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1.0 AUTHORITY

BC Public Health Act (2008). Available at
http://www.leg.bc.ca/38th4th/3rd_read/gov23-3.htm

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.

This will be accomplished by:

- Achieving and maintaining the highest possible coverage for 2 doses of measles/mumps/rubella (MMR) vaccine in childhood
- Conducting enhanced surveillance for measles
- Promoting rapid reporting of all suspected and confirmed measles cases
- Providing contact follow-up for all cases of measles and immunoprophylaxis when indicated
- Instituting prompt outbreak control measures.

2.1 Target

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

3.0 DEFINITIONS

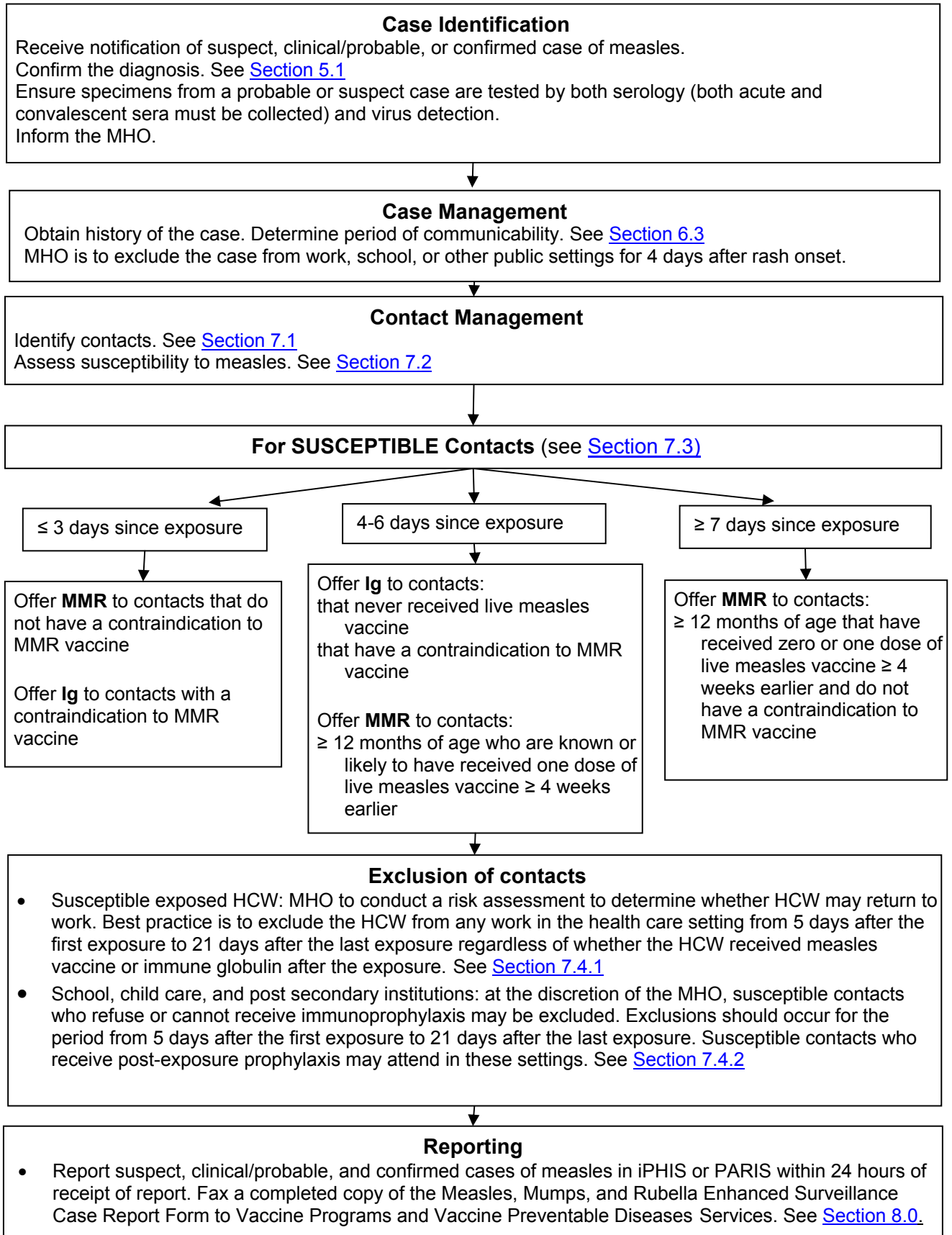
Mode of transmission - airborne by aerosol and droplet spread, direct contact with nasal or throat secretions of infected persons; less commonly by articles freshly soiled with nose and throat secretions.

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.





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) or PARIS.

Inform the local Medical Health Officer.

Surveillance definitions^①		Reportable
Confirmed case	Measles compatible illness and laboratory confirmation of infection in the absence of recent (i.e., within the previous 28 days) immunization with measles-containing vaccine by: <ul style="list-style-type: none"> 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 between acute and convalescent sera by any standard serologic assay OR detection of 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 OR Clinical illness^② in a person with an epidemiologic link to a laboratory-confirmed case. 	Yes Report 'case status' in iPHIS as 'confirmed'
Clinical / Probable case	Clinical illness ^② in the absence of appropriate laboratory tests and not epidemiologically linked to a laboratory-confirmed case.	Yes Report case status in iPHIS as "clinical"
Suspect case	For public health intervention – all of the following: <ul style="list-style-type: none"> Fever $\geq 38.3^{\circ}\text{C}$, and Cough, coryza, or conjunctivitis, and Generalized maculopapular rash of any duration. 	Yes Report 'case status' in iPHIS as "suspect"

^① Public health action, including contact management, may commence at any level of the case definition, including for a suspect case.

^② Clinical illness is characterized by all of the following features:

- fever 38.3°C or greater, and
- cough, coryza, or conjunctivitis, and
- generalized maculopapular rash **for at least 3 days**



6.0 CASE MANAGEMENT

Initiate control measures immediately upon the identification of a case, including a clinical or suspect case. Initiation of control measures must not await laboratory confirmation of the case.

6.1 Laboratory Testing

Probable and suspect cases of measles should be tested **by both serology and virus detection** (by RT-PCR testing and/or isolation in cell culture). Specimens should be sent to the BCCDC Public Health Microbiology & Reference Laboratory. Notify the medical microbiologist at BCCDC if priority testing is required: [604-707-2627 from 8:30 – 4:30; 604-661-7033 (24 hours, 7 days per week)]. If necessary, contact the BCCDC Public Health Microbiology & Reference Laboratory PHSA Lab Results Line to ascertain test results (1-877-747-2522).

For more information regarding testing and requisition forms, refer to <http://www.bccdc.ca/PHSALaboratories>.

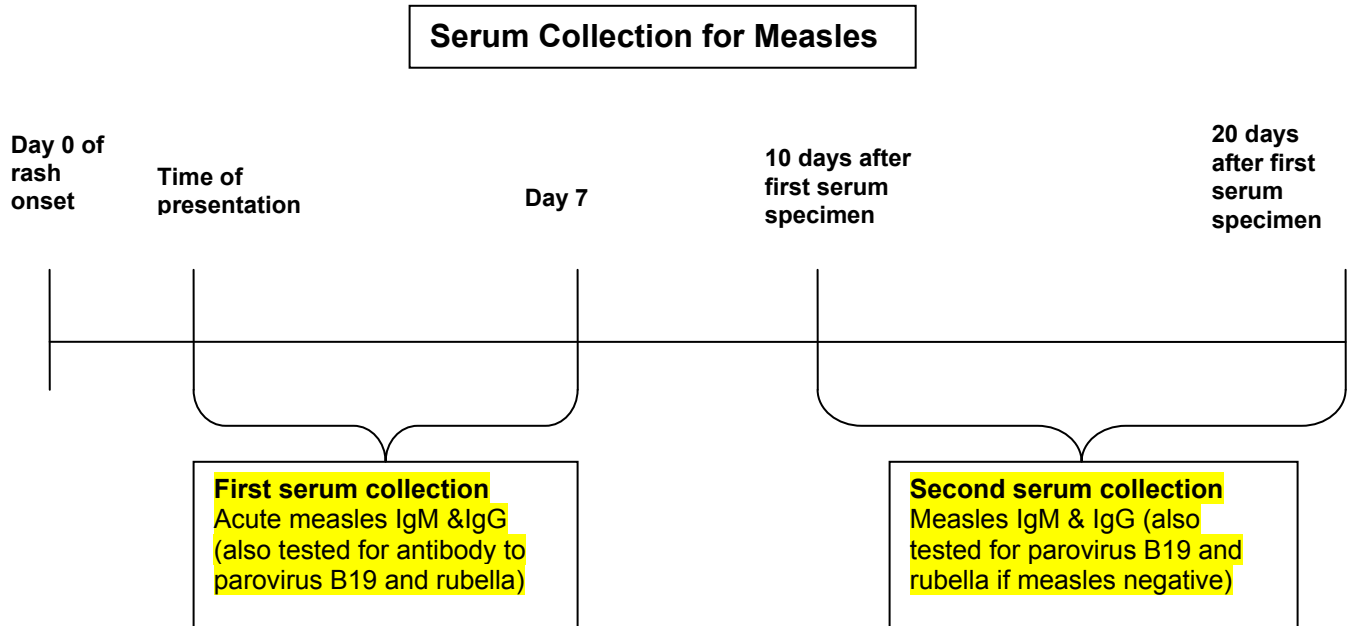
6.1.1 Serology

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.

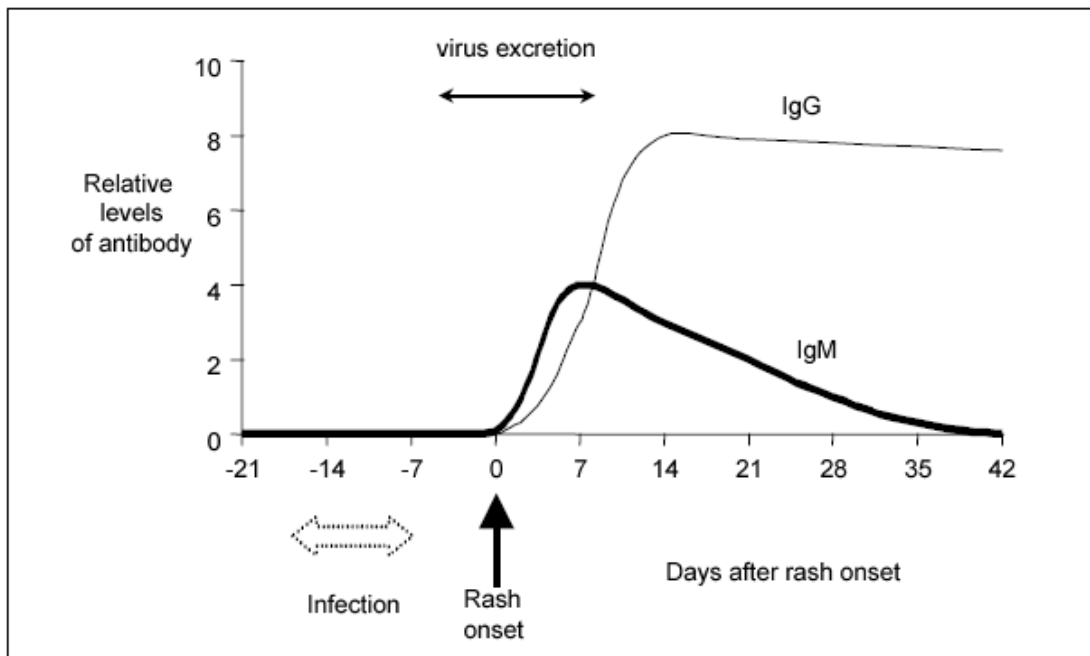
For IgM and IgG serology, obtain the first (acute) sample at the time of presentation and no later than day 7 following rash onset. Note that 20% of measles cases will not have a reactive IgM when blood is drawn within the first 3 days of rash. For this reason, a second blood sample is indicated if the 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. These paired sera are tested simultaneously to determine if seroconversion has occurred.



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.

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

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 that will allow for demonstration of a rise in IgG titre.

A protective level of anti-measles IgG antibodies is at least 200 mIU per milliliter (i.e., the international standard).

Given the nuances and relative infrequency of measles infections in BC, if the clinical and epidemiological data do not fit with a true infection it is recommended that the case be discussed with a Medical Microbiologist (604-661-7033).

6.1.2 Virus Identification

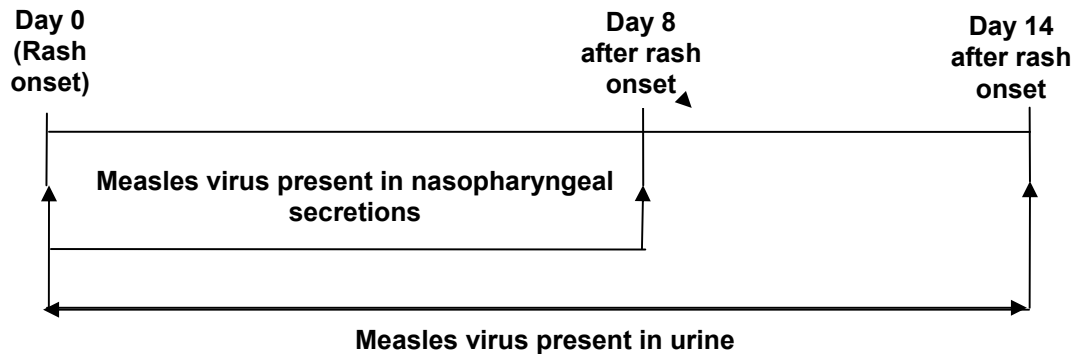
Virus identification should be attempted for all sporadic cases of suspect or probable measles. In an outbreak, specimens should be collected from several cases to increase the success of virus identification, isolation, and subsequent genotyping.

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. 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.

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.

Sample Collection for Measles Virus Identification



Collect specimens in a sterile container, place on ice, and ship immediately to the BCCDC Public Health Microbiology & Reference Laboratory. 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 and is now available at the BCCDC Public Health Microbiology & Reference Laboratory. Specimens that test positive by RT-PCR will also be set up for virus isolation in cell culture. Virus isolation in cell culture is not recommended as the sole method for laboratory diagnosis because it is less sensitive than PCR. However, it will permit 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.

6.2 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 positives 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 <ul style="list-style-type: none"> • Nasopharyngeal swab • Urine specimen 	Confirms acute measles infection

If results are inconclusive or inconsistent, call the Medical Microbiologist (604-661-7033).

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 history, and timing of sample collection relative to disease onset are all factors that must be considered in the interpretation of lab results for the purpose of confirming measles cases.

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.

See [12.0 MEASLES, MUMPS, RUBELLA ENHANCED SURVEILLANCE CASE REPORT FORM](#). The form is available at <http://www.bccdc.ca/dis-cond/CDSurveillanceForms/default.htm>



6.4 Case Treatment

Clinical management of cases is outside the scope of this guideline. 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.

In health care facilities, initiate respiratory 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.

6.5 Exclusion of Cases

6.5.1 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.

Advise the case to immediately notify Occupational Health and/or Infection Control for the facility in which they work.

The MHO should exclude a case of measles from work in a health care setting for at least 4 days after the appearance of the rash.

6.5.2 Exclusion from workplace, school, or child care settings

The MHO should exclude all cases of measles from work, school, and other public settings for at least 4 days after the appearance of the rash. When the case is in a school setting, notify the health and safety officer of the respective school board.

6.6 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, C.L., 1996; Amanna, I.J., 2007).

6.7 Case Travel

If the case travelled outside of BC during the infectious period, inform BCCDC and provide case's itinerary so that other public health authorities may be notified.

7.0 CONTACT MANAGEMENT

7.1 Contact Identification

The highest attack rates are among susceptible household contacts with secondary household cases experiencing more serious disease.

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.

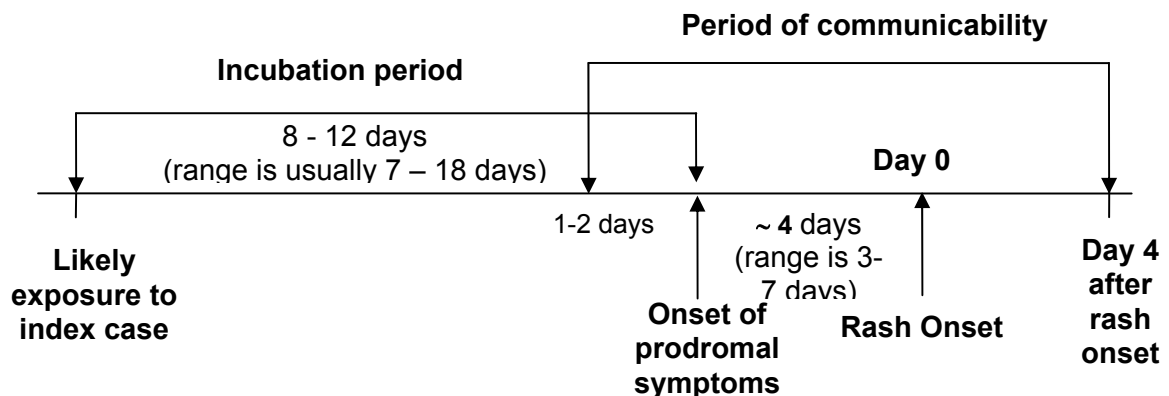
The 2 hour timing recommendation is consistent with Canadian and US infection control guidelines. It is based on documented transmission events related to such exposures in medical waiting rooms after the index case has left the room (Bloch, A. B., 1985; Remington, P. L., 1985). It is recognized that 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.

Where disease transmission is widespread, there may not be sufficient resources to identify contacts outside of the following high risk groups:

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

The [Measles, Mumps, and Rubella Enhanced Surveillance Case Report Form \(Section 12.0\)](#) may be used for data collection.

Occupational Health and Infection Control are responsible for follow-up of exposed staff and in-patients exposed in the health care facility. Follow up of patients discharged from emergency rooms may be conducted either by public health or infection control. This will be determined on a case-by-case basis.



7.2 Assess susceptibility of contacts

Assess whether each identified contact is susceptible or immune to measles.

Investigate the possibility of additional suspect cases among the contacts. Refer all identified suspect and probable cases to a physician. Refer to [Section 7.5 Contact Education](#) for more information.

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

- birth date before January 1, 1957. ❶
- documented evidence of vaccination with 2 valid doses ❷ 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 **susceptible** contacts ≥ 6 months of age born on or after January 1, 1957 ❸ ❹ who:

- **do not have** at least one of the following:
 - documented evidence of vaccination with 2 valid doses ❷ 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** HIV infection, regardless of their measles immunization status. The exception is an HIV+ contact who is receiving IVIg at regular intervals and their last dose was received within 3 weeks of exposure.
- **have** certain immuno-suppressive conditions (e.g., HSCT recipients). Refer to [BC Communicable Disease Control Manual, Chapter 2, Section III – Immunization of Special Populations](#)

❶ These persons are assumed to have acquired immunity to measles from natural infection. There may be the occasional susceptible individual in this age group.

❷ Primary vaccine failure occurs in about 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 footnote ❶ in [Section 7.3 Immunoprophylaxis of susceptible contacts](#).

❹ The 1956 cut-off recommended in BC differs from the NACI-recommended cut-off year of 1970. BC pre-natal blood specimens tested in 1999 showed only a difference of 2% in the measles IgG seroprevalence between those born from 1970–1980 (92% immune) versus those born from 1957–1969 (94% immune) (Skowronski, 2000, unpublished data on file at BCCDC).



7.3 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 (e.g., immuno-compromised, HIV+, pregnant) ❸ ❹
		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	MMR ❷	1 st dose MMR vaccine	2 nd dose MMR vaccine	Ig
4 - 6 days (inclusive)	Ig ❺	Ig ❺	2 nd dose MMR vaccine	Ig
≥ 7 days ❻	∅	Offer 1 st or 2 nd 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 BCCDC CDC Manual, Immunization Chapter, Section VII “Immune Globulin Preparations or Blood: Timing Intervals for Vaccines Containing Live Measles, Mumps, Rubella, or Varicella Virus” available at: http://www.bccdc.ca/NR/rdonlyres/CD9F6894-8373-469C-9F8A-6B27F76418D9/0/SectionVII_BiologicalProducts_June.pdf.

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



Susceptible individuals ≥ 6 months of age who are exposed to measles may be protected from disease if MMR vaccine is given within 72 hours of the exposure.

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

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 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, A., 2001; Janeway, C.A. 1945; Ordman, C.W., 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.

7.4 Exclusion of Susceptible Contacts

7.4.1 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. Available at: <http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/02vol28/28s1/index.html>

Administer one dose of MMR vaccine to the susceptible HCW immediately and a second dose 4 weeks later.

When a susceptible HCW is exposed to the case of measles, a risk assessment must be made to determine whether the HCW may return to work. Best practice is to exclude the HCW from any work in the health care setting from 5 days after the first exposure until 21 days after the last exposure^❶ regardless of whether the HCW received measles vaccine or immune globulin after the exposure, because neither of these confers a guarantee of protection and infectiousness can precede symptom onset. For further details, refer to the interim guideline developed by the Provincial Infection Control Network of BC (PICNet) for the management of health care workers who are cases or contacts of measles. The interim guideline is available at:

http://picnetbc.ca/sites/picnetbc2/files/Guidelines/Interim_Management_of_HCW_Pre_and_Post_Exposure_to_Measles_21June2010.pdf

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

7.4.2 Workplace, school, or child care settings

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

Susceptible contacts that have received post-exposure prophylaxis within the appropriate time lines may attend in these types of settings. See [7.3 Immunoprophylaxis of Susceptible Contacts](#)

Notify the health and safety officer of the respective school board.

❶ 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 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.



7.5 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 measles.

7.6 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 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 individual case report in iPHIS or PARIS within 24 hours following identification of a suspect, clinical, or confirmed case of measles.

Fax the completed "Measles, Mumps and Rubella Enhanced Surveillance Case Report Form" to Vaccine Programs and Vaccine Preventable Diseases Services, BCCDC within 24 hours following receipt of the report: (fax 604 707-2516). See [12.0 MEASLES, MUMPS, RUBELLA ENHANCED SURVEILLANCE CASE REPORT FORM](#). The form is available at <http://www.bccdc.ca/dis-cond/CDSurveillanceForms/default.htm>



Update iPHIS/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 may notify other Canadian jurisdictions about the occurrence of measles via the Canadian Network for Public Health Intelligence (CNPHI).

9.0 OUTBREAK MANAGEMENT

Because measles is considered under elimination in Canada, a single case warrants attention. Investigation may uncover additional cases, and exposure to this single case may result in several additional cases.

The main strategies in a measles outbreak 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.
- 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 subsequent cases. Institute surveillance measures to identify cases prospectively and retrospectively. Where possible, identify the source of all cases, particularly the index case. Through detailed interviews of cases, identify common exposure settings. Consult BCCDC Vaccine Programs and Vaccine Preventable Diseases Services 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

It is not possible to control measles outbreaks by restricting school activities or community events. Athletic events and other school programs should not be cancelled or postponed as it 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, hand hygiene, avoid sharing food/drink/utensils, cough or sneeze into crook of elbow, stay home if ill);
- about measles symptoms and prevention;
- 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
- Website: <http://www.healthlinkbc.ca/kbaltindex.asp>

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 Vaccine Programs and Vaccine Preventable Diseases Services of the outbreak and provide an estimate of the number of extra doses of vaccine required if expanded immunization services are being planned. Vaccine Programs and Vaccine Preventable Diseases Services will notify Pharmacy Services at BCCDC to arrange additional vaccine purchasing, if required.

9.4 Communication

Contact physicians, labs, 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

Following an outbreak, a descriptive analysis of the cases (time, place, and person) 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 leukemia, 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 is now uncommon in British Columbia and the incidence has declined dramatically since the measles elimination campaign in 1996. Sustained transmission has not been observed in recent years. Sporadic cases occur typically in persons with a travel history and in those that have a history of one or fewer doses of measles-containing vaccine. There were no cases of measles in 2008 or 2009.

A large measles outbreak of 82 confirmed and clinical cases occurred in the spring of 2010 in British Columbia. Three co-primary cases were identified with a common exposure of attending (non-ticketed) Olympic related events in downtown Vancouver. Rash onsets ranged from March 9 to April 28, with a peak of April 6. Initial transmission was in the lower mainland spreading to the north in the latter half of the outbreak; all 5 health authorities were affected. Cases were young (mean age of 23 years) with 61% born after 1980. Overall 37% of cases were unimmunized; 38% had an unknown immunization history and 9% were fully immunized. Aboriginals were disproportionately affected comprising 23% of cases but only 5% of the population. A high proportion of cases sought emergency medical care; 65 % of cases attended emergency rooms, 23% were hospitalized and one was admitted to the intensive care unit.



11.1 Measles Immunization 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 table summarizes the number of doses of MMR vaccine recommended for BC residents based on its constituent components:

Date of birth	Measles	Mumps	Rubella❶	MMR vaccine❶
Prior to 1957	0 doses	0 doses	0 doses	0 doses
1957 – 1969	2 doses	1 dose	1 dose	2 doses
1970+	2 doses	2 doses	1 dose	2 doses

❶ One dose of MMR for rubella protection is recommended for all Health Care Workers regardless of age.



12.0 MEASLES, MUMPS, RUBELLA ENHANCED SURVEILLANCE CASE REPORT FORM

Complete and fax the “Measles, Mumps and Rubella Enhanced Surveillance Case Report Form” to BCCDC, Vaccine Programs and Vaccine Preventable Diseases Services within 24 hours of receipt of report (fax: 604 707-2516). The form is available at <http://www.bccdc.ca/dis-cond/CDSurveillanceForms/default.htm>

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