The following infection control definitions and guidelines are derived from documents and guidelines produced by the Health Protection Agency in the UK, the Centers for Disease Control and Prevention in the USA, the American Academy of Paediatrics and recent documents issued by the Auckland Regional Public Health Service. For up to date information on the number of cases of Measles in the Auckland area see the website of the Auckland Regional Public Health Service (www.arphs.govt.nz.)

**Mode of transmission**
- The measles virus is most commonly acquired by inhaling microscopic droplets that contain viral particles (“airborne” transmission).
- Less frequently, Measles is acquired by direct contact with body fluids (e.g. nasal, throat secretions) of infected patients.

**Exposure**
Exposed persons are defined as those who enter the same room or work-space as a person who has Measles infection or who enter the room or work-space within two hours of the infected person leaving (the “two hour” rule does not apply to negative pressure rooms).

This definition does not apply in either of the following circumstances:
- The person with Measles is no longer infectious (> 4 days after onset of rash - see “period of infectivity”)
- The exposed individual was wearing appropriate personal protective equipment (i.e. N-95 mask, plus gown and gloves if handling body fluids)

**Non-immune persons**
- Persons born after 1969 who do not have documentation of having received two previous doses of MMR or previous Measles infection
- Severely immunocompromised patients irrespective of vaccination history or previous Measles infection
- Premature infants <28 weeks gestation

**High risk patients**
Persons at high risk of developing Measles complications:
- Pregnant women
- Infants
- Immunocompromised patients of all ages
**Incubation time**
- Typically there are 8-12 days between exposure and onset of symptoms (ie first prodromal symptoms such as fever, coryza, conjunctivitis and cough).
- The time between exposure and onset of symptoms can vary from 7-18 days.
- The average interval between exposure and rash is 14 days.

**Period of infectivity**
- Patients are infectious from 5 days prior to onset of rash until 4 days after onset of rash (approximately 9 days).
- Immunocompromised patients may be infectious for the entire duration of the illness.

**Clinical Case definition**
1. Fever $\geq$ 38°C
2. Maculopapular rash (starts behind ears and neck – pink macules that become faintly palpable)
3. And one or more of the following
   - Cough
   - Coryza
   - Conjunctivitis
   - Koplik’s spots on buccal mucosa

**Laboratory confirmed Measles infection**
Laboratory confirmation of Measles infection requires either Measles virus detection by PCR or detection of Measles IgM by serological testing
- **PCR**
  - This test is most useful in the first few days of illness when serology may be negative (When requesting Measles PCR, the duration of illness / rash must be included on the request form).
  - The test is also useful as a test for Measles infection in severely immunocompromised patients where antibody response is unreliable (Clinical details must be included on the request form)
  - Nasopharyngeal swabs or throat swabs are the preferred specimens for measles PCR
  - Standard viral swabs should be used (flock swabs, broken off into viral transport medium)
- **Serology**
  - Requests for Measles IgM are tested for both IgM and IgG
  - IgM confirms acute Measles (IgM remains positive for up to 30-60 days).
  - If the patient is IgG positive and IgM negative, acute Measles is unlikely
  - If IgM is negative but clinical suspicion of Measles remains high, do PCR if circumstances warrant and/or repeat serology 7 days after the onset of rash.
  - Measles serology is performed once daily Monday –Friday at LabPlus. Ring Paul Austin on extension 6108 (or 021 243 9019) to discuss if there is a particular emergency that may require Measles serology after hours
  - If Measles immune status needs to be determined (for example, in the setting of contact tracing), samples will be tested for measles IgG. A positive result in this setting implies immunity.
Infection Control Measures

1. Managing patients with Measles
   Patients with laboratory confirmed Measles and patients meeting the clinical case definition for Measles should be managed with Airborne Precautions during the “period of infectivity” (see above). If the patient is immunocompromised (including pregnant women), Airborne Precautions should continue for the entire duration of illness.
   - **Airborne infection isolation room (negative pressure room)**
   - Fitted N-95 masks should be worn by all non-immune healthcare workers and visitors who enter the room
   - Single use gown and gloves should be worn by staff if there is a possibility of contact with body fluids and secretions
   - Until placed in a negative pressure room, the patient should wear a surgical mask
   - Healthcare workers and visitors without evidence of immunity (ie. born after 1969, without documentation of adequate vaccination or physician diagnosed measles) should not be permitted to enter the rooms of patients with Measles
   - If a negative pressure room is temporarily unavailable, the patient should be managed in a single room with the door closed.
     - The patient should wear a surgical mask.
     - The room should not be used for at least 2 hours after being vacated by the infectious patient and should be cleaned prior to being reoccupied.
     - Single use gown and gloves should be worn by staff if there is a possibility of contact with body fluids and secretions

2. Managing Staff
   - The immune status of all staff (clinical and nonclinical) in a work area should be determined prior to exposure
     - All staff born during or before 1969 are considered immune
     - All staff born after 1969 are considered immune if they have documentation of having received two doses of MMR, have had laboratory confirmed measles or documented laboratory evidence of immunity
     - All clinical staff will have had pre-employment screening for immunity to measles and if they are not aware of their status they should check with Occupational Health
     - If after checking with Occupational Health, immune status is still uncertain, staff should submit a blood sample to the virology lab (use plain tube) to determine immune status

   - All non-immune staff should be vaccinated with MMR unless contra-indicated (eg pregnancy)
   - If a patient with measles is admitted to a unit then all non-immune staff should be redeployed to other work areas until they have documented evidence of having received at least one dose of MMR vaccine
   - Exposed staff should be offered post-exposure prophylaxis as appropriate (see below)
   - Exposed non-immune staff should be relieved of direct patient contact from day 5 to day 21 post exposure regardless of whether they have received vaccination or immunoglobulin
3. Managing non-immune exposed patients
   - Non-immune exposed patients should be managed with Airborne Precautions until 21 days post exposure or 4 days after development of rash regardless of whether they have received vaccination or immunoglobulin
   - Immunocompromised patients who have been exposed should be managed with Airborne Precautions until 21 days post exposure or for the duration of illness regardless of whether the patient received immunoglobulin

**Post-exposure prophylaxis**
See Appendix 1 for guidelines around dosing of Human Normal Immunoglobulin (HNIG) and intravenous immunoglobulin (IVIG) and Appendix 2 for flow chart summary of approach to post-exposure prophylaxis)

1. Immunocompetent patients and staff
   - Non-immune, immunocompetent, non-pregnant adults should be offered MMR irrespective of time since exposure
   - Non-immune immunocompetent children >1 year should be offered MMR irrespective of time since exposure
     - The second dose should be given one month after the first

2. Immunocompromised patients (see Appendix 3)
   - Measles immune status of “Group A” immunocompromised inpatients (see Appendix 3 for definition) should be determined prior to exposure
   - Non-immune immunocompromised patients >12 months of age should be considered for use of immunoglobulin if within 6 days of exposure.
     - Discuss with the clinical team caring for that patient
   - Patients with severe defects of cell-mediated immunity >12 months of age should be considered for use of immunoglobulin if within 6 days of exposure irrespective of whether IgG can be detected

3. Pregnant patients / staff
   - The Measles immune status of pregnant patients should ideally be determined prior to admission to hospital
   - Non-immune pregnant patients or staff should be considered for use of immunoglobulin if within 6 days of exposure.
     - Discuss with the clinical team caring for that patient
   - Pregnant patients or pregnant staff who have had at least one previous dose of MMR do not require immunoglobulin

4. Infants
   - Exposed infants 6-12 months of age
     - If immunocompromised discuss use of immunoglobulin with the clinical team caring for that patient if within 6 days of exposure
     - If immunocompetent offer MMR if within 72 hours of exposure. Alternatively, if within 6 days of exposure, discuss use of immunoglobulin with the clinical team caring for that patient
   - Exposed infants <6 months of age
     - If the Mother is non-immune and exposure occurred less than 6 days earlier, discuss use of immunoglobulin with the team caring for that patient
     - Premature infants <28 weeks gestation should be considered non-immune irrespective of maternal immune status.
Appendix 1:

NHIG dosing for Measles post-exposure prophylaxis

According to the New Zealand Blood Service, the level of measles-specific antibody in NHIG is lower than recommended (between 14-16 IU/ml). This is lower than the concentration recommended by the British Pharmacopoeia (50IU/ml). The current MedSafe-approved datasheet for NHIG recommends a dose of 0.2mL/kg for measles post exposure prophylaxis. However, because of the low concentrations of Measles-specific antibody in NHIG at the present time, new doses of NHIG are recommended below. These doses are likely to be amended following further testing of the level of measles-specific antibody in NHIG.

The new recommended doses of NHIG are:
- a) Immunocompetent infants (under 12 months) should receive 0.6mL/kg with a maximum volume of 5mL
- b) Pregnant women, immunocompromised adults and immune compromised or deficient children should receive 0.6mL/kg with a maximum dose of 15mL (recommended in three 5 mL injections).

IVIG Dosing for Measles post-exposure prophylaxis

IVIG (Intragam®P) can be considered for immune suppressed measles contacts (who may for example have a central venous catheter) or in patients who require large doses.

The recommended dose of intravenous immunoglobulin is 0.15g/Kg.

See the revised guidance from the Health Protection Agency for further information: [http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1238565307587](http://www.hpa.org.uk/web/HPAwebFile/HPAweb_C/1238565307587)

If there are further queries can be directed to the New Zealand Blood Service medical team via the district health board blood bank.
Appendix 2.

NOTE – If patient is immunocompromised, refer also to Appendix 3.

Management of CONTACTS of Measles

- Is the contact over 12 months of age?
  - Yes: Were they born before 1980? Yes: NO FURTHER ACTION
  - No: Are they pregnant or immune suppressed? Yes: NO FURTHER ACTION
  - No: Have they had 2 doses of MMR or had measles documented? Yes: NO FURTHER ACTION
  - No: OFFER MMR², whether or not it is within 72hrs of exposure

- If pregnant and had at least one MMR: NO FURTHER ACTION.
  - If pregnant and have never had an MMR or if immune suppressed, and if it is still within six days of exposure, DISCUSS USE OF IG WITH PHYSICIAN or PAEDIATRICIAN²

- If the contact between 6-12 months of age?
  - Yes: Is the infant immune suppressed? No: If within 72hrs of exposure OFFER MMR² or If between 3 and 5 days of exposure DISCUSS USE OF IG WITH PAEDIATRICIAN²
  - No: If within 6 days of exposure DISCUSS USE OF IG WITH PAEDIATRICIAN²

- Is the contact under 6 months of age?
  - Yes: Has the mother previously had (doctor diagnosed) measles or 2 MMR immunizations? No: If within six days of exposure DISCUSS USE OF IG WITH PAEDIATRICIAN²
  - Yes: NO FURTHER ACTION

Notes:
- MMR = Measles, mumps and rubella vaccination
- IG = immunoglobulin
- IG is a blood derived product and parental consent is required for immunoglobulin to be given. Consent forms are available from the Ministry of Health and Transfusion Medicine (Blood Bank). GPs should have their own supply of the form.
- If this is to be the first MMR, give the second after one month.
- Subsequently requires follow up to review when it may be appropriate to give MMR for long term measles immunity.
- The contact should subsequently have two MMR doses when over 12 months of age.
Appendix 3.

Immunocompromised patients
The following is adapted from 1 UK guidelines updated May 2009 – full reference available at http://www.hpa.org.uk/web/HPAwebFILE/HPAweb_C/1238565307587

All immunocompromised patients are at risk of severe measles and should be considered for post-exposure prophylaxis with NHIG or IVIG following exposure to measles. However some patients with immunosuppression will have immunity due to past infection or vaccination and measurable levels of measles-specific serum IgG. For patients with severe defects of cell mediated immunity passive immunoglobulin may be indicated even in the presence of measurable antibody.

**Group A**: These patients may have developed an adequate response to vaccination or measles during childhood therefore their measles status needs to be established prior to exposure (for example at the next out-patient appointment) so that post-exposure prophylaxis can be informed.

This group includes most patients with immunosuppression and is listed below:

- Adults with malignant disease until at least 6 months after completion of immunosuppressive chemotherapy and radiotherapy (unless part of group B)
- Adult patients who have received a solid organ transplant and are currently on immunosuppressive treatment
- Patients receiving systemic high-dose steroids, until at least three months after treatment has stopped (for example children on prednisone at a daily dose of 2mg/kg/day for at least one week, or 1mg/kg/day for one month and adults on 40mg of prednisone for >1 week).
- Adult patients with immunosuppression due to HIV without a diagnosis of AIDS
- Patients receiving other types of immunosuppressive drugs (e.g. azathioprine, cyclosporin, methotrexate, cyclophosphamide, leflunomide, anti-TNF alpha and the newer cytokine inhibitors) alone or in combination with steroids, until at least six months after terminating such treatment.

For those with unknown status at the time of exposure, management is on the basis of vaccine history and where possible, rapid antibody testing. If measles IgG is negative or unknown Group A should receive immunoprophylaxis with NHIG or IVIG as outlined earlier.

**Group B**: This group includes patients who are unlikely to have developed or to maintain adequate antibody levels from past exposure or vaccination. This group would include:

- Children with malignant disease until at least 6 months after completion of immunosuppressive chemotherapy or total body irradiation
- Patients on treatment for ALL until at least six months after completion of immunosuppressive chemotherapy
- Patients with severe primary immunodeficiency
- Patients who have received a bone marrow transplant until at least 12 months after finishing all immunosuppressive treatment, or longer where the patient has developed graft-versus-host disease
- Adult patients with AIDS and children with HIV or AIDS

It is recommended that, unless already on replacement immunoglobulin therapy, Group B patients should receive immunoglobulin
Appendix 4.

Use of vitamin A in children with acute measles infection

The World Health Organization currently recommends vitamin A for all children with acute measles, regardless of their country of residence. Vitamin A for treatment of measles is administered once daily for 2 days at the following doses:

- 200 000 IU for children ≥ 12 months of age
- 100 000 IU for infants 6-11 months of age
- 50 000 IU for infants younger than 6 months of age

All hospitalised children with measles should be given Vitamin A and available formulations require Paediatric Pharmacy input.