

Measles (Rubeola)



Communicable Disease Control Branch

1. Case Definition

1.1 Confirmed Case

Consistent clinical illness^a with laboratory confirmation, in the absence of recent immunization (one to 14 days prior) with measles-containing vaccine. Laboratory confirmation includes at least one of:

- isolation of measles virus from an appropriate clinical specimen
- OR
- detection of measles virus RNA
- OR
- seroconversion or a significant rise in measles IgG titre between acute and convalescent sera by any standard serologic assay
- OR
- positive serologic test for measles specific IgM antibody using a recommended assay^b

OR

In the absence of laboratory confirmation, clinical illness^a in a person with an epidemiologic link to a laboratory-confirmed case (1).

1.2 Probable Case

Clinical illness^a in the absence of appropriate laboratory tests and in the absence of an epidemiologic link to a laboratory-confirmed case in a person who has recently been to an area of known measles activity.

Note: Surveillance for measles focuses on evident disease rather than infection. Therefore, surveillance definitions do not take into account asymptomatic or subclinical infections that may be detectable by laboratory methods (1).

2. Reporting Requirements

Laboratory:

- All positive laboratory results should be faxed (204-948-3044 secure fax) and called into Manitoba Health, Public Health Surveillance Unit at 204-788-6736 or 204-788-8666 (24 hours) for rapid notification.
- Operators of Manitoba clinical laboratories are required to submit to Cadham Provincial Laboratory (CPL) the residual serum, plasma or respiratory specimens or respiratory viral isolate sub-cultures from individuals who tested positive for measles virus within seven days of report.

Health Care Professional:

- The *Communicable Disease Control Investigation Form* (available at: www.gov.mb.ca/health/publichealth/cdc/protocol/form2.pdf) should be faxed (204-948-3044 secure fax) to Manitoba Health, Public Health Surveillance Unit when a health professional becomes aware that a person meets or has recently met the probable or confirmed case definition for measles.

a Clinical illness is characterized by all of the following:

- fever 38.3°C or greater;
- cough, coryza (runny nose) or conjunctivitis; and
- generalized maculopapular rash for at least three days.

Atypical cases in immunocompromised or partially immune persons may lack hallmark symptoms.

b IgM serology may be a false positive. If the clinical presentation is inconsistent with a diagnosis of measles or in the absence of recent travel/exposure history, IgM results must be confirmed by another listed confirmatory method. Most acute measles cases develop IgM three days or more after rash onset. Therefore, a suspected measles case where serum collected ≤ 3 days post rash onset initially tests IgM negative should have a second serum collected > 3 days post rash onset for retesting for IgM.

3. Clinical Presentation/Natural History

The prodromal phase begins 8-12 days after exposure in susceptible persons (2) and may resemble a severe upper respiratory tract infection (3). This phase is characterized by malaise, fever, anorexia, conjunctivitis and respiratory symptoms such as cough and coryza (3). Other symptoms may include diarrhea, especially in infants, and generalized lymphadenopathy (4). Older children may complain of photophobia and occasionally of arthralgia (5). Koplik spots may appear toward the end of the prodrome, just before the appearance of the rash (3). Koplik spots (white spots on a red base on the inner lining of the mouth) usually occur on the mucosa opposite the second molars and begin to slough as the rash appears (3) but occasionally occur on the conjunctiva, vaginal mucosa or the gastrointestinal mucosa (6). The maculopapular rash of measles is usually identified approximately 14 days after exposure (2). It begins on the face, then progresses down the body to the extremities, including the palms and soles (3, 4), and lasts approximately five days (3). Patients tend to be most ill on the first or second day of the rash (3). The rash fades in the same sequence it appears, from head to extremities (4). The characteristic rash may not develop in immunocompromised patients (7). Uncomplicated illness, from late prodrome to resolution of the fever and rash, lasts seven to 10 days (3). The disease is usually more severe in infants and adults than in children (10). Measles is also often more severe in immunocompromised individuals (4) and malnourished children, including those with Vitamin A deficiency (4).

Uncomplicated recovery from measles is the norm in resource-rich areas; but serious complications of the respiratory tract (pneumonia) and central nervous system (CNS) (acute encephalitis) may occur (3). Other potential serious complications include myocarditis, pericarditis and hepatitis. Complications are more common among children younger than five years of age and adults 20 years of age and older (4). Measles virus may directly cause croup, bronchiolitis and pneumonia (3).

Secondary viral (6) or bacterial invasion may also occur, resulting in complications such as pneumonia and otitis media (3). Measles associated with Vitamin A deficiency is a common cause of blindness in developing countries (8). Measles occurring during pregnancy has been associated with spontaneous abortion, premature delivery (3, 9) and low birth weight infants (9). Acute measles encephalitis occurs in approximately one of every 1,000 reported cases and may result in permanent neurologic damage (9). In Canada, death is estimated to occur once in 3,000 cases of measles (9).

A rare late complication of measles infection is subacute sclerosing panencephalitis (SSPE), a chronic and degenerative central nervous system disease characterized by behavioural and intellectual deterioration and seizures progressing to death (2). It occurs several to many years after an attack of measles (3).

Modified forms of measles with generally mild symptoms may occur in infants who still have partial protection from maternal antibody and, occasionally, in persons with only partial protection from the vaccine (5).

Atypical measles may occur in persons who received inactivated (“killed”) measles vaccine (KMV) and are subsequently exposed to wild-type measles virus (4). This is prevented by revaccinating with live measles vaccine (4).

4. Etiology

Measles virus is an RNA virus with only one serotype, classified as a member of the genus *Morbillivirus* of the family Paramyxoviridae. There are numerous distinct genotypes (3). Molecular characterization of a specific virus genotype may identify an outbreak strain when the epidemiologic observations are consistent (5). The primary site of infection is the respiratory epithelium of the nasopharynx (4).

5. Epidemiology

5.1 Reservoir and Source

Humans (10). No non-human reservoir or source of infection has been identified (9). An asymptomatic carrier state has not been documented (4, 11).

5.2 Transmission

Measles is spread by airborne droplets (sneezing or coughing) or direct (close personal) contact with nasal or throat secretions of infected persons (12). The virus may remain infective in droplet nuclei in the air for several hours (3, 4), especially under conditions of low relative humidity (3). It is spread less commonly by articles freshly soiled with nose and throat secretions (10, 12).

In Canada, sustained transmission has been mostly eliminated with high vaccine coverage and the current two dose vaccine schedule for specific groups (9). However, secondary spread from imported cases to the few remaining vulnerable Canadians may occur (9).

Respiratory excretion of the attenuated measles virus used in vaccines may occur after vaccination; however, person-to-person transmission has not been documented (5).

5.3 Occurrence

General: Measles is endemic worldwide (4, 5), with approximately 20 million cases occurring annually (13). In temperate climates, outbreaks generally occur in late winter and early spring (5). In tropical climates, transmission appears to increase after the rainy season (5). Prior to the introduction of universal vaccination, epidemics of measles lasting three to four months occurred consistently every two to five years (3). Outbreaks are attributed to the accumulation of individuals susceptible to measles virus, including both unvaccinated or partially vaccinated persons and those who were vaccinated but failed to seroconvert (5). Since the initiation of universal measles vaccination with the resulting decrease in measles virus circulation, the

average age at which infection occurs has increased (5). Measles is still a common disease and an important cause of death and disability in countries with limited health infrastructure (11). Between 2000 and 2007, the number of reported cases of measles worldwide declined by two-thirds (14). However, there is substantial underreporting of measles cases even in industrialized countries (14). Global mortality from measles was reduced by 74% during this period from an estimated 750,000 to 197,000 (14, 15). The largest regional percentage reduction in estimated measles mortality during 2000-2007 occurred in the Eastern Mediterranean and African regions (14).

Canada: Between 2001 and 2005, the number of measles cases reported annually ranged from six (2005) to 34 (2001), with a yearly average of 14 (9). All cases were imported or import-related (9).

Manitoba: The last large outbreak occurred in 1986 with greater than 3,000 cases. From 2000 to 2009 inclusive, three cases of measles were reported, one in each of 2002, 2003 and 2004.

5.4 Incubation Period

The incubation period of measles following exposure to the onset of the prodrome is 8-12 days (2). Exposure to rash onset averages 14 days (range, 7-18 days) (4). Incubation may be slightly longer in adults (3). Immune globulin given for passive protection early in the incubation period may extend the incubation period rather than prevent disease (10).

5.5 Host Susceptibility and Resistance

All individuals who have not had infection or been effectively immunized or those with profound cellular immunosuppression are susceptible (10). Immunity following natural infection is believed to be lifelong, and vaccination with measles-containing vaccine has been shown to be protective for at least 20 years (5). In Canada, measles-containing vaccine is only available in combination with the rubella and mumps vaccine (MMR).

Individuals are presumed to be immune to measles if they were born before 1970, have a history of laboratory-confirmed measles disease, documented evidence of vaccination with two doses of measles-containing vaccine after their first birthday, or have laboratory evidence of immunity (9). Vaccination protects against all wild-type genotypes (5). Infants whose biological mothers have had disease are generally protected until six to nine months of age or longer by passively acquired maternal measles antibody (10). Infants whose mothers have been immunized have lower levels of passive antibody and may have a shorter duration of protection (10).

5.6 Period of Communicability

Measles is one of the most highly communicable diseases in humans (10). It is most infectious during the late prodromal phase of the illness, when cough and coryza are at their peak (3). The virus can be spread for about four days before rash onset (i.e., one to two days before fever onset) until about four days after rash onset (4, 5, 10, 12). Secondary attack rates among susceptible household contacts have been reported to be 75%- 90% (5). Patients with SSPE are not contagious (2).

6. Laboratory Diagnosis

All lab specimens should include date of onset of both fever and rash.

Virus Detection:

Cadham Provincial Laboratory (CPL) virology section (204-945-6123) should be consulted prior to sending specimens for virus detection. All specimens should be transported with a cold pack (to maintain a temperature of approximately 4°C) to CPL as soon as possible. When investigating a sporadic case, a nasopharyngeal (refer to:

http://www.gov.mb.ca/health/publichealth/cpl/docs/nasopharyngeal_collection.pdf)

or throat swab should be collected for virus isolation. Nasopharyngeal swabs are preferred. Nasopharyngeal and throat swabs should be collected within four days of rash onset. Since the virus is cell associated, the technique should be

vigorous enough to capture some epithelial cells. Swabs should be placed in a tube containing 2-3 ml of viral transport medium (VTM). Also acceptable but least preferred of the virological specimens is urine, 50 mL of which may be collected within seven days of rash onset.

Further strain characterization may be indicated for epidemiological and public health control activities.

Serology:

Serological testing is preferred during established outbreaks. Generally, IgM is used for diagnostic testing and IgG for immune status testing. A specimen for the detection of measles specific IgM antibodies should ideally be taken within three to seven days after rash onset, but may be taken up to 28 days after rash onset. Both false positive and false negative measles IgM results can occur. If the clinical presentation is inconsistent with a diagnosis of measles or in the absence of recent travel/exposure history, a positive IgM result must be confirmed by one of the confirmatory methods listed in section 1, "Case Definition". If a specimen taken ≤ 3 days after rash onset is negative for measles IgM, a second specimen should be obtained three days later. Consideration should also be given to investigation for other exanthem viruses, including parvovirus and rubella.

7. Key Information for Public Health Response

- Immunization history including date(s) and type of vaccine if known.
- Recent exposure/travel history of cases (i.e., 7-18 days before rash onset).
- Identification and appropriate follow-up of susceptible contacts.

8. Control

8.1 Management of Cases

Measles is an uncommon infection in Manitoba that may present with signs and symptoms suggesting a wide differential diagnosis and has a possibility for severe adverse outcomes if not

managed appropriately. Consultation with an expert in infectious diseases is recommended for the management of individual cases of probable or confirmed disease. Reported cases are referred to the Regional Health Authority (RHA) of patient residence or First Nations Inuit Health (if applicable) for follow-up.

Airborne Precautions in addition to Routine Practices should be followed when individuals with probable measles present to a health care setting. Refer to *Infection Control Guidelines: Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care. Canada Communicable Disease Report CCDR, 1999; 25S4: 1-142.*

All cases should be advised to stay home (self-isolate) from school, post-secondary educational institutions, child care facilities, workplaces and other group settings for four days after rash onset. Cases should be advised to practice good hand hygiene, avoid sharing drinking glasses or utensils and cover coughs and sneezes with a tissue or forearm.

Treatment:

- Consultation with an expert in infectious diseases.
- Treatment is supportive (3).
- Bacterial superinfection should be promptly diagnosed and treated with appropriate antimicrobials; prophylactic antibiotics to prevent superinfection are of unproven value and not recommended (3).
- The World Health Organization (WHO) currently recommends Vitamin A for all children with acute measles, regardless of the country of residence. The following doses, once daily for two days are recommended (2):
 - 200,000 IU for children 12 months of age or older;

- 100,000 IU for infants six through 11 months of age; and
- 50,000 IU for infants younger than six months of age.

Cases who are health care workers should be advised to immediately notify Occupational Health and/or Infection Prevention and Control for the facility/regional program in which they work and in consultation with them determine when it is appropriate to return to work. A health care worker (HCW) includes individuals who have the potential to acquire or transmit infection during the course of their work and includes nurses, physicians, other hospital workers, students, volunteers, home-care workers, emergency responders, and support staff (16).

Public Health Measures:

- Individuals with confirmed or probable measles should be excluded from child care facilities, schools, universities and workplaces for four days following appearance of the rash (7, 10).
- Hospitalized Patients:
 - Only measles immune^c personnel should enter the room.
 - In addition to Routine Practices, Airborne Precautions from onset of catarrhal stage of the prodromal period through fourth day of rash should be used to reduce the exposure of other patients. Refer to *Infection Control Guidelines: Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care. Canada Communicable Disease Report CCDR, 1999; 25S4: 1-142.*

c Individuals are presumed to be immune to measles if they were born before 1970, have a history of laboratory-confirmed measles disease, documented evidence of vaccination with two doses of measles-containing vaccine after their first birthday or have laboratory evidence of immunity (9).

8.2 Management of Contacts

Regional Public Health (of case area of residence) or First Nations Inuit Health (FNIH) (if applicable) will contact all reported cases to establish a list of exposed persons and identify susceptible contacts. Examples of exposure situations where contacts should be identified include home, child care facility, school, school bus, workplace, physician office and hospital emergency department. Airline passengers who have been exposed to a confirmed measles case on the same flight should be considered for notification of exposure, assessment of immune status, and recommendation for vaccination if appropriate (i.e., where vaccination is able to be completed within 72 hours of exposure).

Contacts should be counselled regarding the signs and symptoms of measles and the need to report to their health care provider should they occur. Symptomatic contacts should be instructed to call before presenting to a health care provider to reduce the potential impact on susceptible individuals. Contacts should be encouraged to practice good hand hygiene, avoid sharing drinking glasses or utensils and cover coughs and sneezes with a tissue or forearm.

Contacts who are health care workers should be advised to notify Occupational Health and/or Infection Prevention and Control for the facility/regional program in which they work and in consultation with them determine when it is appropriate to return to work.

Definitions:

Contact: Someone who shared the same airspace (no minimum length of time) during the infectious period^d.

Susceptible Contact: A contact (defined above) born during or after 1970^e and not meeting any of the following criteria (9):

- Documented evidence of vaccination with two doses of measles-containing vaccine after their first birthday;

- Laboratory evidence of immunity; or
- History of laboratory-confirmed measles disease.

High Risk Susceptible Contact: A susceptible contact (as defined above) meeting one or more of the following criteria:

- Immunocompromised;
- Pregnant;
- Infant < 12 months of age; or
- Other valid contraindication to the receipt of measles vaccine (e.g., allergy to a vaccine component) (9).

8.2.1 Management of Susceptible Contacts

Susceptible contacts, as defined above, who are ≥ 12 months of age AND do not have contraindications to measles-containing vaccine (e.g., immunocompromised, pregnant, see “High Risk Susceptible Contact” above) should be immunized with MMR as soon as possible. Immunization within 72 hours of exposure may prevent disease. There are no known adverse effects when vaccine is given to people incubating the disease (9). A second dose of MMR vaccine given at least 28 days after the first dose is indicated only for susceptible contacts who received no doses of measles-containing vaccine prior to the exposure. Susceptible contacts who received one dose of measles-containing vaccine prior to the exposure do not require a second post-exposure dose of MMR vaccine. Routine post-immunization serology is not indicated (9).

d The infectious period is four days prior to and four days after rash appears (4, 5, 10, 12).

e Depending on the number of cases, their age and immunization histories, a decision may be made by the Public Health and Primary Health Care Division or Regional Health Authority, in consultation with an Outbreak Response Team, to consider older persons, without two doses of live vaccine, as susceptible.

Immune globulin (Ig) should be considered for susceptible contacts presenting more than 72 hours but within six days of exposure (i.e., too late for vaccine). The recommended dose for immunocompetent individuals is 0.25 mL/kg body weight up to a maximum of 15 mL (9). Refer to the current *Canadian Immunization Guide* and the product monograph for information on clinical use. Refer to “Follow-up After Ig Administration” below.

8.22 Management of High Risk Susceptible Contacts

Immune globulin (Ig) should be administered as soon as possible to high risk susceptible contacts as defined above (i.e., for whom measles-containing vaccine is contraindicated), preferably within three days of exposure but as long as six days after exposure (9). The recommended dose for immunocompetent individuals is 0.25 mL/kg body weight up to a maximum of 15 mL (9). For immunocompromised persons, 0.5 mL/kg is given, up to a maximum of 15 mL (9). Refer to the current *Canadian Immunization Guide* and the product monograph for information on clinical use.

Follow-up After Ig Administration: If clinical measles does not develop in a person administered Ig, measles-containing vaccine should be given five or six months later depending on the Ig dose used (refer to current *Canadian Immunization Guide*), provided the individual is greater than one year of age and there are no contraindications to the vaccine (e.g., pregnant, immunocompromised) (9). A second dose of MMR vaccine given at least 28 days after the first dose is indicated only for susceptible contacts who received no doses of measles-containing vaccine prior to the exposure. Susceptible contacts who received one dose of measles-containing vaccine prior to the exposure do not require a second post-exposure dose of MMR vaccine. Routine post-immunization serology is not indicated (9).

8.23 Children in Schools and Child Care Facilities

Parents/guardians of susceptible^f children attending facilities where a case has occurred should be informed that:

- The measles virus is extremely contagious.
- Susceptible^f children who have not received vaccine within 72 hours of first exposure or Ig within six days of first exposure are highly likely to develop measles infection. Therefore, self-exclusion for 14 days after disease onset in the last known case in the facility is recommended to prevent infection in unimmunized children (2).

Note: Susceptible^f individuals in workplaces and adult educational facilities where a case has occurred who have not received vaccine within 72 hours of first exposure or Ig within six days of first exposure should be informed that self-exclusion for 14 days after disease onset in the last known case is recommended (2, 17) to prevent infection. Individuals attending such facilities who were born before 1970 are presumed to be immune to measles.

Refer also to section 8.3 “Management of Outbreaks” below.

8.24 In Hospitals

Susceptible^f contacts should be discharged if possible before the fifth day after first exposure. Otherwise, place susceptible contacts on Airborne Precautions from day five after first exposure to day 21 after last exposure (11). Refer to *Infection Control Guidelines: Routine Practices and Additional Precautions for Preventing the Transmission of Infection in Health Care. Canada Communicable Disease Report CDR, 1999: 25S4: 1-142.*

^f An individual born during or after 1970 who has no documented evidence of vaccination with two doses of measles-containing vaccine after their first birthday, no laboratory evidence of immunity and no history of laboratory-confirmed measles disease. Depending on the number of cases, their age and immunization histories, a decision may be made by the Public Health and Primary Health Care Division or Regional Health Authority, in consultation with an Outbreak Response Team, to consider older persons, without two doses of live vaccine, as susceptible.

8.3 Management of Outbreaks

Definition of Outbreak: Confirmed cases in excess of what is expected in the jurisdiction over a given time period.

With the current childhood two-dose schedule for measles-containing vaccine, large outbreaks of measles are not expected to occur (9). However, imported cases will result in limited transmission of measles, usually among unvaccinated children and young adults who have not received two doses of vaccine (9).

- Before any intervention is initiated, probable measles cases should be promptly confirmed by culture or serology (9).
- Public notification should occur: the level of notification will be at the discretion of regional Public Health and/or the Office of Disaster Management.
- Contacts^g of confirmed cases should be informed that measles virus is circulating and that immunization should be updated if necessary (9). Measles-containing vaccine may be given as early as six months of age in outbreak situations, with an additional two doses given after the child's first birthday according to the recommended immunization schedule below under section 8.4 (2, 9).
- Management of outbreaks may require mass immunization campaigns for selected age ranges. This will be determined by the Public Health and Primary Health Care Division or Regional Health Authority, in consultation with an Outbreak Response Team.
- Ig is not recommended as a general strategy to control measles outbreaks; however, it should be administered to high risk susceptible contacts as described above under "Management of Contacts" (9).

- Active surveillance measures should remain in place until four weeks after the last case occurs (17).

8.4 Preventive Measures

- Prompt identification and management of cases and contacts.
- Immunization:
 - Children: Routine two-dose immunization of all children, unless contraindicated (9). Infants should receive a first dose combined with mumps and rubella vaccines (MMR) on or shortly after their first birthday; the second dose should be given at least 28 days after the first dose and after 15 months of age, but before school entry (9). Refer to the current *Manitoba Recommended Immunization Schedules for Infants, Children and Adults* available at: <http://www.gov.mb.ca/health/publichealth/cdc/fs/irg.pdf>. Vaccination of children as early as six months of age may be recommended during outbreaks or international travel to an area where measles is endemic with an additional two doses of MMR given after the child's first birthday (2, 9).
 - Adults: Immunization of adults born *during or after 1970 who have not received a measles-containing vaccine or had natural measles infection*, unless contraindicated (9). A second dose of MMR should be offered only to adults born *during or after 1970* who are at greater risk of exposure specifically:
 - Travellers to measles endemic areas;
 - Health care workers;
 - Military recruits; and
 - Students at post-secondary institutions.

^g For practical purposes, all students attending the same school or facility should be considered contacts (9).

Please refer to the current *Canadian Immunization Guide* as well as the manufacturer's package insert instructions for clinical use information on measles-containing vaccine.

Note: Not all recommended vaccines and immune globulins are provided by Manitoba Health (e.g., second MMR dose for travel). Refer to Manitoba Health's eligibility criteria for high risk individuals available at:

<http://www.gov.mb.ca/health/publichealth/cdc/vaccineeligibility.html>.

9. Additional Resources

- Manitoba Immunization Schedules – available at:
<http://www.gov.mb.ca/health/publichealth/cdc/schedule.html>
- *Canadian Immunization Guide*

References

1. Public Health Agency of Canada. Case Definitions for Communicable Diseases under National Surveillance. *Canada Communicable Disease Report CCDR*, 2009; 35S2: 71-72.
2. American Academy of Pediatrics. Measles. In: Pickering LK ed. *Redbook 2009 Report of the Committee on Infectious Diseases 28th ed.* Elk Grove Village, IL: American Academy of Pediatrics, 2009; 444-455.
3. Gershon Anne A. Measles Virus (Rubeola). In: Mandell GL, Bennell JE, Dolin R eds. *Principles and Practice of Infectious Diseases 6th ed.* Elsevier, Philadelphia, 2007; 2031-2038.
4. Centers for Disease Control and Prevention. Chapter – Measles. *Epidemiology and Prevention of Vaccine-Preventable Diseases, The Pink Book: Updated 11th Edition* 2009.
5. Pan American Health Organization. *Measles Elimination Field Guide Second Edition* 2005.
6. Steichan, Oliver and Dautheville Sandrine. Koplik spots in early measles. *Canadian Medical Association Journal* 2009; 180(5): 583.
7. Manitoba Health Communicable Disease Control Branch. Measles – Communicable Disease Management Protocol, November 2001.
8. Perry, Robert T and Halsey, Neal A. The Clinical Significance of Measles: A Review. *Journal of Infectious Diseases* 2004; 189 (Suppl 1): S4-16.
9. National Advisory Committee on Immunization. *Canadian Immunization Guide 7th ed.* Public Health Agency of Canada, 2006; 228-236.
10. Heymann David L. Measles. In: *Control of Communicable Diseases Manual 19th ed.*, American Public Health Association, Washington, 2008; 402-408.
11. World Health Organization. Measles vaccines: WHO position paper. *Weekly Epidemiological Record* 2009; No. 35, 84: 349-360.
12. Public Health Agency of Canada. Vaccine-Preventable Diseases Measles. Updated: February 19, 2008.
13. Centers for Disease Control and Prevention. Measles – United States, January 1-April 25, 2008. *Morb Mort Wkly Rep MMWR* 2008; 57(18): 494-498.
14. World Health Organization. Progress in global measles control and mortality reduction, 2000-2007. *Weekly Epidemiological Record* 2008; No. 49, 441-448.
15. Joint News Release WHO/UNICEF/American Red Cross/CDC/UN Foundation 4 December 2008. Global Measles Deaths Drop by 74%: The Eastern Mediterranean region achieves measles goal three years early.
16. Public Health Agency of Canada. Guidelines for the Prevention and Control of Mumps Outbreaks in Canada. *Canada Communicable Disease Report CCDR*, 2010; 36S1: 1-46.
17. Health Canada. Guidelines for Control of Measles Outbreaks in Canada (Revised 1995). *Canada Communicable Disease Report*, 1995; 21: 189-195.