictor of immunity.

<table>
<thead>
<tr>
<th>Year of birth</th>
<th>Number testing negative for measles IgG</th>
<th>Number testing positive for measles IgG</th>
<th>Total number tested</th>
<th>Percentage testing negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950-1954</td>
<td>0</td>
<td>120</td>
<td>120</td>
<td>0.0%</td>
</tr>
<tr>
<td>1955-1959</td>
<td>5</td>
<td>261</td>
<td>266</td>
<td>1.9%</td>
</tr>
<tr>
<td>1960-1964</td>
<td>28</td>
<td>450</td>
<td>478</td>
<td>5.9%</td>
</tr>
<tr>
<td>1965-1969</td>
<td>52</td>
<td>453</td>
<td>505</td>
<td>10.3%</td>
</tr>
<tr>
<td>1970-1974</td>
<td>116</td>
<td>564</td>
<td>680</td>
<td>17.1%</td>
</tr>
<tr>
<td>1975-1979</td>
<td>134</td>
<td>534</td>
<td>668</td>
<td>20.1%</td>
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<tr>
<td>1980-1984</td>
<td>194</td>
<td>497</td>
<td>691</td>
<td>28.1%</td>
</tr>
<tr>
<td>1985-1989</td>
<td>284</td>
<td>458</td>
<td>742</td>
<td>38.3%</td>
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<tr>
<td>1990-1994</td>
<td>323</td>
<td>443</td>
<td>766</td>
<td>42.2%</td>
</tr>
<tr>
<td>Total</td>
<td>1136</td>
<td>3780</td>
<td>4916</td>
<td>-</td>
</tr>
</tbody>
</table>
### Appendix 9: Table for management of pregnant measles contacts

Table for management of pregnant measles contacts.

<table>
<thead>
<tr>
<th>Pregnant women</th>
<th>Measles infection/vaccination history</th>
<th>Action to take</th>
</tr>
</thead>
<tbody>
<tr>
<td>Born before 1990</td>
<td>History of measles infection</td>
<td>Assume immune</td>
</tr>
<tr>
<td></td>
<td>No history of measles infection</td>
<td>Test and administer HNIG within six days only if measles antibody negative</td>
</tr>
<tr>
<td></td>
<td>Two measles vaccines</td>
<td>Assume immune</td>
</tr>
<tr>
<td>Born 1990 or later</td>
<td>Two measles vaccines</td>
<td>Assume immune</td>
</tr>
<tr>
<td></td>
<td>One measles vaccine</td>
<td>Test and administer HNIG within six days only if measles antibody negative</td>
</tr>
<tr>
<td></td>
<td>Unvaccinated</td>
<td>Test and administer HNIG if measles antibody negative. If not possible to test within six days of exposure, offer HNIG.</td>
</tr>
</tbody>
</table>

Source: PHE. Reproduced with permission.
Appendix 10: Tables for assessment and management of immunosuppressed measles contacts

Tables for assessment and management of immunosuppressed measles contacts of probable or virologically confirmed case of measles.

TABLE ia: Classification of immunosuppression: Group A - individuals who should develop and maintain adequate antibody from past exposure or vaccination. (See table ii for assessing the evidence of protection in immunosuppressed contacts of measles cases once classification is established.)

<table>
<thead>
<tr>
<th>Group A</th>
<th>Description of classification</th>
</tr>
</thead>
</table>
| Manage on basis of evidence of protection at any time (prior to or since the diagnosis or treatment end) | • Patients receiving or within six months of completing immunosuppressive chemotherapy or radiotherapy for malignant disease, (other than those with ALL, a lymphoproliferative disorder or who have had HSCT)  
• Patients receiving systemic high-dose steroids, or who have received high dose steroids in the past three months. This would include:  
  • Children who receive prednisolone, orally or rectally, at a daily dose (or its equivalent) of 2mg/kg/day for at least one week, or 1mg/kg/day for one month.  
  • Adults who receive short term high-dose corticosteroids (>40mg prednisolone per day or equivalent for more than 1 week)  
  • Adults who receive short long term lower dose corticosteroids (>20mg prednisolone per day or equivalent for more than 14 days)  
• Patients receiving high doses of non-biological oral immune modulating or other types of immunosuppressive drugs (alone or in combination with steroids) or who have received such therapy in the past three months. This would include  
  • Adults who receive >25mg per week  
  • Adults who receive azathioprine >3.0mg/kg/day or  
  • Adults who receive 6-mercaptopurine >1.5mg/kg/day  
  • Adults on cyclosporin, cyclophosphamide, leflunomide AND children (<16years) who receive any dose of the above drugs  
  • Patients with human immunodeficiency virus (HIV) infection with a CD4 count <200 cells/μl (but without a diagnosis of AIDS) if >5 years of age or <500 cells/μl if 5 years or less |

Source: PHE. Reproduced with permission.
TABLE ib: Classification of immunosuppression: Group B – individuals who lose or may not maintain adequate antibody levels from past exposure or vaccination. See table ii for assessing the evidence of protection in immunosuppressed contacts of measles cases once classification is established.

<table>
<thead>
<tr>
<th>Group B</th>
<th>Description of classification</th>
</tr>
</thead>
</table>
| B (i): Manage on basis of IgG obtained at the time of exposure (or since the diagnosis or treatment end) | • Patients on or after completion of immunosuppressive chemotherapy for acute lymphoblastic leukaemia (ALL)  
• Patients with lymphoproliferative disorders (including haematological malignancies such as indolent lymphoma, leukaemia and plasma cell lymphoma).  
• Patients who have received a solid organ transplant  
• Patients more than 12 months after receiving a haematopoietic stem cell transplant (HSCT)  
• Patients receiving or within six months of completing biological therapies (alone or in combination with steroids). These include:  
  • monoclonal antibodies e.g. alemtuzumab, ofatumumab and rituximab  
  • cytokine inhibitors e.g. etanercept  
• Patients with a diagnosis of acquired immunodeficiency syndrome (AIDS) |
| B (ii): Offer PEP regardless of status | • Patients who have received a haematopoietic stem cell transplant (HSCT) within the past 12 months  
• Patients with severe primary immunodeficiency* |

* this group may already be on long term IVIG replacement, which should provide equivalent protection to post exposure immunoglobulin.

Source: PHE. Reproduced with permission.
TABLE iia: Assessing evidence of protection in immunosuppressed contacts of measles: Group A- individuals who should develop and maintain adequate antibody from past exposure or vaccination.
(See table i for determining classification of immunosuppression.)

<table>
<thead>
<tr>
<th>Group A</th>
<th>Measles infection/ vaccination history</th>
<th>Action to take</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ages</td>
<td>Previous measles IgG positive</td>
<td>Assume immune- do not give IVIG</td>
</tr>
<tr>
<td>Born before 1970</td>
<td>Positive history of measles infection</td>
<td>Assume immune- do not give IVIG</td>
</tr>
<tr>
<td></td>
<td>No history of measles infection</td>
<td>Rapid IgG test and issue if negative or equivocal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If not possible to test within six days of exposure, assume immune - do not give IVIG</td>
</tr>
<tr>
<td>Born between 1970</td>
<td>Positive history of measles infection or vaccination</td>
<td>Rapid IgG test and give IVIG if negative or equivocal</td>
</tr>
<tr>
<td>and 1990</td>
<td></td>
<td>If not possible to test within six days of exposure, assume immune - do not give IVIG</td>
</tr>
<tr>
<td></td>
<td>No history of measles infection or vaccination</td>
<td>Rapid IgG test and issue if negative or equivocal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If not possible to test within six days of exposure, give IVIG</td>
</tr>
<tr>
<td>Born after 1990</td>
<td>History of two measles containing vaccines</td>
<td>Rapid IgG test and issue if negative or equivocal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If not possible to test within six days of exposure, assume immune - do not give IVIG</td>
</tr>
<tr>
<td></td>
<td>History of one measles containing vaccine</td>
<td>Rapid IgG test and issue if negative or equivocal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If not possible to test within six days of exposure, give IVIG</td>
</tr>
<tr>
<td></td>
<td>Unvaccinated</td>
<td>Give IVIG</td>
</tr>
</tbody>
</table>

Source: PHE. Reproduced with permission.
TABLE iiB: Assessing evidence of protection in immunosuppressed contacts of measles: Group B – individuals who lose or may not maintain adequate antibody levels from past exposure or vaccination. (See table i for determining classification of immunosuppression.)

<table>
<thead>
<tr>
<th>Group B</th>
<th>Measles infection/ vaccination history</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group B (i)</td>
<td>Measles IgG positive since diagnosis or treatment completed</td>
<td>Assume immune - do not issue</td>
</tr>
<tr>
<td></td>
<td>No documentation or negative IgG since treatment or diagnosis</td>
<td>Rapid IgG test and give IVIG if negative or equivocal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If not possible to test within three days of exposure, give IVIG</td>
</tr>
<tr>
<td>Group B (ii)</td>
<td>Offer IVIG regardless of status</td>
<td>Offer IVIG regardless of status</td>
</tr>
</tbody>
</table>

Source: PHE. Reproduced with permission.
Appendix 11: List of those consulted

<table>
<thead>
<tr>
<th>Groups consulted- 2017 Review</th>
<th>Profession</th>
</tr>
</thead>
<tbody>
<tr>
<td>Members of the Scottish Immunisation Programme</td>
<td>Public Health (including Consultants in Public Health Medicine and Health Protection Nurses)</td>
</tr>
<tr>
<td>Health Protection Teams</td>
<td>Public Health</td>
</tr>
<tr>
<td>Scottish Microbiology and Virology Network (consulted on virological section)</td>
<td>Microbiologists, virologists and others</td>
</tr>
<tr>
<td>Infection Control (Health Protection Scotland and NHS Boards with experience in measles control)</td>
<td>Public Health, Infection Control</td>
</tr>
</tbody>
</table>