Appendix A: Disease-Specific Chapters

Chapter: Measles

Revised August 2014

Ontario

Measles

☒ Communicable

☐ Virulent

Health Protection and Promotion Act:
Ontario Regulation 558/91 – Specification of Communicable Diseases

Health Protection and Promotion Act:
Ontario Regulation 559/91 – Specification of Reportable Diseases

1.0 Aetiologic Agent

Measles is caused by the measles virus, a member of the genus *Morbillivirus* of the family *Paramyxoviridae*.[1]

2.0 Case Definition

2.1 Surveillance Case Definition

See Appendix B.

Measles is eliminated in Canada; therefore, one case is unexpected.

Public health units should notify PHO, as specified by the ministry, via telephone when there is a strong degree of clinical and epidemiological suspicion of measles (i.e. travel history in an unimmunized person with clinically compatible signs and symptoms), even if laboratory confirmation is pending.

3.0 Identification

3.1 Clinical Presentation

Symptoms of measles begin 7 – 18 days after exposure to a case of measles and include fever, runny nose (coryza), cough, drowsiness, irritability and red eyes (conjunctivitis). Small white spots (known as "Koplik's spots") can appear on the inside of the mouth and throat, but are not always present. Then, 3 – 7 days after the start of the symptoms, a red blotchy (maculopapular) rash appears on the face and then progresses down the body.

Complications include diarrhea, pneumonia, blindness and infections of the brain.[2] Complications such as otitis media and bronchopneumonia occur in about 10% of reported cases. Measles encephalitis occurs in approximately 1 of every 1,000 reported cases and may result in permanent brain damage. Measles infection can cause subacute sclerosing panencephalitis (SSPE), a rare but fatal disease.

Measles complications disproportionately affect persons suffering from malnutrition, immunodeficiency and pregnant women.[2]

3.2 Diagnosis

See Appendix B for diagnostic criteria relevant to the Case Definitions.

For further information about human diagnostic testing, contact the Public Health Ontario Laboratories or refer to the Public Health Ontario Laboratory Services webpage: http://www.publichealthontario.ca/en/ServicesAndTools/LaboratoryServices/Pages/default.aspx

4.0 Epidemiology

4.1 Occurrence

Canada has been free of endemic measles since 1998.[2] However, measles occurs outside of the region of the Americas and remains a serious and common disease in developing countries. According to the World Health Organization, it is a leading cause of vaccine preventable deaths in children worldwide and especially impacts malnourished children.

Canada has achieved its goal of measles elimination, and endemic transmission of measles has been interrupted by high two-dose vaccine coverage as a part of routine infant and childhood immunization programs. However importation and travel-related cases still occurs. Ontario contributes to continued documentation of measles elimination through enhanced surveillance of the disease. This includes weekly reporting to the Public Health Agency of Canada including reporting of 0 cases, and ensuring data on immunization status and travel are collected on all cases.

Between 2009 and 2012, 27 confirmed cases of measles were reported, 25 (92.6%) of which were associated directly or indirectly with travel outside Canada. Exposure source could not be determined for the remaining two cases. Three distinct clusters with at least one chain of transmission resulted in a total of 17 cases of measles; an additional 10 cases did not result in further transmission. For more information on infectious diseases activity in Ontario, refer to the current version of the annual provincial epidemiology report and the Monthly Infectious Diseases Surveillance Reports.

4.2 Reservoir

Humans.[1]

4.3 Modes of Transmission

The virus is highly contagious and is spread by airborne droplet nuclei, close personal contact or direct contact with the respiratory secretions of a case.[1] Transmission can occur as a result of the persistence of the virus in the air or on environmental surfaces.[2] Measles virus can remain active and contagious in the air or on infected surfaces for at least two hours. Measles is one of the most highly communicable infectious diseases.[1]

4.4 Incubation Period

About 10 days, but may be 7-18 days from exposure to onset of fever, usually 14 days until rash appears; rarely as long as 19-21 days.[1]

4.5 Period of Communicability

One day before the start of prodromal period, which is usually about 4 days before rash onset, to 4 days after the onset of rash.[1]

Immunocompromised patients may have prolonged excretion of the virus from their respiratory tract and be contagious for the duration of their illness.[2]

4.6 Host Susceptibility and Resistance

After infection, immunity is generally lifelong.[1]

The following individuals should be considered **susceptible**:

- Lack of documented evidence of vaccination with measles-containing vaccine (See Note 1):
  - One dose for adults 18 years of age and older and born in 1970 or later who are not health care workers or students in post-secondary educational setting
  - Two doses for health care workers, military personnel or students in post-secondary educational settings
  - Two doses for children 12 months to 17 years of age (given on or after the first birthday and given at least 4 weeks apart for MMR vaccine, or 6 weeks apart for MMRV vaccine)
  - Infants under age 12 months, regardless of immunization history

  OR

- Lack of laboratory evidence of prior measles infection or documentation of prior confirmed measles disease in iPHIS

  OR

- Lack of laboratory evidence of immunity (i.e. “reactive” or “positive” anti-measles IgG antibody or a previous measles antibody level of $\geq$ 200 mIU per ml).

Note 1: It is important to note that the susceptibility criteria outlined above apply on a population basis and it is possible that small numbers of individuals within these groups may not be immune to measles. For this reason, contacts should be advised of any relevant exposure and counselled to monitor for signs and symptoms, even if they are not recommended to receive post-exposure prophylaxis or other public-health management (self-isolation or exclusion).

5.0 Reporting Requirements

5.1 To local Board of Health

Individuals who have or may have measles shall be reported to the medical officer of health by persons required to do so under the *Health Protection and Promotion Act*, R.S.O. 1990.

Note: Laboratory confirmed cases are to be reported by phone to the local public health unit as soon as identified.

5.2 To the Ministry of Health and Long-Term Care (the ministry) or Public Health Ontario (PHO), as specified by the ministry

Ontario is currently documenting the elimination of measles and is involved in enhanced surveillance for this disease. Any case of measles identified by the public health unit should be reported via telephone to PHO, as specified by the ministry, within one business day of receipt of initial notification.

Cases shall also be reported using the integrated Public Health Information System (iPHIS), or any other method specified by the ministry **within one business day of receipt of initial notification** as per iPHIS Bulletin Number 17: Timely Entry of Cases.[3]

As part of elimination documentation, it is essential to document travel history and other exposure history to assess source of infection, as well as immunization status, on every measles case.

The minimum data elements to be reported for each case are specified in the following:

- *Ontario Regulation 569* (Reports) under the *Health Protection and Promotion Act* (HPPA);
- The disease-specific User Guides published by PHO; and,
- Bulletins and directives issued by PHO.

6.0 Prevention and Control Measures

6.1 Personal Prevention Measures

Immunize as per the current *Publicly Funded Immunization Schedules for Ontario.*[4] According to the *Immunization of School Pupils Act*, all students over 6 years of age must have documented receipt of two doses of measles containing vaccine and students under this age must have documented receipt of a single dose of measles containing vaccine. Children attending day nurseries should, at a minimum, be immunized according to the current *Publicly Funded Immunization Schedules for Ontario*.[4]

With recent immunization, the most frequent reaction (approximately 5% of immunized children) is malaise and fever with or without rash lasting up to 3 days and usually occurring 6 - 23 days after MMR immunization, although the range can be longer. Measles vaccine produces a mild, non-transmissible and usually subclinical infection. Adverse reactions are less frequent after the second dose of vaccine and tend to occur only in those not protected by

the first dose.[5] A measles-like rash should be reported as an adverse event following immunization (AEFI) if it meets the reporting criteria for rash specified in Appendix B, Provincial Case Definition for AEFIs (i.e., occurring between 5 and 42 days after immunization).

Healthcare workers should have documentation of two doses of measles-containing vaccine given after the first birthday, or laboratory evidence of immunity prior to or upon employment, regardless of their year of birth (refer to the Ontario Hospital Association; Ontario Medical Association. Measles surveillance protocol for Ontario hospitals. Toronto: Ontario Hospital Association; 2011).

6.2 Infection Prevention and Control Strategies

- For hospitalized cases, in addition to routine practices, airborne transmission precautions are indicated for 4 days after onset of rash in otherwise healthy persons and for the duration of illness in immunocompromised persons.[6] The conservative approach is to maintain patients on precautions until all their measles symptoms have resolved.[2]
- All cases of measles will be investigated immediately in order to confirm the diagnosis, identify the source of infection, identify other cases and protect susceptible contacts in the community.
- Public health advice to probable and confirmed cases, as well as for persons suspected of having measles, includes the following: to self-isolate, to practice good hand hygiene, avoid sharing drinking glasses or utensils and cover coughs and sneezes with a tissue or forearm.[2]

6.3 Management of Cases

Confirm the diagnosis and ensure that appropriate specimens have been collected for diagnosis according to the case definition, including specimens for viral detection. This is particularly important for accurate diagnosis, as well as genotyping, which may provide information on the geographic region of imported and import-associated cases. Genotyping can only be conducted if specimens for viral detection (i.e. PCR testing) are collected.

Investigate the case to determine source of infection, including inquiring about travel history or exposure to persons who have recently travelled and documenting location of travel. Immunization status of all cases should be determined; including total number of doses of measles-containing vaccine received and dates of receipt. Collect appropriate data as per the *Ontario Regulation 569* under the HPPA, and include the following in the investigation:

- Symptoms and date of symptom onset;
- Determination of likely exposure period and period of communicability for the case;
- Travel history (dates and location);
- History of exposure to measles cases;
- Contact during their period of communicability with high risk individuals who are vulnerable to measles and measles complications (high risk individuals include immunocompromised persons, pregnant women and infants under 12 months of age);

- Attendance or work during their period of communicability within a high risk setting (a high risk setting is a setting where individuals vulnerable to measles and measles complications are likely to be found, i.e. day-care centres, healthcare environments such as doctors waiting rooms or hospital emergency rooms);
- Case's immunization status (including dates of vaccination with measles-containing vaccine, number of doses received, whether vaccine was received after exposure to measles);
- Occupation; and
- Residency/attendance at a facility or institution.

There is no specific treatment for persons with measles infection; however severe complications can be avoided through supportive care that ensures good nutrition and adequate fluid intake.[2]

Individuals diagnosed with measles should be advised to stay home (self-isolate, including but not limited to, isolation from: child care facilities, schools, post-secondary educational institutions, work places, sporting events, healthcare and other group settings; and away from non-household contacts) for 4 days after the appearance of the rash. This should apply to all cases, regardless of their vaccination history. Self-isolation will help to prevent further transmission of the virus.[2]

6.4 Management of Contacts

Within 24 hours of reporting a suspect case of measles, all contacts should be identified and classified as susceptible or non-susceptible.[2]

Contact identification and tracing:

- Contact history during period of communicability;
- Assessment of type of contact and probability of transmission;
- Identification of contacts for follow-up and determine immunization status of contacts;
- Occupation of contact; and
- Residency/attendance at a facility or institution.

A measles contact is any susceptible (see section 4.6 for susceptibility criteria) person who shared the same air space for **any** length of time during the period of communicability, including two hours after the case left the air space (e.g. home, school, day care, school bus, doctor's office, emergency room, etc.).[7]

Post-exposure prophylaxis (PEP):

The timely administration of MMR vaccine or immune globulin (Ig) can be used to reduce the risk of infection in susceptible individuals exposed to measles. The effectiveness of MMRV vaccine for PEP has not been established. PEP is not 100% effective and contacts who receive PEP should be counseled on the signs and symptoms of measles. They should also be counseled to avoid contact with high risk individuals (pregnant women, infants < 12

months of age, and the immunocompromised) and to avoid high-risk exposure settings/gatherings where high risk individuals are likely to frequent.

Some adults born after 1970 and who have only received one documented dose of MMR vaccine may still be susceptible to measles, as a single dose of MMR vaccine has a vaccine effectiveness of between 85-95%. Therefore in the context of contact management, consideration should be given to offering these adults a second dose of vaccine.

Immunization with MMR vaccine of immunocompetent susceptible contacts over 6 months of age within 72 hours after exposure may prevent measles infection. MMR vaccine may be given for children between 6 months and 12 months of age however, two **additional** doses of measles-containing vaccine must be administered after the child is 12 months of age to ensure long lasting immunity to measles.[2]

For infants under 12 months of age the following is recommended for PEP:

- Infants under 6 months of age: Ig to be administered within 6 days of exposure
- Infants 6-12 months of age:
  - If immunocompromised: Ig to be administered within 6 days of exposure
  - If immune competent but beyond 3 days and within 6 days of exposure: Ig
  - If immune competent and within 3 days of exposure: MMR vaccine

Susceptible individuals with a medical contraindication to MMR vaccine (infants under 6 months of age, pregnant women, and immunocompromised individuals) who are within 6 days of exposure should be offered Ig at the recommended dose. In addition, certain immunocompromised individuals should be considered to receive Ig for post-exposure prophylaxis regardless of their past vaccination status (i.e. even if they do not meet the susceptibility criteria outlined above). These individuals are those with advanced HIV with severe immunosuppression[5] and hematopoietic stem cell transplantation (HSCT) recipients, regardless of vaccination status pre-transplant unless they have been vaccinated post-HSCT and are known to have a protective measles antibody titre.[5]

Please refer to the measles chapter of the Canadian Immunization Guide[5] for a list of conditions considered contraindications to vaccination with MMR in regards to individuals who may be candidates for Ig for post-exposure prophylaxis, if susceptible. Please refer to the GamaSTAN®S/D product monograph for dosing recommendations (http://www.grifols-pi.info/inserts/gamastans-d.pdf).

Exclusion of susceptible contacts

Individuals that refuse or cannot receive MMR vaccine or Ig may be excluded from child care facilities, schools, and post-secondary educational institutions at the discretion of the medical officer of health; and may be required to self-isolate from work places, or other group settings, including travel. If exclusions occur, the period of exclusion should extend from 5 days after the first exposure and up to 21 days after the last exposure, or until the individual is:

- Adequately immunized according to age (based on the susceptibility criteria described above, not the publicly-funded schedule); or

- Demonstrates laboratory confirmation of immunity; or
- Has received immune globulin.

Consideration should be given to: the number of susceptibles in that setting; the presence of high risk individuals (i.e. susceptible infants, or immunocompromised individuals); and the reliability of the incubating individual to comply with early recognition and self-isolation.

There is no requirement to exclude individuals for any length of time after their receipt of vaccine or Ig before their re-entry to childcare facilities, schools, or other settings (with the exception of healthcare workers [see below]). This also is at the discretion of the medical officer of health, as neither vaccine nor Ig is 100% effective in preventing measles.

Health care workers that have been exposed to a confirmed case of measles should have their immune status reviewed. If they have had two documented doses of measles-containing vaccine or documentation of antibodies to measles, they can be considered immune and can return to work. If they have had only one documented dose of measles-containing vaccine, without laboratory evidence of immunity or history of laboratory confirmed measles, it is recommended that they be tested for measles IgG antibody and one dose of MMR vaccine be administered immediately. While waiting for the serology results, health care workers should be excluded from work from the fifth day to the 21st day after the last exposure.[2]

Children identified as contacts who are under 6 years of age and who have only had one dose of measles containing vaccine (i.e., have not yet reached age for the recommended booster dose according to the Ontario schedule [four to six years]), should be excluded from a school or day-care setting until they receive a second dose of measles containing vaccine. Children could return to school/day-care setting immediately following immunization.

Chain of Transmission

Assessing the immunization status of the contacts of an individual exposed to measles can assist in reducing the possibility of subsequent transmission, especially in settings with children who have received only 1 dose of MMR vaccine. Health units should consider:

- Assessing the immunization status of persons in high risk settings if a susceptible contact of measles attends the setting (e.g., in daycare centres) and
- Vaccinating susceptible contacts of the exposed individual, by providing the 2nd dose MMR vaccine in children who have only received 1 dose of measles-containing vaccine and offering MMR vaccine for children who are unvaccinated.

7.0 References

1 Heymann DL, editor. Control of communicable diseases manual. 19th ed. Washington, DC: American Public Health Association; 2008.

2 Public Health Agency of Canada. Guidelines for the prevention and control of measles outbreaks in Canada. CCDR. 2013;39(ACS-3):1-52.

3 Ontario. Ministry of Health and Long-Term Care. Timely entry of cases and outbreaks. iPHIS Bulletin. Toronto, ON: Queen’s Printer for Ontario;2012: 17.

4 Ontario. Ministry of Health and Long-Term Care. Publicly funded immunization schedules for Ontario – August 2011. Toronto, ON: Queen's Printer for Ontario; 2011 [cited 2012 Dec 10]. Available from: http://www.health.gov.on.ca/en/public/programs/immunization/docs/schedule.pdf

5 National Advisory Committee on Immunization; Public Health Agency of Canada. Canadian immunization guide. Evergreen ed. Ottawa, ON: Her Majesty the Queen in Right of Canada; 2012 [cited 2012 Dec 12]. Available from: http://www.phac-aspc.gc.ca/publicat/cig-gci/index-eng.php

6 American Academy of Pediatrics: Section 3: summaries of infectious diseases. In: Pickering LK, Baker CJ, Long SS, McMillan JA, editors. Red book: 2012 report of the Committee on Infectious Diseases. 29th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2012:629-34.

7 Public Health Agency of Canada [homepage on the Internet]. Ottawa, ON: Her Majesty the Queen in Right of Canada; c2012. Notifiable disease on-line: measles; 2003 Dec 11 [cited 2013 Dec 13]. Available from: http://dsol-smed.phac-aspc.gc.ca/dsol-smed/ndis/diseases/meas-eng.php

8.0 Additional Resources

Plotkin, SA, Orenstein, WA, Offit, PA, editors. Vaccines 6th ed. St. Louis, MO: Elsevier Saunders; 2012.

Bellini, WJ, Icenogle, JP. Measles and rubella viruses. In: Versalovic J, Carrol KC, Funke G, Jorgensen JH, Landry MH, Warnock DW, editors. Manual of clinical microbiology. 10th ed. Washington, DC: ASM Press; 2011. p. 1372-87.

Public Health Ontario, Public Health Ontario Laboratory. Labstract: measles PCR – addition to testing menu at PHO laboratories and laboratory testing guidelines for suspected measles cases. Toronto, ON: Ontario Agency for Health Protection and Promotion; 2011 [cited 2012 Dec 13]. Available from: http://www.publichealthontario.ca/en/eRepository/LAB_SD_079_Measles_PCR_testing_guidelines_addition.pdf

Health Protection and Promotion Act, R.S.O 1990, c. H.7. Available from: http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90h07_e.htm

Immunization of School Pupils Act, R.S.O 1990, c. I.1. Available from: http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90i01_e.htm

Day Nurseries Act, R.S.O 1990, c. D.2. Available from: http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_90d02_e.htm

Reports, R.R.O. 1990, Reg. 569. Available from: http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_900569_e.htm

Health Canada. Prevention and control of occupational infections in health care. An infection control guideline. CCDR. 2002;28S1:1-264. Available from: http://publications.gc.ca/collections/Collection/H12-21-3-28-1E.pdf

Joint Communicable Diseases Surveillance Protocols committee, Ontario Hospital Association; Ontario Medical Association. Measles surveillance protocol for Ontario hospitals. Toronto, ON: Ontario Hospital Association; 2014 [cited 2014 Jul 11]. Available from: http://www.oha.com/Services/HealthSafety/Documents/MEASLES%20Revised%20Protocol%20-%20May%202014.pdf

Gregg MB, editor. Field epidemiology. 3rd ed. New York, NY: Oxford University Press; 2008.

Ontario. Ministry of Health and Long-Term Care. Infectious diseases protocol, 2013. Toronto, ON: Queen's Printer for Ontario; 2013. Available from: http://www.health.gov.on.ca/en/pro/programs/publichealth/oph_standards/docs/infectious_diseases.pdf

9.0 Document History

Table 1: History of Revisions

Revision Date	Document Section	Description of Revisions
April 2014	2.1 Surveillance Case Definition	Addition of "Measles is eliminated in Canada; therefore, one case is unexpected." Addition of last paragraph: "Public health units should notify PHO..."
April 2014	2.2 Outbreak Case Definition	Section 2.2 is deleted.
April 2014	3.2 Diagnosis	Addition of "for diagnostic criteria relevant to the Case Definitions" and "For further information…"
April 2014	4.1 Occurrence	Entire section revised.
April 2014	4.6 Host Susceptibility and Resistance	Entire section revised.
April 2014	5.1 To local Board of Health	First paragraph, replaced "Confirmed and suspected cases" with "Individuals who have or may have measles…"
April 2014	5.2 To the Ministry of Health and Long-Term Care (the ministry) or Public Health Ontario (PHO), as specified by the ministry	First paragraph, second sentence: "Any confirmed or probable case of measles identified" replaced with "Any case of measles identified by the public health unit…"
April 2014	6.1 Personal Prevention Measures	First paragraph, second sentence changed from "According to the *Immunization of School Pupils Act*, all students must have documented

Revision Date	Document Section	Description of Revisions
		receipt of two doses of measles containing vaccine" to "According to the *Immunization of School Pupils Act*, all students over 6 years of age must have documented receipt of two doses of measles containing vaccine and students under this age must have documented receipt of a single dose of measles containing vaccine". Second paragraph, first sentence changed from "….days after MMR immunization" to "...days after MMR immunization, although the range can be longer." Second paragraph, last sentence, addition of "(i.e., occurring between 5 and 42 days after immunization)." Third paragraph, first sentence changed from "Healthcare workers should have documentation of two doses of live measles vaccine given after the first birthday, or laboratory evidence of immunity prior to or upon employment…" to "Healthcare workers should have documentation of two doses of measles-containing vaccine given after the first birthday, or laboratory evidence of immunity prior to or upon employment, regardless of their year of birth…"
April 2014	6.2 Infection Prevention and Control Strategies	First bullet point, last sentence changed from "The conservative approach is maintaining patients…" to "The conservative approach is to maintain patients…" Third bullet point updated.
April 2014	6.3 Management of Cases	First paragraph, addition of "including specimens of viral detection. This is particularly important for accurate diagnosis, as well as genotyping, which may provide information on the geographic region of imported and import-associated cases. Genotyping can only be conducted if specimens for viral detection (i.e. PCR testing) are collected." Second paragraph, bullet points updated. Last paragraph, addition of "sporting events" to first sentence. Second last sentence in last paragraph changed

Revision Date	Document Section	Description of Revisions
		from “This should apply whether the case had been previously vaccinated or not” to “This should apply to all cases, regardless of their vaccination history.” Addition of “further” in last sentence.
April 2014	6.4 Management of Contacts	Entire section updated.
April 2014	7.0 References	Updated.
August 2014	4.6 Host Susceptibility and Resistance	First bullet, addition of “(See Note 1)”. Addition of Note 1 at the end of section 4.6.
August 2014	6.3 Management of Cases	Seventh bullet, addition of “whether vaccine was received after exposure to measles” at the end of the sentence. Last paragraph, addition of “self-isolate, including but not limited to, isolation” in the first sentence.
August 2014	6.4 Management of Contacts	Under section titled “Post-exposure prophylaxis (PEP)”, paragraph beginning with “Some adults born after 1970…” moved up from below. Section beginning with “For infants under 12 months of age…” moved up from below. In paragraph beginning with “Susceptible individuals with a medical contraindication to MMR…”, addition of last two sentences. Addition of last paragraph, beginning with “Please refer to the measles chapter…” Under section titled “Exclusion of susceptible contacts”, first bullet revised to include “based on the susceptibility criteria described above, not the publicly-funded schedule”. In paragraph beginning with “There is no requirement to exclude…” addition of “as neither vaccine nor Ig is 100% effective in preventing measles”.

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