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1.0 AUTHORITY

The authority for the control of communicable diseases through case and contact management exists under the BC Public Health Act (2008) . This is further detailed in Section 1.0 Preamble to BC Communicable Disease Control Manual, Introduction, Communicable Disease Control Manual.

2.0 GOAL

The goal of the measles control program is to maintain the elimination of indigenous measles in B.C. and prevent transmission from imported cases.

The objectives of this guideline are:

- Promoting rapid reporting of all suspected and confirmed measles cases.
- Conducting enhanced surveillance for measles.
- Providing contact follow-up for all cases of measles and immunoprophylaxis when indicated.
- Instituting prompt outbreak control measures.

2.1 Target immunization coverage

The Pan American Health Organization (PAHO) defines measles elimination as the lack of a circulating endemic genotype for at least one year, and member nations are:

- To achieve and maintain 95% coverage of one dose of measles-containing vaccine, with an opportunity for a second dose.

The Canadian national target is:

- To achieve and maintain the national target of 99% two dose coverage with a measles-containing vaccine at school entry.

3.0 DEFINITIONS

Mode of transmission: airborne by aerosol and droplet spread, direct contact with nasal or throat secretions of infected persons; less commonly by articles freshly soiled with nose and throat secretions.
Incubation period: average is 8 – 12 days with a range of 7 – 18 days, rarely may be as long as 21 days.
Period of communicability: from 1 – 2 days before the beginning of the prodromal period (usually about 4 days before rash onset) to 4 days after rash appearance in a healthy person and for the duration of measles illness in an immunocompromised person.

4.0 MEASLES FLOW CHART

The flow chart describes actions to be taken by Public Health when notified of a case of measles. A sporadic case of measles requires urgent follow-up.

Case Identification

Receive notification of suspect, clinical/probable, or confirmed case of measles.
Confirm the diagnosis and obtain history from the case. See Section 5.1.
Ensure specimens from a probable or suspect case are tested by both serology (both acute and convalescent sera should be collected) and virus detection.
Inform the medical health officer (MHO).

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Case Management

Obtain history of the case. Determine period of communicability and places and dates of likely acquisition and transmission. See Section 6.3. Case must be excluded from work, school, or other public settings for 4 days after rash onset.

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Contact Management

Identify contacts. See Section 7.1.
Assess susceptibility to measles. See Section 7.3.

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For SUSCEPTIBLE Contacts (see Section 7.4)

≤ 3 days since exposure	4-6 days since exposure	≥ 7 days since exposure
Offer **MMR** to contacts that do not have a contraindication to MMR vaccine. Offer **Ig** to contacts with a contraindication to MMR vaccine.	Offer **Ig** to contacts: who never received live measles vaccine. who have a contraindication to MMR vaccine. Offer **MMR** to contacts: ≥ 12 months of age who are known or likely to have received one dose of live measles vaccine ≥ 4 weeks earlier.	Offer **MMR** to contacts: ≥ 12 months of age that have received zero or one dose of live measles vaccine ≥ 4 weeks earlier and do not have a contraindication to MMR vaccine.

↓

Exclusion of contacts

Susceptible exposed HCW: MHO will conduct a risk assessment to determine whether HCW may return to work. Consider excluding the HCW from any work in the health care setting from 5 days after the first exposure to 21 days after the last exposure regardless of whether the HCW received measles vaccine or immune globulin after the exposure. See Section 7.5.1.

School, child care, and post secondary institutions: at the discretion of the MHO, susceptible contacts who refuse or cannot receive immunoprophylaxis may be excluded. Exclusions should occur for the period from 5 days after the first exposure to 21 days after the last exposure. Susceptible contacts who receive post-exposure prophylaxis may attend in these settings. See Section 7.5.2.

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Reporting

Report confirmed cases of measles within 24 hours of receipt of report. Fax a preliminary Case Report Form for Measles, Mumps, and Rubella Enhanced Surveillance to Immunization Programs and Vaccine Preventable Diseases Service, BCCDC, and an updated/ final as soon as possible. See Section 8.0.

5.0 CASE IDENTIFICATION

5.1 Confirm the Diagnosis

Investigate all confirmed, probable, and suspect cases of measles within 24 hours and complete the individual case report in iPHIS (Integrated Public Health Information System)/ Panorama or PARIS. Public health action, including contact management, may commence at any level of the case definition, including for a suspect case.

Inform the local Medical Health Officer and initiate control measures immediately.

All categories of the surveillance case definition below are reportable.

Case status	Criteria
Confirmed case	Laboratory confirmed: Laboratory confirmation of infection in the absence of recent immunization with measles-containing vaccine: isolation of measles virus from an appropriate clinical specimen; **or** • detection of measles virus RNA; **or** • seroconversion or a significant (e.g. fourfold or greater) rise in measles IgG titre by any standard serologic assay between acute and convalescent sera; **or** • positive serologic test for measles IgM antibody using a recommended assay in a person who is either epidemiologically linked to a laboratory-confirmed case or has recently travelled to an area of known measles activity. Epidemiologically-linked: • Clinical illness (fever≥ 38.3ºC and cough, coryza or conjunctivitis and generalized maculopapular rash for at least 3 days) in a person with an epidemiologic link to a laboratory-confirmed case.
Clinical / Probable case	Clinical illness (fever≥ 38.3ºC and cough, coryza or conjunctivitis and generalized maculopapular rash for at least 3 days) • in the absence of appropriate laboratory tests; **or** • in the absence of an epidemiologic link to a laboratory-confirmed case; **or** • in a person who has recently travelled to an area of known measles activity.
Suspect case	For public health intervention – all of the following: • Fever ≥ 38.3ºC; **and** • Cough, coryza; or conjunctivitis **and** • Generalized maculopapular rash of any duration.

6.0 CASE MANAGEMENT

Consult with the MHO and initiate control measures immediately upon the identification of a case, including a clinical or suspect case, if the risk assessment is suggestive that this is measles. Initiation of control measures need not await laboratory confirmation of the case.

6.1 Laboratory Testing

Diagnostic work-up of probable and suspect cases should include both ***serology and virus detection*** (by RT- PCR testing and/or isolation in cell culture). Specimens should be sent to the British Columbia Centre for Disease Control (BCCDC) Public Health Microbiology & Reference Laboratory for testing (BCPHMRL). The medical health officer may request priority testing from the medical microbiologist at BCCDC if required at tel: 604-707-2627 from 8:30 – 4:30; 604-661-7033 (24 hours, 7 days per week). For laboratory test results, contact the BCPHMRL PHSA Lab Results Line (1-877-747-2522) or access the information through PLIS (Provincial Laboratory Information System).

Specimen receiving hours at BCPHMRL for Central Processing & Receiving Pre-Analytical 0730 - 2100 Monday to Friday and 0900 - 1700 Saturday. See the Guide to Programs and Services.

For more information regarding testing and requisition forms, refer to PHSA Laboratories.

6.1.1 Virus Identification

Virus identification should be attempted for all sporadic cases of suspect or probable measles. In an outbreak, specimens should be collected from several cases to increase the success of virus identification, isolation, and subsequent genotyping.

Submit a nasopharyngeal swab and urine sample for measles virus isolation and PCR testing. Viral detection methods (e.g., RT-PCR followed by sequencing) enable a definitive diagnosis, allow the laboratory to distinguish vaccine virus type from wild virus type, and can determine if there are single or multiple genotypes of virus circulating in a community. Genotyping of the measles virus is helpful in understanding transmission patterns and is especially useful if there are no epidemiological links between cases because such results can indicate whether the origin of the virus is the same or different.

Collect nasopharyngeal swabs and urine samples at the time of presentation.

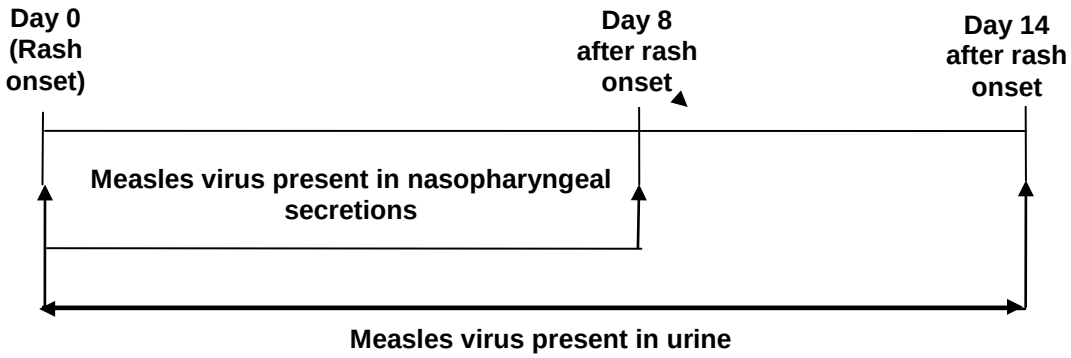
Nasopharyngeal swabs may be collected up to 8 days after rash onset. For nasal/NP swabs, use a BCPHMRL flocked swab (COPAN, red top with viral transport media). For nasopharyngeal swabs use a BCPHMRL virus isolation swab (Starplex, S160V, blue

top).

To collect the nasopharyngeal swab, insert the flexible wire shaft swab through the nares parallel to the palate (not upwards) until resistance is encountered or the distance is equivalent to that from the ear to the nostril of the patient indicating contact with the nasopharynx. Gently, rub and roll the swab. Leave the swab in place for several seconds to absorb secretions before removing.

Urine samples may be collected up to 14 days after rash onset. The yield may be lower with the longer timelines for collection of these samples. For urine collection, use a sterile container.

Sample Collection for Measles Virus Identification



Place specimens on ice, and ship immediately to the BC Public Health Microbiology & Reference Laboratory (BCPHMRL). If immediate transport is not feasible, place the specimen(s) in a refrigerator (not a freezer) and transport to the laboratory on ice within 24 hours.

PCR performed on the nasopharyngeal and urine specimens is a very sensitive assay for measles. Specimens that test positive by RT-PCR will also be set up for virus isolation in cell culture. This will allow for genotypic analysis of the isolate, which may indicate the likely source of the infection. Virus identification methods are also useful when serological results conflict with the epidemiological or clinical features of the case.

6.1.2 Serology

Identify the specimen as “acute measles” on the lab requisition. Acute measles serology includes testing for measles specific *IgM and IgG* class antibodies.

As the clinical presentation of measles can resemble other viral infections, request that sera from suspect or clinical cases of measles be tested for antibody to parvovirus B19 and rubella. Request these tests on the initial ACUTE measles specimen.

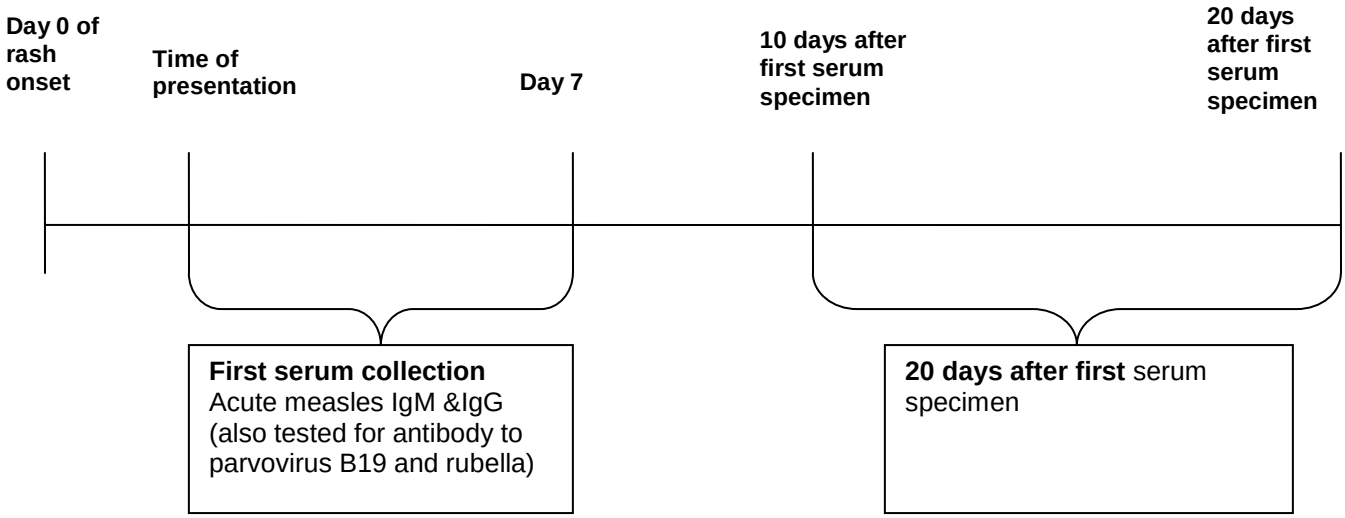
Use a BCPHMRL SST (serum separator tube) gold top blood collection tube.

For IgM and IgG serology, obtain the first (acute) sample at the time of presentation and no later than day 7 following rash onset. Note that 20% of measles cases will not have a reactive IgM when blood is drawn within the first 3 days of rash. For this reason, a second blood sample is indicated if the IgM serology results from an early acute phase sample are inconclusive or negative for measles, rubella, and parvovirus B19, and the person meets the clinical case definition for measles.

Collect the second (convalescent) sample 10 to 20 days after the first sample and record as such on the laboratory requisition. These paired sera are tested simultaneously to determine if seroconversion has occurred.

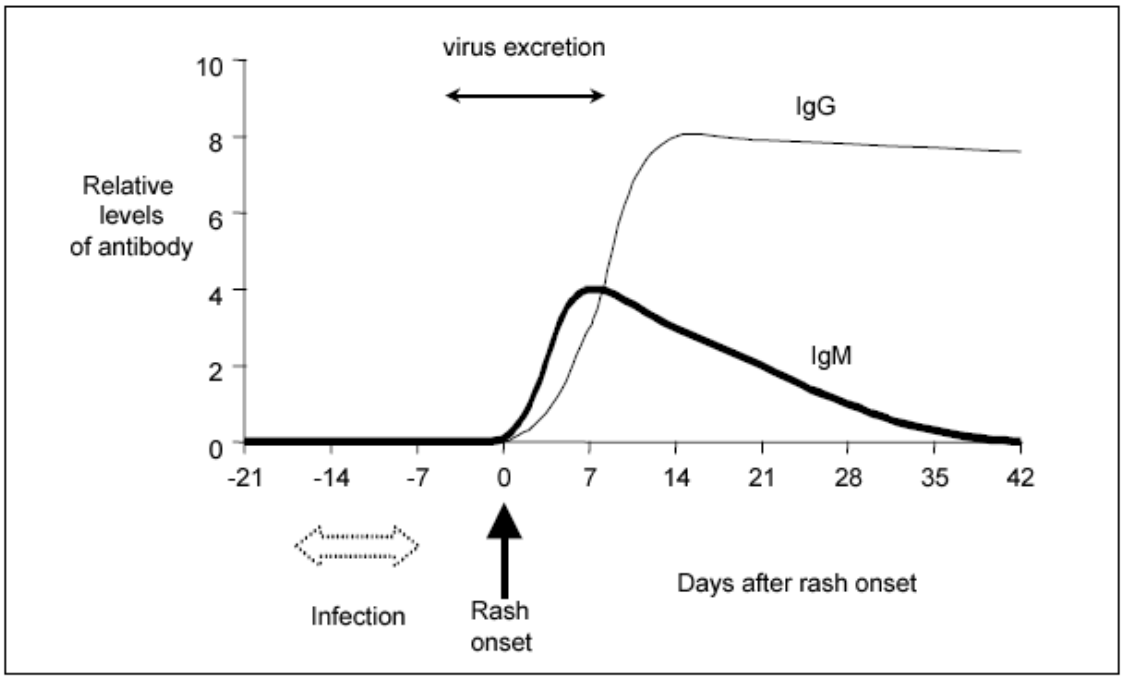
If the case is confirmed by RT-PCR virus identification, a convalescent specimen is not necessary.

Serum Collection for Measles



The graph below depicts the antibody response to measles infection (WHO, 1999).

Figure 1: Antibody response to measles virus infection



Antibodies are first detectable when the rash appears, and life-long protection results from natural infection. IgM antibodies are produced initially, followed by IgG and IgA in serum and secretions.

Due to the very low incidence of measles in BC, an anti-measles IgM positive result in a sporadic case without links to other cases must be interpreted with caution because these may be false positives. Such sporadic cases should be confirmed by convalescent blood specimens, which will allow for demonstration of a rise in IgG titre and/ or virus identification.

Given the nuances and relative infrequency of measles infections in BC, if the clinical and epidemiological data do not fit the picture of measles, or if results are inconclusive or inconsistent, it is recommended that the medical health officer discuss the case with the medical microbiologist at BCCDC tel: 604-707-2627 from 8:30 – 4:30; 604-661-7033 (24 hours, 7 days per week).

6.2 Interpretation of Test Results

Where serology test results are reported in international units, a four-fold increase between acute and convalescent serum is considered consistent with seroconversion. Where these results are not reported in international units, seroconversion may be established on consultation with the virologist.

The timing of specimen collection must always be considered in the interpretation of a laboratory result. Samples from the early acute phase (i.e., those drawn before 3 days after rash onset) may not have detectable IgM antibody compared with those drawn 3 to 28 days after rash onset. For this reason, a second blood sample is indicated if the IgM serology results from an early acute phase sample are inconclusive or negative for measles and the person meets the probable case definition for measles.

Measles Testing Results	
Test Result	**Interpretation**
Reactive IgM antibody	Possible acute measles infection. False positive may occur in about 0.4%. IgM is also detected after immunization against measles. IgM may remain detectable in some individuals for years after vaccination or natural infection.
Non-reactive or equivocal IgM antibody	Not acute measles infection (Note: 20% of measles cases will not have a reactive IgM when blood is drawn within the first 3 days of rash).
Protective anti-measles IgG (generally ≥ 200 mIU per milliliter)	Test results will be reported out as "reactive" (i.e., immune to measles).
A significant rise in IgG titre between the acute and convalescent sera	Acute measles infection.
Positive RT-PCR or culture • Nasopharyngeal swab • Urine specimen	Confirms acute measles infection

Immunization against measles will result in a seroresponse of IgM and IgG measles antibodies that is indistinguishable from acute infection. Testing for virus identification should resolve such cases.

6.3 Case History

In order to properly interpret laboratory results, consider both clinical and epidemiologic information along with the laboratory information. Prior vaccination history, travel and exposure history, and timing of sample collection relative to symptom onset are all factors that must be considered in the interpretation of lab results for the purpose of confirming measles cases. If dates of likely exposure are compatible with acquisition in BC, investigate for a source case.

Using the known incubation period for measles (see Section 3.0), determine the likely source of infection. Determine the **period of communicability -** from 1 – 2 days before the beginning of the prodromal period (usually about 4 days before rash onset) to 4 days after rash appearance in a healthy person and for the duration of measles illness in an immunocompromised person.

Use the "Measles, Mumps, and Rubella Enhanced Surveillance Case Report Form" to collect data and determine if the case report meets the case definitions for measles. The form is available at Measles, Mumps and Rubella Enhanced Surveillance Case Report Form.

If the case travelled outside of BC during their infectious period, or may have acquired their infection elsewhere in Canada, inform BCCDC and provide the case's itinerary so that the appropriate Canadian public health authorities may be notified if indicated.

6.4 Case Treatment

Clinical management of cases is outside the scope of this guideline. There is no specific treatment for measles and clinical management is largely supportive.

6.5 Future Immunization of the Case

Defer all immunizations with live and inactivated vaccines until at least four weeks after illness onset in the case. This is because measles infection is accompanied by marked and prolonged abnormalities of cell-mediated immunity (CMI). CMI is measurably suppressed for several weeks after infection, during which time new immune responses are impaired (Karp 1996; Amanna 2007).

People who have had laboratory confirmed measles need not be immunized against measles as they are considered immune. Measles immune individuals, however, may be safely immunized with MMR vaccine for rubella and/ or mumps protection.

6.6 Case Isolation

Isolation in a health care facility:
In health care facilities, initiate respiratory isolation (full airborne precautions with negative pressure isolation) from the onset of the catarrhal stage of the prodromal period through the 4th day of rash for otherwise healthy individuals and for the duration of illness for immunocompromised individuals. This will reduce the exposure of other patients at high risk and of health care workers.

Isolation in the community:
Public health advice to suspect, probable, and confirmed cases should include the following: to practice good hand hygiene, avoid sharing drinking glasses or utensils, and cover coughs and sneezes with a tissue or forearm. The case should also be advised to wear a mask to avoid infecting others.

6.7 Exclusion of Cases

Clinical and suspect cases should be managed as confirmed cases until laboratory evidence suggests otherwise.

6.7.1 Exclusion of health care workers

Health care workers (HCWs) include and are not limited to: nurses, physicians,

physiotherapists, laboratory technicians, HCW students, volunteers, medical office assistants, home care workers, emergency responders, and support staff in acute care, long-term care, home care, and community health settings.

Notify Occupational Health and/or Infection Control for the facility in which the case works. The case is also obligated to inform Occupational Health of their illness.

If the case is a HCW, the MHO should exclude them from work for at least 4 days after the appearance of a rash.

6.7.2 Exclusion from workplace, school, or child care settings

The MHO should exclude cases from school, daycare, post-secondary institutions and the workplace for at least 4 days after the appearance of the rash if there are susceptible individuals present in that setting.

When the case is in a school setting, notify the appropriate school administrator.

7.0 CONTACT MANAGEMENT

7.1 Contact Identification

Definition: Contacts are individuals who have spent any length of time in a room or enclosed space while the infectious measles case was present or for up to 2 hours after the case left the room/space.

The highest attack rates are among susceptible household contacts with secondary household cases experiencing more serious disease. Therefore, these should be priorized for contact identification and management.

The 2 hour timing recommendation is consistent with Canadian and US infection control guidelines. It is based on documented transmission events related to such exposures in medical waiting rooms after the index case has left the room (Bloch, A. B., 1985; Remington, P. L., 1985). It is recognized that transmission of this type may be a relatively uncommon event; however, a risk assessment should be undertaken that considers the respiratory symptoms, speed of isolation of the case after arrival in that setting, and the contacts' susceptibility.

Priorization of contacts should take into account the transmission risk and the risk of susceptibility and serious complications among exposed individuals. The following should receive priority for contact identification and management:

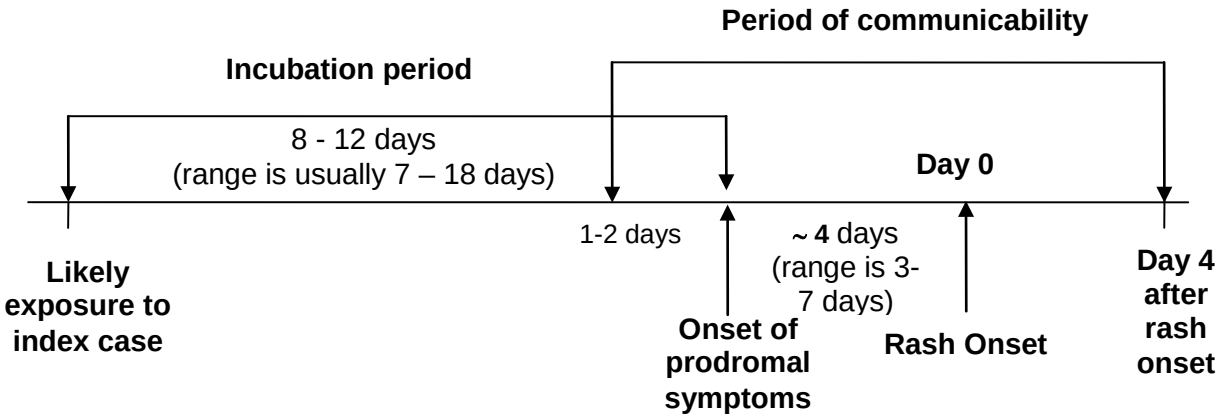
- immunocompromised individuals,
- children under one year of age,
- pregnant women,
- household-type contacts, and

- health care workers

Health care workers (HCWs) include students and facility employees who were in a shared airspace with the case. All of these individuals should be assessed with respect to their exposure.

The Measles, Mumps and Rubella Enhanced Surveillance Case Report Form may be used for data collection.

Occupational Health and Infection Control are responsible for follow-up of exposed staff and inpatients exposed in the health care facility. Follow up of patients discharged from emergency rooms occurs in collaboration with institutional infection control staff.



7.2 Case Travel

If the case travelled outside of BC during the infectious period, inform BCCDC and provide sufficient details about the case's itinerary to enable the affected public health jurisdiction to receive the notification and take appropriate action for contact identification and management.

7.3 Assess susceptibility of contacts

Conduct a risk assessment for each identified contact with respect to likelihood of susceptibility to measles using the principles outlined below.

Investigate the possibility of additional suspect cases among the contacts. Refer all identified suspect and probable cases to a physician. Refer to Section 7.6 Contact Education for more information.

Consider as **immune** those persons who have any of the following:

- birth date before January 1, 1970 (1957 for health care workers).❶
- documented evidence of vaccination with 2 valid doses❷ of live measles-containing vaccine after their 1st birthday and given at least one month apart.
- laboratory evidence of immunity (i.e., “reactive” or ”positive” anti-measles IgG antibody or a previous measles antibody level of ≥ 200 mIU per ml).
- laboratory evidence of prior measles infection. Physician diagnosis of measles without laboratory confirmation is no longer considered proof of immunity in the current Canadian epidemiologic context.

Consider as potentially **susceptible** contacts ≥ 6 months of age born on or after January 1, 1970 (1957 for health care workers) ❸❹ who:

- **do not have** at least one of the following:
  - documented evidence of vaccination with 2 valid doses❷ of live measles-containing vaccine after their 1st birthday and given at least one month apart; **or**
  - laboratory evidence of immunity (i.e., “reactive” or “positive” anti-measles IgG antibody or a previous measles antibody level of ≥ 200 mIU per ml); **or**
  - laboratory evidence of prior measles infection. Physician diagnosis of measles without laboratory confirmation is no longer considered proof of immunity in the current Canadian epidemiologic context.
- **have** certain immuno-suppressive conditions (e.g., HSCT recipients). Refer to BC Communicable Disease Control Manual, Chapter 2, Section III – Immunization of Special Populations for more information.

❶ These persons are assumed to have acquired immunity to measles from natural infection. Those without a history of measles disease should be considered susceptible and offered vaccine.

❷ Primary vaccine failure occurs in 5-10% of infants following a single dose of measles vaccine.

❸ There are exceptions to this and infants less than 6 months of age may be susceptible. See footnote❶ in Section 7.4 Immunoprophylaxis of susceptible contacts.

❹ This represents a change in BC policy from use of birth years prior to 1957 for assumption of immunity for those who are not health care workers, and is reflective of recommendations made by the National Advisory Committee on Immunization in the Canadian Immunization Guide 2006 and 2012, and the Canadian Guidelines for the Prevention and Control of Measles in Canada (2012). This age criterion is supported by results of a BC pre-natal blood specimen survey conducted in 2010 which demonstrated that 95% of women born prior to 1970 and 88% born 1970-79, respectively, were immune to measles (data on file at BCCDC).

7.4 Immunoprophylaxis of Susceptible Contacts

Offer the following to prevent or modify measles in susceptible contacts (see 7.1 Contact Identification):

Time Since First Exposure to Case	**6 – 11 months of age ❶**	**≥ 12 months of age and for whom MMR vaccine is safely indicated**		**≥ 6 months of age with a contraindication to MMR vaccine ❸❹**
		Persons who have never received live measles-containing vaccine	Persons who are known or likely to have received one dose of live measles vaccine ≥ 4 weeks earlier	
≤ 3 days	MMR❷	1st dose MMR vaccine	2nd dose MMR vaccine	Ig
4 - 6 days (inclusive)	Ig❺	Ig❺	2nd dose MMR vaccine	Ig
≥ 7 days❻	∅	Offer 1st or 2nd dose of MMR vaccine		∅

❶ Ig may be offered to infants younger than 6 months of age if maternal immunity to measles is lacking, uncertain, or measles-vaccine acquired and the exposure occurred in a household-like setting. The BCCDC Public Health Microbiology & Reference Laboratory retains prenatal bloods for two years and may be able to test for immunity. Discuss this with the MHO.

❷ Infants who receive a dose of MMR vaccine at less than 12 months of age should receive two additional doses of MMR vaccine according to the routine schedule.

❸ See BC Communicable Disease Control Manual, Chapter 2, Section III – Immunization of Special Populations for list of immunocompromising conditions.

❹ On a case-by-case basis, consider serological testing for immunity for immunocompromised individuals who are likely to have pre-existing immunity from prior vaccination or measles disease as well as for pregnant women (as prenatal sera may be stored at the BCCDC Public Health Microbiology & Reference Laboratory for two years).

❺ When clinical measles does not develop in a contact given one dose of Ig, MMR vaccine should be given 5 or 6 months later, depending on the Ig dose used, provided the individual is ≥ 12 months of age and there are no contraindications to the vaccine. See BC CD Manual, Chapter 2, Immunization, Section VII "Immune Globulin Preparations or Blood: Timing Intervals for Vaccines Containing Live Measles, Mumps, Rubella, or Varicella Virus".

❻ If infection has already occurred, immunoprophylaxis will not prevent or modify disease. Therefore, vaccine only offers protection in subsequent measles exposures.

Both measles vaccine, given as MMR vaccine, and human serum immunoglobulin (Ig) have a role in measles post-exposure prophylaxis for susceptible individuals. One or the other of these should be considered for this circumstance; both products are not to be used concurrently as immunoglobulin will interfere with the response to the live attenuated vaccine. Immunoglobulin should not be used for the control of measles outbreaks, although exposed susceptible individuals with a contraindication to measles vaccine should be considered for Ig prophylaxis.

MMR vaccine should be preferentially used for post-exposure prophylaxis in those ≥ 6 months of age if there are no contraindications to receipt and MMR can be given within 72 hours of the exposure**.**

There are no known adverse effects of vaccine given to people incubating measles.

Immune globulin is recommended for susceptible individuals with contraindications to MMR vaccine receipt (immunocompromised, pregnant women) or those exposed susceptibles at high risk of measles complications who could not be vaccinated within 72 hours of exposure but are still within 4-6 days post exposure (exposed infants <1 year of age, household contacts). The efficacy of Ig prophylaxis decreases with time since exposure; therefore, prompt administration of Ig is encouraged.

Ensure that all clients who receive immune globulin are informed of the potential risks associated with receipt of a blood-derived product and provided with a written record. This is a requirement of the Canadian Standards Association for Blood and Blood Products.

Available efficacy data on the use of Ig for post exposure measles prophylaxis is from studies dating as far back as the 1940s, indicating levels of efficacy around 70-80% (Endo 2001; Janeway 1945; Ordman 1944). The allowable minimum for anti-measles antibody in immunoglobulin preparations is 25.2 IU/ml based on a potency ratio of 0.6 set by the US Food and Drug Administration's Center for Biologics Evaluation and Research Ref#176. Currently available immunoglobulin preparations for the Canadian Blood Services are well above the allowable minimum (personal communication, Jo-Ann Cybulski, Plasma Products Specialist, CBS Plasma Products & Services, October 2010).

The efficacy of measles vaccine post exposure is less well studied, with estimates ranging from as low as 4% and as high as 100%.

Comparative efficacy of Ig and measles vaccine by time since exposure is an area for further research.

In contacts who have received measles vaccine post-exposure and develop symptoms of measles including fever and rash (occurring within 7-12 days of immunization), specimens must be collected for virus identification to confirm the diagnosis of measles

as serology will not distinguish between wild type infection and measles vaccine seroresponse with IgM and IgG. Virus isolation and typing will distinguish wild from vaccine strain virus.

7.5 Exclusion of Susceptible Contacts

7.5.1 Health care settings

Assess the measles susceptibility status of all health care workers (HCWs) who are exposed to a case of measles. When a suspect case of measles is identified within a health care setting, attempt to have only staff known to be immune to measles entering the patient's room. When any staff member enters the room of a patient for whom airborne precautions are in place for suspected measles, refer to the following recommendations: Public Health Agency of Canada. (2002). Prevention and Control of Occupational Infections in Health Care. Canada Communicable Disease Report, Volume 28S1 March 2002.

When a susceptible HCW is exposed to a case of measles, conduct a risk assessment to determine whether the HCW may return to work. In consultation with the MHO, consider exclusion of the HCW from any work in the health care setting from the 5th day after the first exposure until 21 days after the last exposure to the case of measles.[1] These time intervals reflect the incubation period and the potential period of communicability before the possible onset of symptoms.

Administer one dose of MMR vaccine to the susceptible HCW immediately and a second dose 4 weeks later. Measles vaccine or immune globulin given after the exposure does not guarantee protection and infectiousness can precede symptom onset. In circumstances where patient care would be compromised by exclusion of a health care worker, conditions for return to work can be determined in consultation with a medical health officer.

HCWs who develop a measles-like illness following exposure should be tested (by serology and culture/RT-PCR) to confirm the diagnosis, and be excluded from work until no longer infectious (i.e., on or after 5th day after rash onset and clinically recovered).

7.5.2 Workplace, school, or child care settings

Susceptible contacts from the above settings who refuse or cannot receive MMR vaccine or immune globulin may be excluded from that setting at the discretion of the

[1] The rationale for the 5 to 21 day time period is as follows: if the individual became infected with measles as a result of the exposure, shedding of the measles virus can occur as early as 5 days following the exposure; 21 days is the longest possible incubation period. The incubation period ends with the onset of prodromal symptoms (e.g., fever, cough, coryza, conjunctivitis, Koplik spots). The person is infectious 1 to 2 days before the onset of prodromal symptoms.

Medical Health Officer. If exclusions occur, the period of exclusion should extend from 5 days after the first exposure to 21 days after the last exposure. Consideration should be given to: the number of susceptibles in that setting; the presence of high risk individuals, susceptible infants, or immunocompromised individuals; and the reliability of the incubating individual to comply with early recognition and self isolation. Exposed individuals who are age eligible to receive 2 doses of MMR vaccine and who have not received their 2nd dose would typically be offered the 2nd dose immediately post exposure but not be excluded, as the likelihood of immunity after 1st dose is high (≥90%).

Susceptible contacts who have received post-exposure prophylaxis within the appropriate time lines may attend in these types of settings at the discretion of the medical health officer. See 7.4 Immunoprophylaxis of Susceptible Contacts.

Notify the appropriate school administrator of the respective school board.

7.6 Contact Education

Advise susceptible contacts:

- about the signs and symptoms of measles, how it is transmitted, and to isolate themselves at home immediately if any symptoms of measles develop and for four days after the onset of rash.
- to observe for signs and symptoms of measles beginning 7 to 21 days after the first contact with a case or longer if the contact received immune globulin.
- to avoid other measles susceptible people and immunocompromised persons 5 to 21 days after exposure to a case,
- to rapidly report any symptoms compatible with measles to their doctor/health care provider. Advise them to call ahead before going to any health care facility, including laboratories, to inform the staff of measles symptoms so that they can be isolated on arrival to avoid exposing any susceptible persons.
- to inform their local public health unit should they develop symptoms of measles.

7.7 Transient airborne contacts

In large social and/or public events (i.e., repeated aggregate settings and one-time events), where the case was known to be, assess the degree of exposure in order to determine those who can reasonably be considered susceptible contacts and thus eligible and accessible for further assessment and intervention, including potential immunization. For those who cannot be individually identified but who may have been present in the general area, consider the need to provide notices, a letter, or a media release informing them of their possible exposure.

Individual follow-up may not be possible in these settings and broad community

notification through a media release to newspapers, radio and television outlets may be considered.

The occurrence of additional cases, particularly among individuals who were not initially identified as contacts, may indicate the need for reassessment of control measures and the need to issue additional communications to health care providers, hospitals, and the public.

8.0 REPORTING

Complete the "Measles, Mumps and Rubella Enhanced Surveillance Case Report Form" and send by fax 604-707-2515 to the Immunization Programs and Vaccine Preventable Diseases Service, BCCDC within 24 hours of the case report. The form is available at: Measles, Mumps and Rubella Enhanced Surveillance Case Report Form.

In addition, complete the individual case report in iPHIS/ Panorama or PARIS within 7 days following identification of a suspect, clinical, or confirmed case of measles.

Update iPHIS or Panorama /PARIS if more or new information becomes available. Update the case status item if the case changes from confirmed, clinical or suspect status.

The BCCDC will notify other Canadian jurisdictions about the occurrence of measles via the Canadian Network for Public Health Intelligence (CNPHI).

BC participates in the Canadian Measles & Rubella Surveillance System (CMRSS) which includes real time reporting of epidemiologic and laboratory parameters to the Public Health Agency of Canada (PHAC) including National Microbiology Laboratory.

9.0 OUTBREAK MANAGEMENT

Measles is considered under elimination in Canada and a single case warrants attention.

The main components of measles outbreak management are:

- Identify the population affected by the outbreak.
- Identify the population at risk of infection.
- Determine where transmission is occurring.
- Identify individuals at potential risk of infection.
- Identify and vaccinate susceptible individuals in the identified population who do not have a contraindication to MMR vaccine. Depending on the epidemiology of the outbreak, administration of the 2nd dose of MMR earlier than at age 4 years may be considered for children.
- Increase awareness about measles in the population and in the medical community.

9.1 Intensify Surveillance

When a case occurs, attempt to identify the source of infection and all related cases. Institute surveillance measures to identify cases prospectively and retrospectively. Where possible, identify the source of all cases, particularly the index case. Consult BCCDC Immunization Programs and Vaccine Preventable Diseases Service about assistance with an outbreak investigation or other control strategies.

If the index case is a student, ascertain the reason for absenteeism of other students from the schools attended or in the area of the confirmed case for the 2 week period prior to the identified case. This is to help identify earlier unreported cases. Continue active surveillance until 4 weeks after the last case occurs.

9.2 Mass Gatherings

Cancelling or restricting athletic events and other school programs or community events has not been shown to be effective for controlling measles outbreaks.

In the context of a measles outbreak, public health and event organizers should advise participants:

- of the potential for exposure and measures to take to reduce risk of spreading the disease (e.g., check that immunization is up-to-date, use good hand hygiene, avoid sharing food/drink/utensils, cough or sneeze into crook of elbow, stay home if ill);
- about measles symptoms and prevention; and
- that if they become ill with a fever and rash, to call ahead about possible measles before visiting their health-care provider.

Refer individuals to HealthLink BC for more information:

- Phone 8-1-1.

9.3 Immunization

Remind the public about the recommendations for measles immunization.

Consider the scheduling of extra immunization clinics for those at risk without up-to-date measles immunization status.

Notify the Immunization Programs and Vaccine Preventable Diseases Service at the BCCDC of the outbreak and provide an estimate of the number of extra doses of vaccine required if expanded immunization services are being planned. This will ensure that adequate supplies of vaccine can be secured for both the outbreak intervention and routine immunization programs.

9.4 Communication

Contact physicians, laboratories, and hospitals in the area to alert them of the outbreak and request reports of suspect cases. This is to ensure diagnosis and reporting of cases but also to ensure health care worker immunization and infection control policies are fully implemented.

9.5 Analyze the Outbreak

A descriptive analysis in the course of and at the conclusion of the outbreak (person, place and time) provides a useful local reference of the outbreak.

Review the effectiveness of control procedures, and revise as necessary

10.0 CLINICAL DESCRIPTION

Measles (rubeola) is one of the most contagious of all infectious diseases, with >90% attack rates among susceptible close contacts. The infection is characterized by a 2 - 4 day prodrome of fever, coryza, cough, conjunctivitis and Koplik spots (i.e., small spots with white or bluish centers on an erythematous base on the buccal mucosa). The prodrome is followed by a characteristic maculopapular rash appearing on the 3rd to 7th day. The rash begins on the face, then becomes generalized, lasts 4 – 7 days, and sometimes ends in brawny desquamation.

Complications such as otitis media and bronchopneumonia occur in about 10% of reported cases, even more commonly in those who are poorly nourished, chronically ill, and in infants < 1 year of age. Measles encephalitis occurs in approximately 1 of every 1,000 cases and may result in permanent brain damage. Very rarely (~1/100,000 cases), subacute sclerosing panencephalitis (SSPE) develops several years after measles infection. In developed countries, such as Canada, death (predominantly resulting from respiratory and neurologic complications) is estimated to occur once in 3,000 cases.

Case fatality rates are increased in children younger than 5 years of age and in immunocompromised children, including children with leukaemia, HIV infection, and severe malnutrition. Measles during pregnancy results in a higher risk of premature labour, spontaneous abortion, and low birth weight infants.

11.0 EPIDEMIOLOGY

Measles in now uncommon in British Columbia and the incidence has declined dramatically since the measles elimination campaign in 1996. Sustained transmission has not been observed since 1997. Sporadic cases occur typically in under or unvaccinated persons with a travel compatible with acquisition of measles out of

country. Most clusters and outbreaks in association with imported cases, although not all index cases are recognized or reported, with occasional cases reported among individuals without history of travel and with no known exposure to cases of febrile rash illness. BC has experienced a few small outbreaks and two larger outbreaks (2010 and 2014) in recent years, typically lasting not more than two to three months. For details please refer to the Annual Summary of Reportable Diseases and for periodic updates about measles activity at Vaccine Preventable Diseases Reports.

12.0 IMMUNIZATION AGAINST MEASLES IN B.C.

In 1969, measles (rubeola) live vaccine was recommended for infants at 12 months of age, preschool and susceptible school children. MMR vaccine began to be used in the publicly funded immunization program in 1981 for children aged 12 months, preschoolers, and susceptible school children. In 1985, an MMR campaign was conducted over a 1 to 2 year period for school children in grades K to 12, with immunizations given by public health nurses in the schools.

In 1996 as part of the national and Pan American Health Organization measles elimination strategy, BC conducted a measles elimination campaign targeting children aged 19 months of age through to those attending post-secondary (college/ university) educational institutions. This campaign utilized measles-rubella (MR) vaccine, and did not deliver a second dose of mumps vaccine.

In the same year, a policy of second dose of MMR vaccine at 18 months of age was recommended in addition to the first dose given at 12 months of age.
BCCDC immunization guidelines also recommended a second dose of measles vaccine given as MMR vaccine to health care workers born after 1956 and to students of colleges and universities; public funding for these groups was effected in 2006 and 2007, respectively.

In 1996 and 1997 every province and territory in Canada added a second dose of measles-containing vaccine to its routine schedule and most conducted catch-up programs in school-aged children. These interventions achieved vaccine coverage for the second dose in excess of 85%, reducing the proportion of vulnerable children to such a negligible level that measles virus transmission could not be sustained.

The efficacy of a single dose of live measles vaccine given at 12 or 15 months of age is estimated to be 85% to 95%. With a second dose, almost 100% of children are protected.

The following tables summarize the number of doses of MMR vaccine recommended for BC residents based on its constituent components:

Health care workers

Year of birth	Measles	Mumps❷	Rubella❶	MMR vaccine
Prior to 1957	0 doses	0 doses	1 dose	1 dose
1957 – 1969	2 doses	1 dose		2 doses
1970+		2 doses		2 doses

All others

Year of birth	Measles	Mumps❷	Rubella	MMR vaccine
Prior to 1957	0 doses	0 doses	0 doses	0 dose
1957 – 1969			1 dose	1 dose
1970+	2 doses	1 or 2 doses		2 doses

❶One dose of MMR for rubella protection is recommended for all health care workers regardless of age, and for adults born after 1956 who do not have documentation of receiving 1 dose of rubella containing vaccine on / after their first birthday or laboratory evidence of immunity or laboratory confirmed rubella.
❷One dose of mumps vaccine is recommended for any susceptible adult born in 1970 and later. The following should receive two doses: children as per routine schedule; students of post-secondary educational settings and travelers to outside of North America. Health care workers should receive 1 dose if born between January 1, 1957-December 31, 1969; 2 doses if born on or after 1970.

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