Section 4

Vector-Borne and Zoonotic Disease

Government of Saskatchewan

Notification Timeline:

From Lab/Practitioner to Public Health: Immediate.

From Public Health to Saskatchewan Health: Within 72 hours.

Public Health Follow-up Timeline: Initiate within 24-48 hours.

Public Health Purpose for Notification of Hantavirus Infections (adapted from Public Health Ontario, 2016)

- To track trends of the epidemiology of Hantavirus infections in Saskatchewan including risk factors and geographic distribution;
- To monitor disease burden and outcomes of hantavirus infections in Saskatchewan;
- To inform the public, occupational and health care provider communities about this disease and how to prevent it; and
- To identify locations where increased transmission of Hantavirus may be occurring in order to inform other interventions.

Surveillance Case Definition[1] – Hantavirus Pulmonary Syndrome (HPS)

Confirmed Case (Public Health Agency of Canada, 2008)	Clinical illness[1] with laboratory confirmation of infection: • detection of IgM antibodies to hantavirus **OR** • detection of a significant (e.g., fourfold or greater) increase in hantavirus-specific IgG **OR** • detection of hantavirus ribonucleic acid (RNA) in an appropriate clinical specimen **OR** • detection of hantavirus antigen by immunohistochemistry.
Probable Case (Saskatchewan Ministry of Health, 2013)	Clinical illness[1] with a history of exposure compatible with hantavirus transmission and lab confirmation is pending.

[1] Surveillance case definitions ensure uniform reporting to allow comparability of surveillance data and support public health investigation and management. The definition is not intended to be used for clinical or laboratory diagnosis or management of patients.

[1] Clinical illness is typically characterized by:

- a febrile illness (temperature > 38.3°C (101°F) oral) requiring supplemental oxygen
  AND
- bilateral diffuse infiltrates (may resemble acute respiratory distress syndrome[ARDS])
  AND
- develops within 72 hours of hospitalization in a previously healthy person.

OR

An unexplained illness resulting in death with an autopsy examination demonstrating noncardiogenic pulmonary edema without an identifiable specific cause of death.

Epidemiology and Occurrence

Under Development

Additional Background Information

Causative Agent

Any of several hantavirus strains.

Hantaviruses are RNA viruses of the *Bunyaviridae* family. The most common cause of hantavirus pulmonary syndrome (HPS) is the Sin Nombre species. There are multiple other strains of hantavirus that cause different clinical illnesses (American Academy of Pediatrics, 2015).

Symptoms

The prodromal illness of HPS is 3-7 days. Signs and symptoms during this time period include fever; chills; headache; myalgia of the shoulders, lower back and thighs; nausea; vomiting; diarrhea; dizziness and sometimes coughing. Following the onset of cough and dyspnea is the onset of respiratory tract signs and symptoms caused by pulmonary edema and severe hypoxemia, after which the disease progresses over a period of a few hours (American Academy of Pediatrics, 2012).

Complications

Rapid progression to severe respiratory failure and shock with fatality rates of approximately 35-50% (Heymann, 2015).

Reservoir/Source
The main reservoir for the Sin Nombre strain of hantavirus in North America is the deer mouse, but can also be isolated in pack rats, chipmunks and other rodents. Rodent species of the subfamily *Sigmodontinae* are mainly associated with other hantavirus strains (Heymann, 2008).

Mode of Transmission
Aerosol transmission from rodent excreta, especially inside closed, poorly ventilated homes, vehicles and out buildings is the most likely mode of transmission (Heymann, 2015). Other potential routes include ingestion, contact of infectious materials with mucous membranes, broken skin and animal bites. Person-to-person transmission is extremely rare but has occurred in Argentina (Public Health Agency of Canada, 2010).

Incubation Period
Approximately 2 weeks, with a range of a few days to 6 weeks (Heymann, 2015).

Period of Communicability
Person-to-person transmission has not been described in North America. Outside of a host, the virus is inactive within a week outdoors and after a few hours when exposed to direct sunlight (Canadian Centre for Occupational Health and Safety, 2008).

Specimen Collection and Transport
Collect blood in serum separator vacutainer (SST). Centrifuge. If shipping will be delayed, ship 2 ml serum in a screw cap tube, with cold packs or on dry ice. Follow Roy Romanow Provincial Laboratory (RRPL) specimen collection guidelines available in the RRPL Compendium of Tests at https://rrpl-testviewer.ehealthsask.ca/.

Risk Groups
- farmers;
- grain handlers;
- hikers;
- campers;
- people in occupations with unpredictable or incidental contact with rodents or their nesting materials are at risk (e.g., telephone installers, oil workers, plumbers, electricians, pest control officers and certain construction, maintenance and wildlife workers [Saskatchewan Ministry of Labour and Workplace Safety, 2011]).

Risk Activities

Handling or trapping rodents, cleaning/entering rarely used and closed rodent-infested structures, cleaning animal shelter or food storage areas, living in a place with an increased density of mice in or around the home, or sleeping in a structure inhabited by rodents (American Academy of Pediatrics, 2015).

Public Health Investigation

I. Case

History

Classify case in consultation with the attending physician and the case definitions. Refer to Attachment – Hantavirus Data Collection Worksheet to assist in the investigation.

- Clinical manifestation and onset dates can help identify exposure timelines.
- Exposure to mice, their saliva, and their excrement is key in the *acquisition* of hantavirus infections. In the past 6 weeks identify if the case has been involved in:
  - cleaning/entering rarely used and closed rodent-infested structures;
  - cleaning animal shelter or food storage areas;
  - handling or trapping rodents;
  - living in a place with an increased density of mice in or around the home;
  - sleeping in structure inhabited by rodents;
  - exposure through camping, hiking, etc.;
  - other.
- Identify the area where the exposure has occurred. Was there indoor exposure in closed, poorly ventilated:
  - barns;
  - outbuildings;
  - vehicles;
  - homes where visible rodent infestation is apparent?

If yes, identify geographic area where exposure occurred (e.g. city, town or RM).

Outcome

Did the patient require admission to an intensive care unit?

What was the outcome of the infection?

- recovered;
- fatal.

Treatment/Supportive Therapy
The primary care provider is responsible for the treatment and clinical management of cases. The following serves as a reference for the public health investigator: Intensive respiratory support is often required. Suspected patients should be immediately transported to a tertiary care facility so supportive management can be initiated within the critial first 24-48 hours of illness (American Academy of Pediatrics, 2015).

Public Health Interventions

Assessment

- Assess for contacts paying particular attention individuals that have had exposure to the same source.

Communication

- Letters can be used to inform contacts of the exposure, symptom monitoring and when to seek medical attention (see Sample letter).

Education

- All cases should be provided disease information as well as information on prevention and control measures.

Environmental Health

- When acquisition is linked to a public facility, inspection may be warranted.

Referrals

When a case of hantavirus is associated with an occupational exposure, Section 9 of *The Disease Control Regulations*[2] stipulates that the medical health officer (MHO) shall notify the director (as defined in *The Occupational Health and Safety Act, 1993*[3]). In order to fulfill this obligation, they must complete and send the form in Appendix L – Notification of Occupational Health and Safety within 14 days.

II. Contact

Contact Definition

Individuals who have been exposed to the same settings where the case likely acquired infection.

[2] http://www.qp.gov.sk.ca/documents/english/Regulations/Regulations/p37-1r11.pdf.
[3] http://www.qp.gov.sk.ca/documents/English/Statutes/Statutes/P37-1.pdf.

Public Health Interventions

Assessment

- Assess for symptoms.

Education

- Hantavirus information sheet is a resource to guide content of education.
- Contacts should be informed that if they develop a fever or respiratory illness within 6 weeks of the last potential exposure they should immediately seek medical attention and inform the attending physician of the risk of having acquired hantavirus infection.

Environmental Health

- If investigation indicates potential for other persons to be exposed, environmental health assessments may be required.

Referral

- Symptomatic contacts should be referred to their primary care provider for assessment.

Testing

- Symptomatic contacts should be tested based on clinical assessment of the practitioner.

III. Environment

Safety measures must be implemented when cleaning areas that have had rodent infestations. Refer to *Hantavirus Disease: Guidelines for Protecting Workers and the PublicA Hantavirus Exposure Control Program for Employers and Workers* (Worksafe BC, 2006)[4] for proper cleaning procedures and use of personal protective equipment.

In situations where the public may be experiencing ongoing exposures, additional measures may need to be taken in consultation with the MHO.

Epidemic Measures

Public education regarding rodent avoidance and control.

[4] https://www.worksafebc.com/en/resources/health-safety/books-guides/a-hantavirus-exposure-control-program-for-employers-and-workers?lang=en&origin=s&returnurl=https%3A%2F%2Fwww.worksafebc.com%2Fen%2Fsearch%23q%3Dhantavirus%26sort%3Drelevancy%26f%3Alanguage-facet%3D%5BEnglish%5D&highlight=hantavirus

Prevention Measures

Refer to the Vector Borne and Zoonotic Diseases – Introduction and General Considerations section of the manual that highlights topics for client education that should be considered and provides further information on high-risk groups and activities.

Prevention measures are where most emphasis should be placed; risk reduction through environmental hygiene practices that discourage rodents from colonizing the home and work environment and that minimize aerosolization and contact with virus in saliva and excreta (America Academy of Pediatrics, 2015).

Immunization
Currently, there is no vaccine available to prevent hantavirus infections.

Education
Education should be provided regarding rodent avoidance and control in homes and outbuildings. People should be informed about personal protective measures that should be taken when handling rodents and rodent excreta.

In addition to general messaging, education should be targeted to Risk Groups on prevention measures as follows:

- control rodents;
- clean buildings and worksites;
- minimize exposure to sources of infection.

Hantavirus Disease: Guidelines for Protecting Workers and the PublicA Hantavirus Exposure Control Program for Employers and Workers (Worksafe BC, 2006).

Additional information can also be found at http://www.saskatchewan.ca/residents/health/diseases-and-conditions/hantavirus.

Revisions

Date	Change
August 2018	• Incorporated Public Health Purpose of Notification. • Reorganized chapter and applied new format. • Included a placeholder for **Epidemiology and Occurrence** section. • Aligned with Panorama configuration. • References reaffirmed or updated as necessary. • Removed link to web content that was no longer available on a Saskatchewan website and replaced with a link to BC content.

References

American Academy of Pediatrics. (2015). *Red book: 2015 Report of the Committee on Infectious Diseases* (30th ed.). Elk Grove Village, IL: Author.

Canadian Centre for Occupational Health and Safety. (2016). *Hantavirus*. Retrieved August, 2018 from http://www.ccohs.ca/oshanswers/diseases/hantavir.html.

Heymann, D. L. (Ed.). (2015). *Control of communicable diseases manual* (20th ed.). Washington, DC: American Public Health Association.

Public Health Agency of Canada. (2008). Case definitions for communicable diseases under national surveillance. *Canada Communicable Disease Report (CCDR), 35S2, November 2009*. Retrieved August, 2018 from http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/09vol35/35s2/Hanta-eng.php.

Public Health Agency of Canada. (2015). *Hantavirus spp.: Pathogen safety data sheet – infectious substances*. Retrieved August, 2018 from http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/hantavirus-eng.php.

Workers Compensation Board of BC. (2006). A hantavirus exposure and control program for employers and workers. Retrieved August, 2018 from https://www.worksafebc.com/en/resources/health-safety/books-guides/a-hantavirus-exposure-control-program-for-employers-and-workers?lang=en&origin=s&returnurl=https%3A%2F%2Fwww.worksafebc.com%2Fen%2Fsearch%23q%3Dhantavirus%26sort%3Drelevancy%26f%3Alanguage-facet%3D%5BEnglish%5D&highlight=hantavirus

Government of Saskatchewan

Hantavirus infection Data Collection Worksheet

PANORAMA

Please complete **all** sections.

Panorama QA complete: ☐ **Yes** ☐ **No**
Initials:

Panorama Client ID: _____
Panorama Investigation ID: _____

A) CLIENT INFORMATION

LHN -> SUBJECT -> CLIENT DETAILS -> PERSONAL INFORMATION

Last Name:	First Name: and Middle Name:	Alternate Name (Goes by):
DOB: YYYY / MM / DD Age: _____ Phone #: ☐ Primary Home: ☐ Mobile contact: ☐ Workplace:	Health Card Province: _____ Health Card Number (PHN): _____	Preferred Communication Method: (specify - i.e. home phone, text): Email Address: ☐ Work ☐ Personal
Place of Employment/School:	Gender: ☐ Male ☐ Female ☐ Other ☐ Unknown	
Alternate Contact: _____ Relationship: _____ Alt. Contact phone: _____	Address Type: ☐ No fixed ☐ Postal Address ☐ Primary Home ☐ Temporary ☐ Legal Land Description Mailing (Postal address): Street Address or FN Community (Primary Home): Address at time of infection if not the same:	

B) INVESTIGATION INFORMATION

LHN-> SUBJECT SUMMARY-> ZOONOTIC AND VECTORBORNE ENCOUNTER GROUP->CREATE INVESTIGATION

Disease Summary Classification: CASE:	**Date**	**Classification: CASE:**	**Date**	**LAB TEST INFORMATION:**
☐ Confirmed	YYYY / MMM / DD	☐ Does Not Meet Case	YYYY / MMM / DD	Date specimen collected: YYYY / MMM / DD
☐ Probable	YYYY / MMM / DD	☐ Person Under Investigation	YYYY / MMM / DD	**Specimen Type**
☐ Suspect	YYYY / MMM / DD			

Disposition:
FOLLOW UP:

☐ In progress	YYYY / MMM / DD	☐ Complete	YYYY / MMM / DD
☐ Incomplete - Declined	YYYY / MMM / DD	☐ Not required	YYYY / MMM / DD
☐ Incomplete – Lost contact	YYYY / MMM / DD	☐ Referred – Out of province (Specify where)	YYYY / MMM / DD
☐ Incomplete – Unable to locate	YYYY / MMM / DD		YYYY / MMM / DD

REPORTING NOTIFICATION Name of Attending Physician or Nurse:	Location:
Provider's Phone number:	Date Received (Public Health): YYYY / MMM / DD

Type of Reporting Source: ☐ Health Care Facility ☐ Lab Report ☐ Nurse Practitioner ☐ Physician ☐ Other_____

C) DISEASE EVENT HISTORY

LHN-> INVESTIGATION->DISEASE SUMMARY (UPDATE)->DISEASE EVENT HISTORY

Site / Presentation: ☐ Hantavirus pulmonary syndrome ☐ Hemorrhagic fever with renal syndrome ☐ Other

Hantavirus infection Data Collection Worksheet

Please complete **all** sections.

Panorama Client ID: _____
Panorama Investigation ID: _____

D) SIGNS & SYMPTOMS *(Bold text = part of case definition)*

LHN-> INVESTIGATION-> SIGNS & SYMPTOMS

Description	Yes – Date of onset	Description	Yes - Date of onset
Acute respiratory distress syndrome (ARDS)	YYYY / MMM / DD	Lab - platelet count low	YYYY / MMM / DD
Chills	YYYY / MMM / DD	Myalgia (muscle pain)	YYYY / MMM / DD
Cough	YYYY / MMM / DD	Nausea	YYYY / MMM / DD
Diarrhea	YYYY / MMM / DD	Oliguria or anuria (decreased urine output)	YYYY / MMM / DD
Dizziness	YYYY / MMM / DD	Pain - abdominal	YYYY / MMM / DD
Dyspnea (shortness of breath)	YYYY / MMM / DD	Pain - back	YYYY / MMM / DD
Fever	YYYY / MMM / DD	**Pulmonary edema - noncardiogenic**	YYYY / MMM / DD
Headache	YYYY / MMM / DD	**Pulmonary edema - unexplained noncardiogenic (autopsy)**	YYYY / MMM / DD
Hemorrhagic manifestations	YYYY / MMM / DD	**Pulmonary infiltrates - diffuse - bilateral**	YYYY / MMM / DD
Hypotension	YYYY / MMM / DD	Rash - petechial	YYYY / MMM / DD
Hypoxemia - severe	YYYY / MMM / DD	**Respiratory compromise - oxygen therapy required**	YYYY / MMM / DD
Lab - hematocrit - elevated		Respiratory failure – requiring mechanical ventilation	
Lab - hypoalbuminemia	YYYY / MMM / DD	Vomiting	YYYY / MMM / DD
Other S/S			

E) INCUBATION

LHN-> INVESTIGATION->INCUBATION & COMMUNICABILITY

Incubation for Case (period for acquisition):
Earliest Possible Exposure Date: YYYY / MMM / DD **Latest Possible Exposure Date**: YYYY / MMM / DD

Exposure Calculation details:

F) RISK FACTORS *(in the 8 weeks prior to onset of illness)*

LHN-> SUBJECT->RISK FACTORS

DESCRIPTION	YES	N – No NA – not asked U - Unknown	DESCRIPTION	YES	N – No NA – not asked U - Unknown
Animal Exposure Rodents/rodent excreta	YYYY /MM/DD		**Occupation** - Other (specify)		
Behaviour – Camping/hiking	YYYY /MM/DD		**Travel** – Outside of Canada (specify)	YYYY /MM/DD	
Behaviour – Lack of personal protective measures			**Travel** – Outside of Saskatchewan, but within Canada (specify)	YYYY /MM/DD	
Environmental Exposure – contaminated building	AE		**Travel** – Within Saskatchewan (Specify)	YYYY /MM/DD	
Occupation – Farmer					

G) COMPLICATIONS

LHN-> INVESTIGATION->COMPLICATIONS

Description	Yes Date of onset	Description	Yes Date of onset
Hemorrhage - severe	YYYY / MMM / DD	Shock	YYYY / MMM / DD
Other complications			

Hantavirus infection Data Collection Worksheet

Please complete **all** sections.

Panorama Client ID: _____
Panorama Investigation ID: _____

H) TREATMENT

INVESTIGATION-> MEDICATIONS->MEDICATIONS SUMMARY

Medication *(Panorama = Other Meds)* : _____

Prescribed by:_____ Started on: YYYY / MMM / DD

I) INTERVENTIONS

INVESTIGATION->TREATMENT & INTERVENTIONS->INTERVENTION SUMMARY

Intervention Type and Sub Type:

Assessment:
☐ Assessed for contacts YYYY / MM / DD
Investigator name

Environmental health:
☐ Inspection YYYY / MM / DD
Investigator name

Communication:
☐ Other communication (see Investigator Notes) YYYY / MM / DD
Investigator name
☐ Letter (See Document Management) YYYY / MM / DD
Investigator name

Referral:
☐ Saskatchewan Occupational Health and Safety YYYY / MM / DD
Investigator name

General: Investigator name
☐ Disease-Info/Prev-Control YYYY/ MM / DD
☐ Disease-Info/Prev-Cont/Assess'd for Contacts YYYY/ MM / DD

Other Investigation Findings:
☐ Investigator Notes YYYY / MM / DD
☐ See Document Management YYYY / MM / DD

Education/counselling:
☐ Prevention/Control measures YYYY / MM / DD
☐ Disease information provided YYYY / MM / DD
Investigator name

Date	Intervention subtype	Comments	Next follow-up Date	Initials
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	

J) OUTCOMES *(optional except for severe influenza)*

LHN-> INVESTIGATION->OUTCOMES

☐ Not yet recovered/recovering YYYY / MM / DD
☐ Recovered YYYY / MM / DD
☐ Fatal YYYY / MM / DD
☐ ICU/intensive medical care YYYY / MM / DD
☐ Intubation /ventilation YYYY / MM / DD
☐ Other _____ YYYY / MM / DD
☐ Hospitalization YYYY / MM / DD
☐ Unknown YYYY / MM / DD

Cause of Death: (if Fatal was selected) _____

K) EXPOSURES

Acquisition Event

LHN-> INVESTIGATION-> EXPOSURE SUMMARY-> ACQUISITION QUICK ENTRY

Acquisition Event ID:_____

Exposure Name: _____

Acquisition Start YYYY / MM / DD to **Acquisition End:** YYYY / MM / DD

Location Name: _____

Setting Type

☐ Travel

☐ Most likely source

Initial Report completed by:		**Date initial report completed:** YYYY / MMM / DD

Notification Timeline:

From Lab/Practitioner to Public Health: Within 48 hours.
From Public Health to Ministry of Health: Within 2 weeks.

Public Health Follow-up Timeline: Within 72 hours.

Public Health Purpose for Notification of Lyme Disease (adapted from Public Health Ontario, 2016)

- To track trends of the epidemiology of Lyme disease in Saskatchewan including risk factors and geographic distribution;
- To inform the public and health care provider community about this emerging disease and how to prevent it;
- To identify locations where increased transmission of Lyme disease may be occurring in order to inform other interventions.

Surveillance Case Definition[1] (adapted from US Centers for Disease Control and Prevention, 2017)

Saskatchewan's Ministry of Health has adapted surveillance case definitions from US Centers for Disease Control and Prevention for surveillance of Lyme disease. The provincial case definitions will facilitate identification of Lyme disease acquired in Saskatchewan from:

1) adventitious infected black-legged ticks originating in the United States that are dropped by migrating birds; and
2) undetected reproducing infected black-legged ticks .

These case definitions acknowledge that Lyme disease is an emerging concern in this province. The Ministry is committed to surveillance of black-legged ticks in the province but this surveillance will never be exhaustive.

[1] Surveillance case definitions ensure uniform reporting to allow comparability of surveillance data and support public health investigation and management. The definition is not intended to be used for clinical or laboratory diagnosis or management of patients.

Confirmed Case	Clinical evidence of illness with laboratory confirmation by one of the following methods: • isolation of *Borrelia burgdorferi* from an appropriate clinical specimen **OR** • detection of *B. burgdorferi* DNA by PCR in synovial fluid, cerebrospinal fluid, erythema migrans tissue biopsies or blood. **OR** Clinical evidence of illness with: • a history of a tick exposure[a] **OR** history of residence in or visit to a risk area **AND** • laboratory evidence of infection: o positive serologic test results using the two-tiered approach (ELISA followed by an immunoblot assay; e.g. Western Blot or line blot).[2]
Probable Case	Clinical evidence of illness without a history of exposure and with laboratory evidence of infection: • positive serologic test results using the two-tiered approach (ELISA followed by an immunoblot assay; e.g. Western Blot or line blot). **OR** Clinician-observed erythema migrans without laboratory evidence and one or more of the following: • history of tick exposurea; • residence in a risk area; • visit to a risk area
Suspect Case	Erythema migrans rash without history of residence in or travel to a risk area and treatment with antibiotics prior to lab test confirmation. NOTE: Visual documentation (digital photo) of the erythema migrans rash may be useful in supporting this diagnosis.
[a] Tick exposure: having been (less than or equal to 30 days before onset of EM) in wooded, brushy, or grassy areas (i.e. potential tick habitats) of Lyme disease vectors. A detailed travel history is needed since infected ticks are not uniformly distributed. History of a tick bite is not required.	

[2] See guidelines of the Canadian Public Health Laboratory Network at: https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2014-40/ccdr-volume-40-11-may-29-2014/ccdr-volume-40-11-may-29-2014-1.html

Epidemiology and Occurrence

Lyme disease is a well-established tick-borne disease in many areas of North America and Europe. The risk of acquiring it increases in areas where the *Ixodes* species that carry *Borrelia burgdorferi* have become established. The range of Ixodes scapularis (black-legged tick) has expanded significantly in Canada and the United States, resulting in an increase in the potential for acquiring Lyme disease. The Public Health Agency of Canada has defined a risk area[3] in Canada as a locality in which there is evidence for the occurrence of reproducing populations of known tick vector species (particularly *Ixodes scapularis* and *I. pacificus*) and the likely transmission of *B. burgdorferi* (Public Health Agency of Canada, 2016).

In Saskatchewan, there are **no known** reproducing populations of black-legged ticks at this time. However, each year adventitious black-legged ticks are found in the province, most likely carried by migratory birds. Since 2008, eight of these ticks have tested positive for *B. burgdorferi*. Primary care providers regularly submit hundreds of blood specimens to the Roy Romanow Provincial Laboratory for testing (**Table 1**). Each year the number of tests increases (Figure 1 - Geographic distribution of black-legged ticks in Saskatchewan 2008–2017). In Saskatchewan, the risk of acquiring Lyme disease or other tick borne infections is low, but not zero.

The known locations of Lyme disease risk areas are available at:

- In Canada - Please refer to provincial risk maps if available, if not refer to the map at this link: https://www.canada.ca/en/public-health/services/diseases/lyme-disease/risk-lyme-disease.html#a3
- In US - https://www.cdc.gov/ticks/geographic_distribution.html
- In Europe (vector is Ixodes ricinus) - https://ecdc.europa.eu/en/disease-vectors/surveillance-and-disease-data/tick-maps
- Elsewhere - https://wwwnc.cdc.gov/travel/destinations/list

[3] A risk area in Canada is determined by one of the following methods:

i) active field surveillance involving capture of wild rodent reservoirs as well as drag sampling on multiple occasions to ensure that ticks have become established (as evidenced by demonstration of all three feeding stages of the tick over more than one year) and that *B. burgdorferi* is being transmitted (as evidenced by molecular detection or culture of ticks or rodent samples);
ii) active field surveillance involving only drag sampling for ticks;
iii) evidence from passive tick surveillance when using field-validated methods of analysis of these data to improve their specificity in detecting tick populations (these may include high numbers of submitted ticks, immature ticks and multiple ticks found feeding on humans or animals);
iv) field-validated signals from human case surveillance; or
v) field-validated ecological/niche models that predict risk.

Table 1: Ticks, human cases and blood samples tested in Saskatchewan by year (2008-2017)

Year	Ticks			Human		
				Cases		Blood specimens Tested
	Ticks (all species)	Black-legged ticks	Black-legged ticks positive for *Borrelia burgdorferi*[1]	Canada	SK	
2008	N/A	5	0	N/A	0	N/A
2009	1,478	5	1	144	0	543
2010	1,139	3	0	143	0	801
2011	736	3	1	266	1[3]	599
2012	2,896	1	0	338	0	850
2013	1,726	10	1	682	1[3]	811
2014	3,176	5	0	522	0	1,174
2015	5,103	9	1	917	0	1,311
2016	5,300	9	0	987	1[3]	1,428
2017	5,112[2]	15[2]	4	N/A	4[3]	1,639[4]
Total	**26,666**	**65**	**8**	**3,853**[5]	**7**	**9,156**[5]

Sources: Public Health Agency of Canada and the Roy Romanow Provincial Laboratory
Notes:
[1] *Borrelia burgdorferi* is the agent that causes Lyme disease.
[2] Number of ticks collected to November 5, 2017.
[3] 2011 case possibly locally acquired but associated with travel; 2013 and 2016 cases linked to travel outside the province; in 2017, one case acquired locally and three cases linked to travel outside the province.
[4] Testing increased by 202 per cent from 2009 to 2017.
[5] Canadian cases include both probable and confirmed cases; Saskatchewan cases are confirmed cases only.

Additional Background Information

Causative Agent

Borrelia burgdorferi, a tick-borne spirochete (Heymann, 2015).

Symptoms

Lyme disease is a multisystem inflammatory disease that generally manifests in three stages: early localized, early disseminated, and late disease.

Symptoms of early or late disseminated Lyme disease are described in the 2006 clinical practice guidelines of the Infectious Diseases Society of America (Wormser, 2006).

Objective evidence of Lyme disease includes the following when an alternative explanation is not found:

Lyme disease has three stages if left untreated:

i) Early localized Lyme disease characterised by a red rash called erythema migrans (EM) that spreads from the site of the tick bite (as described below);

ii) Early disseminated Lyme disease characterised by one of the following:
- multiple EM rashes;
- neurological (facial paralysis or meningitis-like) manifestations;
- heart problems (palpitations caused by heart block) which may last several weeks to months; and

iii) Late disseminated Lyme disease which is most commonly characterized by intermittent arthritis that may last months to over a year.

Erythema migrans: a round or oval expanding erythematous area of the skin greater than 5 cm in diameter and enlarging slowly over a period of several days to weeks. It appears 7-14 days (range 3-30 days) after infection and persists for up to eight weeks. Some lesions are uniform in redness while others have a prominent central clearing or a distinctive target-like appearance. On the lower extremities, the lesion may be partially purpuric. Signs of acute or chronic inflammation are not prominent. There is usually little pain, itching, swelling, scaling, exudation or crusting, erosion or ulceration, except that some inflammation associated with the tick bite itself may be present at the very centre of the lesion.

Note: An erythematous skin lesion present while a tick vector is still attached or that has developed within 48 hours of detachment is most likely a tick bite hypersensitivity reaction (i.e., a non-infectious process), rather than erythema migrans. Tick bite hypersensitivity reactions are usually < 5 cm in largest diameter, sometimes have an urticarial appearance and typically begin to disappear within 24-48 hours.

Complications

Post-Treatment Lyme Disease Syndrome

A small percentage of patients complain of pain, neurocognitive, or fatigue symptoms for months or years afterwards, despite resolution of the objective manifestations of the initial infection with antibiotic therapy (Steere, 2012). Indistinguishable from chronic fatigue syndrome or fibromyalgia, these patients tend to have more generalized or disabling symptoms: marked fatigue, severe headache, diffuse musculoskeletal pain, multiple symmetric tender points in characteristic locations, pain and stiffness in many joints, diffuse paresthesias, difficulty with concentration, or sleep disturbance. Patients with these conditions lack evidence of joint inflammation; they have normal neurologic test results; and they usually have a greater degree of anxiety and depression.

At the present time there is no evidence that persistent subjective symptoms after recommended courses of antibiotic therapy for Lyme disease are caused by active *B. burgdorferi* infection (Steere, 2012). Most medical experts believe that the lingering symptoms are the result of residual damage to tissues and the immune system that occurred during the infection.

Reservoir/Source

The survival and spread of *B. burgdorferi* depends on the availability of a suitable tick vector as ticks and their hosts are the primary means by which the bacteria can move from one habitat to another. Two species of ixodid ticks act as the primary reservoirs for Lyme disease in Canada: *Ixodes scapularis* (blacklegged tick) in eastern and central North America and *Ixodes pacificus* (western blacklegged tick) west of the Rocky Mountains (Ogden, 2009).

Movement of the bacteria into new geographic areas requires the presence of suitable habitat (Public Health Agency of Canada, 2008), vectors and hosts (larval and nymphal stages feed on small mammals, adult ticks feed primarily on deer), and climate (Heymann, 2015). Infected hosts can move the disease into areas with uninfected vectors and vice versa. Refer to Surveillance for approaches for monitoring for black-legged ticks in Saskatchewan.

Mode of Transmission

Infection is transmitted most often through the bite of infected nymphs and adult ticks. Transmission does not occur between infected female ticks and their eggs.

Lyme disease is not transmitted person-to-person. Mother-to-baby transmission of Lyme disease is possible in theory, but the risk appears to be very low (National Institute for Health and Care Excellence, 2018)

Incubation Period
The incubation period from infection to onset of EM is typically 7-14 days, but may be as short as three days and as long as 30 days (Heymann, 2015).

Period of Communicability
Not applicable as there is no evidence of natural transmission from person-to-person. The *B. burgdorferi* spirochete survives in stored blood so transfusion-associated transmission may be possible, though rare.

Specimen Collection and Transport
For details refer to the Roy Romanow Provincial Laboratory (RRPL) Newsletter[4] and RRPL Compendium of Tests at https://rrpl-testviewer.ehealthsask.ca/.

Public Health Investigation

I. Case

History

Classify case in consultation with the attending physician and the case definitions. Refer to Attachment – Lyme Disease Data Collection Worksheet to assist.

- Clinical manifestation and onset dates (presence or history of erythema migrans (EM)-like rash or other clinical symptoms) can help identify exposure timelines.
- Risk factors with consideration to incubation period and clinical stage of illness.
- Acquisition Risk factors include:
  - history of a tick bite or exposure to ticks (tick bites may not always be noticed);
  - travel to a known risk area;
  - residential exposure during property maintenance, recreation, and leisure activities in wooded, brushy, or grassy areas;
  - occupational exposure such as landscaping, brush clearing, forestry, and wildlife and parks management in wooded, brushy, or grassy areas;

[4] https://www.saskhealthauthority.ca/Services-Locations/RRPL/Documents/RRPL-Newsletter-Feb-2012.pdf#search=lyme%20disease

- recreational exposure such as hiking, camping, fishing, and hunting in wooded, brushy, or grassy areas; or
- outdoor dog or cat with exposure to wooded, brushy or grassy areas that shares bed or living space.

- Determine if risk of transmission exists.
- Transmission Risk factor includes history of donating blood/plasma/tissue.

Public Health Interventions

Education

- All cases should be provided disease information as well as information on prevention and control measures.

Referrals

- Complex cases require referral to an infectious disease (ID) or other specialist for case management.
- Canadian Blood Services is to be notified when a case has identified any history of receiving or donating blood or blood products. See Appendix K – Notification to Canadian Blood Services for the template form for making these referrals.

Treatment/Supportive Therapy

Treatment choices are governed by the most recent guidelines. The public health practitioner should direct any questions regarding the current treatment protocols to the physician or an infectious disease specialist. The Infectious Disease Society of America (IDSA) website provides additional information at http://www.idsociety.org/lyme/. or refer to the most current National Institute for Health and Care Excellence (NICE) Guidelines.

II. Contact

Contact Definition

Not applicable. Even though congenital infection occurs with other spirochetal infections, no causal relationship between maternal Lyme disease and abnormalities of pregnancy or congenital disease has been documented conclusively (American Academy of Pediatrics, 2015; National Institute for Health and Care Excellence, 2018).

III. Environment

Ecological and environmental measures that can assist in the management of Lyme disease include habitat modification (clearing underbrush and grass mowing), host exclusion (deer fencing, removing wood piles for rodents) as well as both on and off-host measures (Rahn, 1993).
Personal protective measures continue to be important prevention measures.

IV. Epidemic Measures

Reinforce personal protective measures through education and risk communication.
Educate public about the vector, mode of transmission and identify tick-infested areas.

Prevention Measures

Refer to the Vector-borne and Zoonotic Diseases – Introduction and General Considerations section of the manual that highlights topics for client education and provides information on high-risk groups and activities. Refer to the Government of Saskatchewan website for general information on Lyme disease and prevention measures at http://www.saskatchewan.ca/residents/health/diseases-and-conditions/lyme-disease

Immunization

There is no vaccine currently available.

Education and Risk Communication

Public communication about measures individuals can take to reduce the risk of tick bites may be beneficial. Key preventative measures include:

Personal Protective Measures

- Avoid tick-infested areas such as scrub land, forest/grassland fringes, forest glades, wooded, brushy, or grassy areas.
- Stay on well-cleared trails and stay in the center of trails or paths.
- Wear long sleeved shirts and long pants tucked into socks or boots.
- Apply DEET - or Icaridin-based repellents (N, N-m-diethyl toluamide; hydroxyethyl isobutyl piperidine carboxylate) according to instructions.
- Insect repellents containing lemon eucalyptus oil, soybean oil, citronella **do not** provide protection from ticks.

- Find and remove ticks from your body.
  - Do a total body check after having been outdoors in wooded, brushy or grassy areas.
  - Bathe or shower as soon as possible after coming indoors (preferably within two hours) to wash off and more easily find ticks that are crawling on you.
  - Conduct a full-body tick check using a hand-held or full-length mirror to view all parts of your body. Parents should check their children for ticks under the arms, in and around the ears, inside the belly button, behind the knees, between the legs, groin area, around the waist, and especially in their hair.
- Examine gear and pets. Ticks can ride into the home on clothing and pets, and then attach to a person later; carefully examine pets, coats, and daypacks. Tumble clothes in a dryer on high heat for 10 minutes to kill remaining ticks (Centers for Disease Control and Prevention, 2018).

Tick Removal[5]

- If you find a tick attached to your skin:
  - Carefully remove it with fine-tipped tweezers and grasp the mouth of the tick as close to the skin as possible.
  - Pull slowly upward and out with a firm steady pressure.
  - Do not handle the tick with bare hands and be careful not to squeeze, crush or puncture the body after removal as this may also contain infectious fluids.
  - Removing ticks within 24-36 hours after the tick bite usually prevents infection.

Surveillance

Tick Surveillance

- The Saskatchewan Tick Surveillance Program monitors whether the black-legged tick is endemic or established in Saskatchewan to inform the risk assessment of acquiring Lyme disease (and other tick-borne diseases) in this province. Tick surveillance determines the distribution and level of establishment of black-legged tick populations, within an area. Tick surveillance is *passive* (examining ticks voluntarily submitted by the public) and *active* (targeted collection of ticks through surveys in their natural habitat). Both methods are useful for monitoring changes in the risk of Lyme disease.

[5] https://www.canada.ca/en/public-health/services/diseases/lyme-disease/removing-submitting-ticks-testing.html

- Black-legged ticks submitted or collected are tested for *Borrelia burgdorferi* (the agent that causes Lyme disease)*, Anaplasma phagocytophilum* (the agent that causes human granulocytic anaplasmosis), and, as of 2013*, Babesia microti* (the agent that causes babesiosis), *Borrelia miyamotoi (*the agent that causes relapsing fever), and *Borrelia mayonii,* a newly described organism that can cause Lyme disease.
- Monitoring for black-legged ticks and the prevalence of infection with *Borrelia* or other bacteria allows Public Health to assess the risk of human exposure to infected ticks in a given area. The status of blacklegged tick populations in an area is classified as:
  - Established – field surveillance suggests that reproducing populations occur. This could consist of all tick life stages (larvae, nymphs and adults) found in one or more calendar years, *B. burgdorferi* or *A. phagocytophilum* infections are detected in resident reservoir hosts such as mice or squirrels or a succession of different tick cohorts is observed (i.e. collection of annual cohorts of ticks, specifically adult ticks from two different cohorts)[6].
  - Adventitious – ticks are found only sporadically, both in time and space, and usually only a single stage of tick (i.e. adult females) is present. These ticks are carried into the area from another location in Canada or the United States by a migratory bird or other animal.
  - Not Present – ticks have not been found in an area.
- Habitat suitability - The habitat suitability for establishment of the black-legged tick has been mapped in Saskatchewan. The map integrates various layers of data such as temperature, relative humidity, woodland habitat and other factors such as deer density and this information has been used to produce a risk map for Saskatchewan. Data from this project have identified areas of low to high potential (risk index 0-5) for the black-legged tick to be present and this has helped to further guide tick surveillance efforts in the province. Of the 64.6 million hectares of habitat classified, 106,049 have been classified as having a high-risk potential for establishment of *I. scapularis*. (Refer to Figure 2 – Potential Risk Areas for Black-legged Tick Establishment in Saskatchewan – Low to High Potential Risk)
- See the Lyme Disease page for detailed information: http://www.saskatchewan.ca/residents/health/diseases-and-conditions/lyme-disease

[6] Ogden NH, Koffi JK, Lindsay LR . Assessment of a screening test to identify Lyme disease risk. Can Comm Dis Rep 2014 40, 83-87

Figure 1. Geographic distribution of black-legged ticks in Saskatchewan 2008-2017.

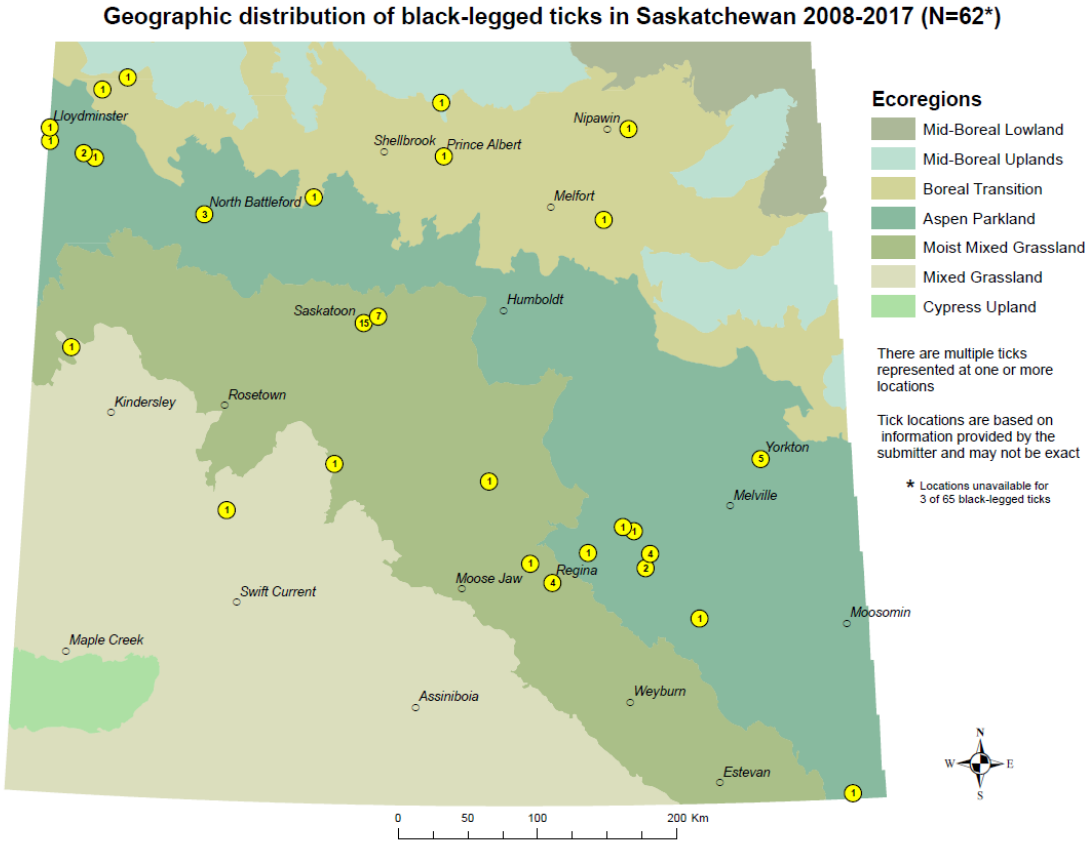
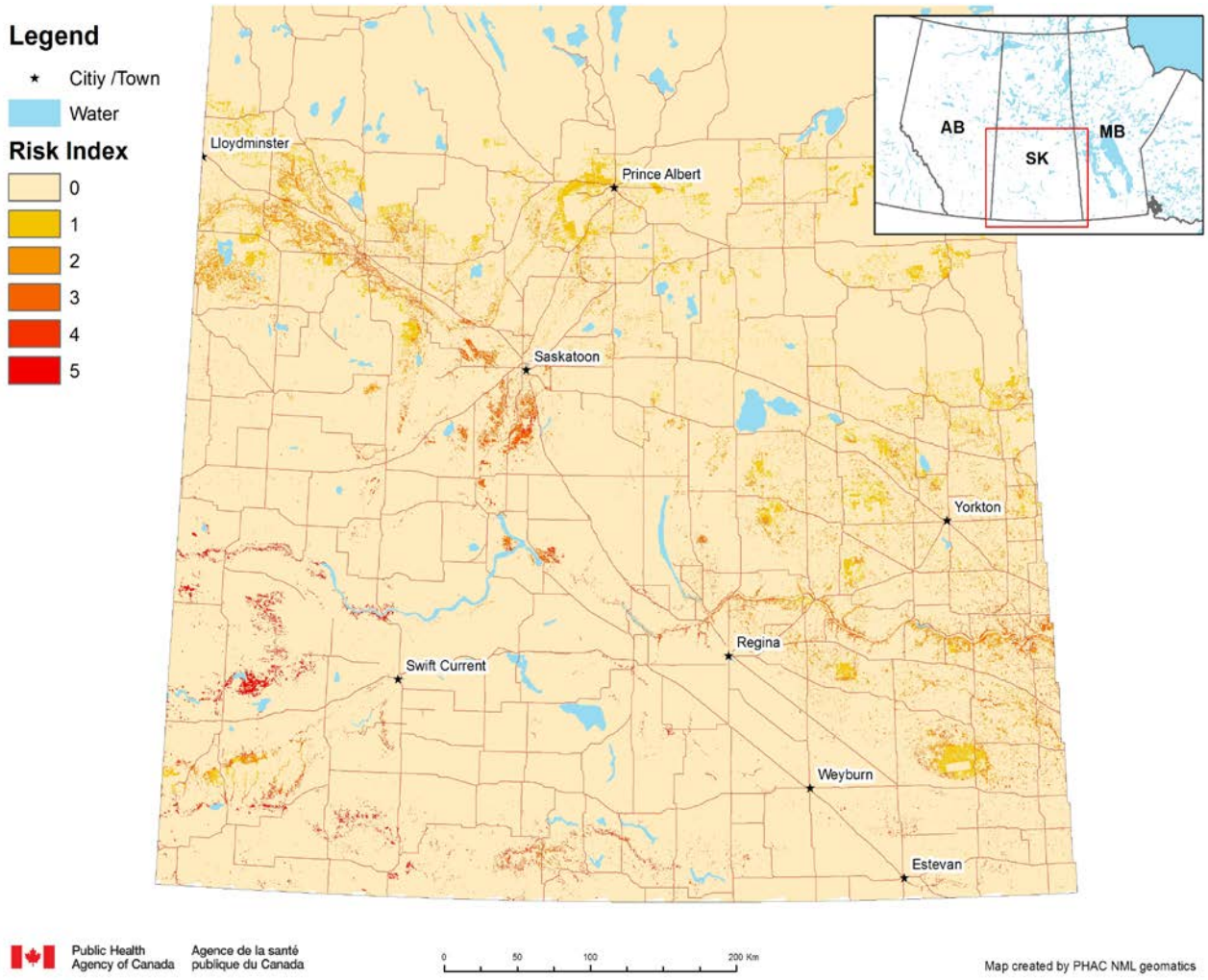


Figure 2: Potential Risk Areas for Black-legged Tick Establishment in Saskatchewan – Low to High Potential Risk (Risk Index 0 – 5)



Revisions

Date	Change
May-September 2018	• Reorganized chapter and applied new format. • Incorporated Public Health Purpose of Notification. • Updated case definition based on adaptation of CDC 2017 definition. • Added **Epidemiology and Occurrence** section. • Updated the information on Risk Areas. • Aligned with Panorama configuration. • Incorporated reference to National Institute for Health and Care Excellence (2018)

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Government of Saskatchewan

Lyme disease Data Collection Worksheet

PANORAMA

Panorama QA complete: ☐ **Yes** ☐ **No**
Initials:

Please complete **all** sections.

Panorama Client ID: _____
Panorama Investigation ID: _____

A) CLIENT INFORMATION

LHN -> SUBJECT -> CLIENT DETAILS -> PERSONAL INFORMATION

Last Name:	First Name: and Middle Name:	Alternate Name (Goes by):
DOB: YYYY / MM / DD Age: _____	Health Card Province: _____ Health Card Number (PHN): _____	Preferred Communication Method: (specify - i.e. home phone, text): Email Address: ☐ Work ☐ Personal
Phone #: ☐ Primary Home: ☐ Mobile contact: ☐ Workplace:		
Place of Employment/School:	Gender: ☐ Male ☐ Female ☐ Other ☐ Unknown	
Alternate Contact: _____ Relationship: _____ Alt. Contact phone: _____	Address Type: ☐ No fixed ☐ Postal Address ☐ Primary Home ☐ Temporary ☐ Legal Land Description Mailing (Postal address): Street Address or FN Community (Primary Home):	

B) INVESTIGATION INFORMATION

LHN-> SUBJECT SUMMARY-> ZOONOTIC & VEVTORBORNE ENCOUNTER GROUP-> CREATE INVESTIGATION

Disease Summary Classification: CASE:	**Date**			**LAB TEST INFORMATION:**
☐ Confirmed	YYYY / MM / DD	☐ Does Not Meet Case Definition	YYYY / MM / DD	Date specimen collected: YYYY / MM / DD
☐ Probable	YYYY / MM / DD	☐ Suspect	YYYY / MM / DD	
☐ Person Under Investigation	YYYY / MM / DD			

Disposition:
FOLLOW UP:

☐ In progress	YYYY / MM / DD	☐ Complete	YYYY / MM / DD
☐ Incomplete - Declined	YYYY / MM / DD	☐ Not required	YYYY / MM / DD
☐ Incomplete – Lost contact	YYYY / MM / DD	☐ Referred – Out of province (Specify where)	YYYY / MM / DD
☐ Incomplete – Unable to locate	YYYY / MM / DD		YYYY / MM / DD

REPORTING NOTIFICATION Name of Attending Physician or Nurse**:**	Location:
Provider's Phone number:	Date Received (Public Health): YYYY / MM / DD

Type of Reporting Source: ☐ Health Care Facility ☐ Lab Report ☐ Nurse Practitioner ☐ Physician ☐ Other_____

C) DISEASE EVENT HISTORY

LHN-> INVESTIGATION-> DISEASE SUMMARY (UPDATE)-> DISEASE EVENT HISTORY

Staging: ☐ Early disseminated ☐ Early localized ☐ Late disseminated ☐ Unknown

Lyme disease Data Collection Worksheet

Please complete **all** sections.

Panorama Client ID: _____
Panorama Investigation ID: _____

D) SIGNS & SYMPTOMS (*bold are part of confirmed case definition*)

LHN-> INVESTIGATION-> SIGNS & SYMPTOMS

Description	No	Yes – Date of onset	Description	No	Yes - Date of onset
Arthralgia		YYYY / MM / DD	**Meningitis - lymphocytic**		YYYY / MM / DD
Arthritis		YYYY / MM / DD	**Meningitis-like manifestations**		YYYY / MM / DD
Cardiac - arrhythmia		YYYY / MM / DD	Myalgia (muscle pain)		YYYY / MM / DD
Cardiac - myopericarditis		YYYY / MM / DD	Neck stiffness (nuchal rigidity)		YYYY / MM / DD
Cardiac - palpitations		YYYY / MM / DD	**Confusion**		YYYY / MM / DD
Chills		YYYY / MM / DD	**Neurologic - memory loss or lapses**		YYYY / MM / DD
Dizziness		YYYY / MM / DD	**Neurologic - paresthesia (numbness)**		YYYY / MM / DD
Encephalomyelitis		YYYY / MM / DD	**Neuropathy - cranial (including motor and sensory palsies)**		YYYY / MM / DD
Encephalopathy		YYYY / MM / DD	Neuropathy - mononeuropathy multiplex		YYYY / MM / DD
Fever		YYYY / MM / DD	Neuropathy - peripheral (including motor and sensory palsies)		YYYY / MM / DD
Headache		YYYY / MM / DD	Neuropathy - radiculopathy		YYYY / MM / DD
History of tick bite		YYYY / MM / DD	Paralysis - facial		YYYY / MM / DD
Joint effusion		YYYY / MM / DD	**Rash - erythema migraines - single lesion (> 5 cm) at site of tick bite (Bull's eye)**		YYYY / MM / DD
Lethargy (fatigue, drowsiness, weakness, etc)		YYYY / MM / DD	**Rash - erythema migraines - multiple lesions**		YYYY / MM / DD
Lymphadenopathy		YYYY / MM / DD			YYYY / MM / DD

E) INCUBATION AND COMMUNICABILITY

INVESTIGATION->INCUBATION & COMMUNICABILITY

Incubation for Case (period for acquisition):

Earliest Possible Exposure Date: YYYY / MMM / DD

Latest Possible Exposure Date: YYYY / MMM / DD

Exposure Calculation details:

F) RISK FACTORS

LHN-> SUBJECT->RISK FACTORS

DESCRIPTION	YES	N – No NA – not asked U - Unknown	DESCRIPTION	YES	N – No NA – not asked U - Unknown
Behaviour - Lack of personal protective measures			**Travel** - Outside of Canada (Add'l Info)	YYYY/MM/DD AE	
Bite - Tick	YYYY/MM/DD		**Travel** - Outside of Saskatchewan, but within Canada (Add'l Info)	YYYY/MM/DD AE	
Tick - Infested area (Add'l Info)	YYYY/MM/DD		**Travel** - Within Saskatchewan (Add'l Info)	YYYY/MM/DD AE	

G) TREATMENT

LHN-> INVESTIGATION-> MEDICATIONS->MEDICATIONS SUMMARY

Medication *(Panorama = Other Meds) :* _____

Prescribed by:_____ Started on: YYYY / MM / DD

Lyme disease Data Collection Worksheet

Please complete **all** sections.

Panorama Client ID: ___________
Panorama Investigation ID: ___________

H) INTERVENTIONS

LHN-> INVESTIGATION->TREATMENT & INTERVENTIONS->INTERVENTION SUMMARY

Intervention Type and Sub Type:

General: Investigator name
- ☐ Disease-Info/Prev-Control YYYY/ MM / DD
- ☐ Disease-Info/Prev-Cont/Assess'd for Contacts YYYY/ MM / DD

Referrals: Investigator name
- ☐ Canadian Blood Services YYYY/MM/DD
- ☐ Infectious Disease Specialist YYYY/MM/DD

Education/counselling: Investigator name
- ☐ Prevention/Control measures YYYY/MM/DD
- ☐ Disease information provided YYYY/MM/DD

Other Investigation Findings:
- ☐ Investigator Notes ☐ Document Management

Date	Intervention subtype	Comments	Next follow-up Date	Initials
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
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YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	
YYYY / MM / DD			YYYY / MM / DD	

I) OUTCOMES (*optional except for severe influenza*

LHN-> INVESTIGATION->OUTCOMES

- ☐ Not yet recovered/recovering YYYY / MM / DD
- ☐ Recovered YYYY / MM / DD
- ☐ Fatal YYYY / MM / DD
- ☐ ICU/intensive medical care YYYY / MM / DD
- ☐ Intubation /ventilation YYYY / MM / DD
- ☐ Other ___________________YYYY / MM / DD
- ☐ Hospitalization YYYY / MM / DD
- ☐ Unknown YYYY / MM / DD

Cause of Death: (if Fatal was selected) ____________________________

Initial Report completed by:		**Date initial report completed:** YYYY / MM / DD

Two-tiered algorithm for the laboratory diagnosis of Lyme disease

The two-tiered approach to testing is illustrated in Figure 1.

1. The first tier involves the use of an EIA. If this EIA test is negative, WB testing is not indicated. If symptoms persist, the EIA test can be repeated on a convalescent sample collected 3-6 weeks later.
2. If the EIA is positive or equivocal, the second tier or corroborative Western blot assay is performed. In early infections (i.e. symptoms for less than six weeks), both the IgM and IgG Western blot tests are performed; however, if the patient has had symptoms for more than six weeks, only the IgG Western blot assay is performed.

The final result of serological testing is considered positive only when the EIA is reactive (positive or equivocal) and the WB is also positive (Table 3). This two-tiered system maximizes the sensitivity and specificity of the assays and increases the likelihood of observing a seroconversion (from IgM to IgG) that is evident in most bona fide *B. burgdorferi* infections

Figure 1. Two-tiered approach to testing Lyme

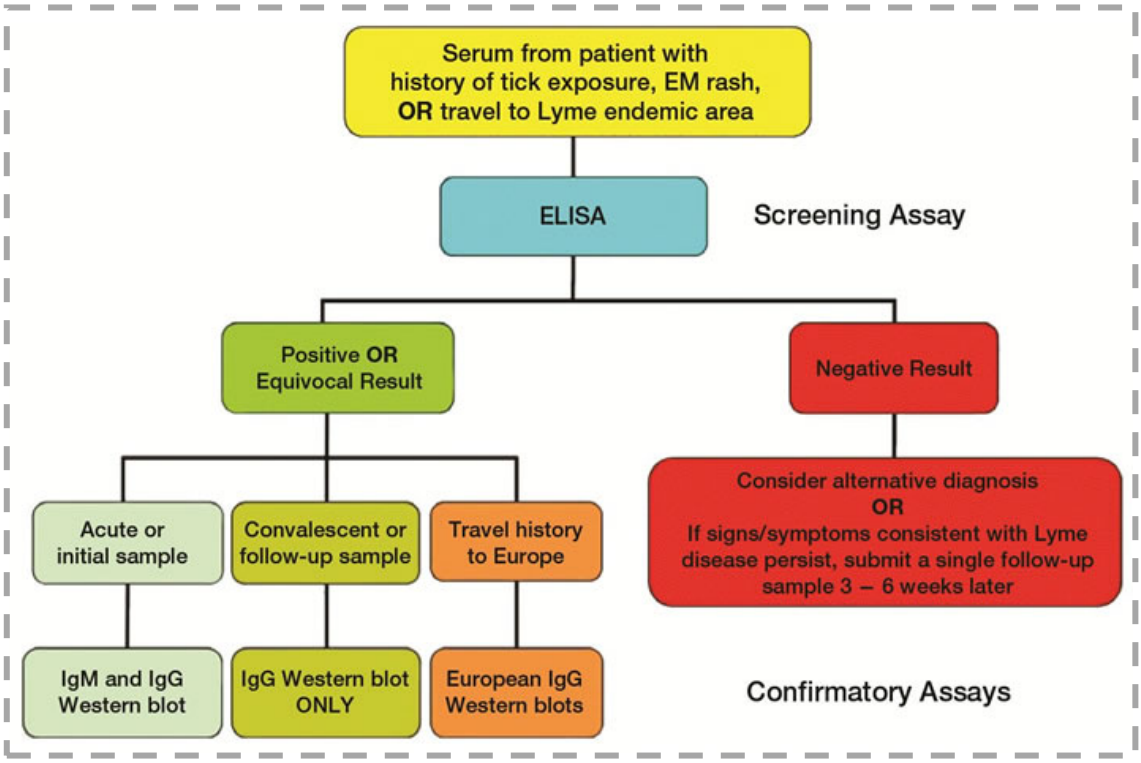

Table 1. Interpretation of Western blot result (in conjunction with an equivocal or positive EIA)

Western blot result	Interpretation
Both IgM and IgG Western blots negative	Result not consistent with a B. burgdorferi infection; however, if symptoms persist submit a follow-up sample 3-6 weeks later.
Only IgM Western blot positiveTable 3 Footnote*	Potentially a false-positive result if this is NOT an acute case (i.e. < 6 weeks post onset of symptoms).
Only IgG Western blot positiveTable 3 Footnote**	Result consistent with an infection with *B. burgdorferi* of greater than 4 weeks' duration.
Both IgM and IgG Western blots positive	Result indicates recent or previous infection with *B. burgdorferi* .
Note: IgM Line Blot is not performed if the sample tested positive by IgG Westernblot	

Source: Canadian Public Health Laboratory Network (retrieved September, 2018) from https://www.canada.ca/en/public-health/services/reports-publications/canada-communicable-disease-report-ccdr/monthly-issue/2014-40/ccdr-volume-40-11-may-29-2014/ccdr-volume-40-11-may-29-2014-1.html

Notification Timeline for Animal Bites Where Rabies Transmission is Possible:

From Veterinarian/Health Care Practitioner to Public Health: Immediate.
From Public Health to Saskatchewan Health: Only cases where Rabies post-exposure prophylaxis (RPEP) is administered – within one month of incident.

Public Health Follow-up Timeline: Initiate within 24 hours.

All incidents of an individual having being exposed to saliva or other potentially infectious material of an animal that may be infected with rabies should be investigated and a risk assessment should be conducted to determine if risk of rabies transmission exists. When notification of an exposure is delayed, prophylaxis may be started as late as 6 months or more after the exposure.

Causative Agent
RNA virus classified Lyssaviruses, such as rabies virus, are in the family *Rhabdoviridae* in the genus *Lyssavirus*.

Symptoms
Animal Rabies – can be characterized by either:
Dumb rabies

- Domestic animals may become depressed and try to hide in isolated places.
- Wild animals may lose their fear of humans and appear unusually friendly.
- Wild animals, that usually only come out at night, may be out during the day.
- Animals may have paralysis. Areas most commonly affected are the face or neck (which causes abnormal facial expressions, difficulty swallowing, or drooling) or the hind legs.

Furious rabies

- Animals may become very excited and aggressive.
- Periods of excitement usually alternate with periods of depression.
- Animals may attack objects or other animals. They may even bite or chew their own limbs.

Complications
Illness almost invariably progresses to death. The differential diagnosis of acute encephalitic illnesses of unknown cause with atypical focal neurologic signs or with paralysis should include rabies (American Academy of Pediatrics, 2012).

Incubation Period
The period is highly variable but usually 3-8 weeks; very rarely as short as a few days, or as long as several years. Length of incubation depends in part on wound severity, wound location in relation to nerve supply, and relative distance from the brain; the amount and variant of virus; the degree of protection provided by clothing and other factors.

Reservoir/Source
All mammals are susceptible. Reservoirs and important vectors include wild and domestic Canidae, such as dogs, foxes, coyotes, wolves and jackals; also, skunks, raccoons, raccoon dogs, mongooses and other common carnivores, such as cats. Infected vampire, frugivorous and insectivorous bats occur in Mexico and Central and South America, and infected insectivorous bats are present throughout Canada and the USA and Eurasia.

Many other mammals such as rabbits, squirrels, chipmunks, rats, mice and opossums are very rarely infected.

Mode of Transmission
- Most commonly through virus laden saliva from a rabid animal introduced through a bite or scratch (very rarely into a fresh break in the skin or through intact mucous membranes).
- Airborne spread has been suggested in a cave where heavy infection of bats were roosting, and demonstrated in a laboratory setting, but this occurs very rarely.
- Person-to-person transmission is theoretically possible, but is rare and not well documented. Several cases of rabies transmission by transplant of cornea, solid organs and blood vessels from person dying of undiagnosed central nervous system (CNS) disease have been reported from Asia, Europe and North America.

Period of Communicability
Defined periods of communicability of animal hosts are only known with reliability of domestic dogs, cats and ferrets, and are usually for 3-7 days before onset of clinical signs (rarely over 4 days) and throughout the course of the disease. Longer periods of excretion before onset of clinical signs (14 days) have been observed with certain canine rabies virus variants in experimental infections, but these are the exception. Excretion in other animals is highly variable. For example, studies have indicated that bats shed virus for 12 days before evidence of illness while skunks can shed virus from 8-18 days and raccoons can shed virus from 5-10 days before onset of clinical signs.

Specimen Collection and Transport
The brain of the animal that was involved in the human exposure is required for testing. Testing occurs through the coordination with the provincial Rabies Risk Assessment Veterinarian (RRAV). See Attachment – Animal Investigation and Testing Consultation.

NOTE: The RRAV will direct that the animal be taken to a designated veterinary clinic or laboratory so specimens can be collected when the possibility of rabies exists and the animal has been in contact with humans or domestic animals. The RRAV could be contacted to explain specimen collection, storage (in remote areas) and transport. The contact information for RRAV is:

Dr. Clarence Bischop
Cell – 1-306-529-2190
Email – RRAV@gov.sk.ca
Fax Number – 1-844-666-DOGS (844-666-3647)

Diagnosis
Intact brain tissue is the key specimen for confirming rabies infection - care must be taken to avoid destroying a sample intended for testing if the animal is being destroyed. Most commonly, rabies diagnosis is confirmed using direct fluorescent antibody test from the animal's brain. Confirmation is provided by the CFIA Laboratory in Lethbridge, AB or the CFIA Reference Laboratory in Ottawa, ON.

Methods of Control/Role of Investigator

Prevention and Education
Refer to the Vector-Borne and Zoonotic Diseases - Introduction and General Considerations section of the manual that highlights topics for client education that should be considered and as well as provides information on high-risk groups and activities.

Immunization
Pre-exposure vaccination
Vaccinate individuals who are potentially at high-risk of contact with rabid animals (e.g., veterinarians, veterinary technicians, animal control staff, wildlife workers, spelunkers, laboratory and field personnel working with rabies virus and travellers to rabies endemic areas where there is poor access to adequate and safe post-exposure management). These people should consider pre-exposure immunization with either human diploid cell culture vaccine (HDCV) or purified chick embryo cell vaccine (PCECV) (Public Health Agency of Canada, 2006).

Post-immunization serological testing is advisable every 2 years for persons with continuing high-risk of exposure, such as certain veterinarians, veterinary technicians, and animal control staff. Those whose titres fall below protective levels (0.5 IU/mL) should receive a pre-exposure booster dose of vaccine (Public Health Agency of Canada, 2006).

Vaccination of Animals
The public should be aware of the benefits of vaccinating animals and take measures to protect their pets or other domestic animals (i.e., horses). The public can also help reduce the spread of rabies through informing authorities when an animal is suspected of having the disease (*The Health of Animals Act*[1] requires individuals who have knowledge of or who suspect rabies in an animal to notify CFIA). The public can also report animals suspected on having rabies to the provincial rabies hotline number at: 1-844-7-RABIES (1-844-772-2437). The veterinary profession can educate individuals regarding the value of vaccinating pets, and the vaccination requirements for pets travelling to other countries.

[1] http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.%2C_c._296/index.html.

Various wildlife departments are involved in vaccinating wildlife species, surveying the extent of wildlife rabies in certain geographic areas, as well as surveying the extent of rabies in certain species (Canadian Food Inspection Agency, 2009).

Animal Control Measures
The management of domestic animals falls under the jurisdiction of the Ministry of Agriculture in Saskatchewan as follows:

- The RRAV and private veterinarians investigate all cases of suspected rabies in any domestic animal;
- Ministry of Agriculture veterinarians (including the RRAV) may quarantine any domestic animal that is known or suspected to have had contact with a rabid animal.
- The management of wild animals falls under the Ministry of Environment or municipal animal control officers, in some instances.

Education
Keeping pets under control, teaching children not to play with wild animals or pets they do not know, keeping a safe distance from wildlife and not trying to raise orphaned or injured wildlife all contribute to preventing rabies (Canadian Food Inspection Agency, 2009). Children should be cautioned against provoking or attempting to capture stray or wild animals, and against touching carcasses.

International travelers to areas with endemic canine rabies should be warned to avoid exposure to stray dogs, and if traveling to an area with enzootic infection where immediate access to medical care and biologicals (e.g., vaccine and immunoglobulin) is limited, pre-exposure prophylaxis is indicated (American Academy of Pediatrics, 2012). Refer to Saskatchewan International Travel Manual for travel-related recommendations.

Pet owners should be reminded of the importance of vaccinating their pets.

Children, pet owners and the general public should be made aware of how to act/behave around animals such as dogs and cats and be informed how to interpret body language of an animal.

Personal Protective Measures

It is important for individuals to take appropriate personal protective measures and to use appropriate protective equipment when handling unknown animals or animals that are seemingly unwell. Standards exist for veterinarians and other occupational groups to prevent exposure to rabies and other zoonotic illnesses. Refer to the Western College of Veterinary Medicine (WCVM) infection control manual for details.

Environmental Measures

Inadvertent contact of family members and pets with potentially rabid animals, such as raccoons, foxes, coyotes and skunks, may be decreased by securing garbage and refuse to decrease attraction of domestic and wild animals. Similarly, chimney and other potential entrances for wildlife, including bats, should be identified and covered. Bats should be excluded from human living quarters. Bat exposure is considered to be high-risk. Refer to the following website for more information on bat-proofing human dwellings: http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/09pdf/acs-dcc-07.pdf.

Management

I. Exposed Individual

Note: Pregnancy and infancy are not contraindications to providing RPEP. Persons presenting even months after the bite must be assessed and managed in the same way as recent exposures.

History

It is important to do a risk assessment. See Attachment – Animal Bite Investigation Worksheet to determine if RPEP is required or recommended.

Attachment – Animal Encounter Follow-Up Flowchart is another tool that has been developed to assist the front line physician in determining the urgency for consulting an MHO regarding the need for RPEP.

The risk assessment involves getting information about the following:

Animal species

- The most common animals in Canada proven rabid are wild terrestrial carnivores (foxes, skunks, and raccoons), bats, cattle, dogs and cats (Public Health Agency of Canada, 2006). The Canadian Food Inspection Agency (CFIA) keeps track of positive specimens by species and province. Refer to the CFIA website.
- In Saskatchewan, horses, cows, goats, skunks, dogs, cats, bats, bears and raccoons have tested positive for rabies.
- The Ministry of Agriculture reports on rabies specimen submissions and positive results by species and municipality

Exposure type

- The World Health Organization (WHO) (2014) categorizes animal exposures into the following:
  - Category I – touching or feeding of animals. Licks of intact skin.
  - Category II – nibbling of uncovered skin. Minor scratches or abrasions without bleeding
  - Category III – single or multiple trans-dermal bites or scratches, licks on broken skin. Contamination of mucous membranes with saliva (i.e. licks).
- Bites – teeth penetrated the skin.
- Non-bite includes contamination of scratches, abrasions or cuts of the skin or mucous membranes by saliva or other potentially infectious material (Public Health Agency of Canada, 2006). Petting a rabid animal, handling blood, urine or feces is not considered an exposure. Additionally, being sprayed by a rabid skunk is not considered an exposure.
- Bat exposures – see page 8 for detailed recommendations on assessing and managing bat exposures.

Investigation of the incident

- The type of the animal (indoor pet/outdoor pet/stray/wild/livestock).
- Consider the risk of rabies in the animal species involved, the behaviour of the domestic animal, and the circumstances surrounding the exposure:
  - What were the individual and the animal doing leading up to the incident?
  - Was the animal acting in a manner that is unusual for it?
  - Was the animal healthy or sick?
  - Was the animal eating or drinking?

  - Some situations when an exposure may be expected (i.e., considered "provoked") include: entering a dog's habitat, interfering with a dog/cat fight, feeding or taking food from a dog, taking puppies/kittens from their mother, physical abuse (i.e., beating a dog), stepping on or bumping into an animal.)
- Consult the RRAV if insight on animal behaviour, clinical signs and risk of rabies in particular species is required.
- Vaccination status of the animal.

Other considerations

- Location of the injury (head, arm, leg, etc.). Injury to the upper body or face may require more timely response (Public Health Agency of Canada, 2008).
- Usual environment of the animal, particularly if it is a pet (is it an exclusively indoor pet or has there been an opportunity for interaction with a rabid animal?). What setting does the animal reside in (city versus rural)? Note: there have been rabies positive bats caught by apartment dwelling cats that never go outside.
- If it is a domestic cat or dog, is it available for observation? If the animal has been euthanized, is the brain available for testing?
- Immunization history of the individual exposed.

Bat Exposures (Public Health Agency of Canada, 2009)
The National Advisory Committee on Immunization (NACI) is now recommending intervention only when **both** of the following conditions apply:

- there has been "direct contact" with a bat
  AND
- a bite, scratch, or saliva exposure into a wound or mucous membrane cannot be ruled out.
- Note: "direct contact" is defined as the bat touching or landing on a person.

NACI recommends that RPEP be initiated without delay when there is a known bat bite, scratch, or saliva exposure in a wound or mucous membrane. This is especially important when the exposure involves the face, neck, or hands, or when the behaviour of the bat is clearly abnormal (such as when it hangs on tenaciously or when the bat has attacked the person). If the bat is available for testing, RPEP can be discontinued if the bat is found to be negative for rabies. The clinician may feel it will be safe to delay RPEP in some instances where the exposure is less certain (i.e., when the bat touches the individual while in flight) if the bat is being tested for rabies. However, if RPEP is indicated based on the NACI recommendations, it should never be delayed beyond 48 hours while waiting for bat testing results.

Recommendations Regarding Bat Testing

No direct contact with the bat: If there has been no "direct contact" with the bat, it should not be captured for testing. There are risks of direct contact when attempting to capture the bat; this potentially exposes the individual to rabies. If the bat is inadvertently tested and comes back positive, determining the need for RPEP should be based on whether direct contact with the bat occurred; not the rabies status of the bat.

In order to get the bat out of a house in which there has been no direct contact with the bat, the area with the bat should be closed off from the rest of the house. The doors or windows in the area with the bat should be opened to the exterior, allowing the bat to escape. People and pets should be kept away from the area.

Direct contact with the bat: If there has been "direct contact" with the bat, it is best to call a trained animal control or wildlife professional to capture the bat, if possible. Capturing the bat and testing it will mean that RPEP is not needed if the results come back negative. The Centers for Disease Control (2011) identifies steps that can be used to catch a bat at the following website: http://www.cdc.gov/rabies/bats/contact/capture.html.

Extreme care should be taken to ensure that there is no further exposure to the bat if it is captured. If attempting to capture the bat, the person should always wear thick leather gloves and place the bat in a closed secure container. Once the bat has been captured, the local public health department should be contacted to make arrangements with the RRAV to send the bat for rabies testing.

Referrals

1. Animal Exposures that pose a rabies risk require follow-up in a timely manner.
2. Animal Exposures involving either the victim or animal (or both) from other regions or jurisdictions (such as other provinces, territories or countires) require assistance or coordination in completing the follow-up.
3. Sharing of information with other P/Ts must ensure that privacy and confidentiality standards are maintained. (i.e. information sharing should be limited to the information required to carry out the requested action).

To facilitate efficient referrals for coordinated follow-up, complete the relevant sections of the Attachment – Interjurisdictional Referral Following an Animal Exposure and follow routine communicable disease referral processes.

Animal Bite Exposures

Table 1 - PEP Recommendations for Persons Not Previously Immunized Against Rabies (Public Health Agency of Canada, 2006)

Animal species	Condition of animal at time of exposure	Management of exposed person
Dog, cat or ferret	Healthy and available for 10 days observation.	1. Local treatment of wound. 2. At first sign of rabies in animal, give RPEP as per Table 2. If bite or wound to head or neck, begin treatment immediately.
	Rabid or suspected to be rabid.* Unknown or escaped.	1. Local treatment of wound. 2. RPEP as per Table 2.
Skunk, bat, fox, coyote, raccoon, and other carnivores.	Regard as rabid* unless geographic area is known to be rabies-free.	1. Local treatment of wound. 2. RPEP as per Table 2.**
Livestock, rodents or lagomorphs (hares and rabbits	Consider individually. Consult appropriate public health and Ministry of Agriculture officials. Bites of squirrels, chipmunks, rats, mice, hamsters, gerbils, other rodents, rabbits and hares may warrant PEP if the behaviour of the biting animal was highly unusual.	

*If possible, the animal should be humanely killed and the brain tested for rabies as soon as possible; holding for observation is not recommended. Discontinue vaccine if fluorescent antibody test of animal brain is negative.
**See text for potential bat exposure.

Management of the Animals Involved in a Exposure Incidents

- Detain and observe any **healthy-appearing** dog, cat or ferret known to have bitten a person for 10 days. These animals should be confined and observed at the owner's residence. They should be confined in such a way that prevents contact with other animals or people during the observation period to prevent further exposures if the animal is found to have rabies.

If the biting animal is infective at the time of the bite, it usually develops signs of rabies within 4-7 days, such as change in behaviour, excitability or paralysis, followed by death. Owners should make the vet aware that the animal was involved in a biting incident and is currently under 10 day observation.

- **Stray or ownerless** dogs or cats may be euthanized for testing. Contact RRAV for collection of specimen. Contact animal protection services to capture the animal.
- **Dogs and cats showing suspicious clinical signs of rabies and all wild mammals** that have bitten a person should be euthanized for testing. Animal owner to be made aware that this should be ideally done by a vet, or to ensure the animals head is not destroyed. Contact RRAV to arrange for collection of specimen.

The Ministries of Agriculture and Health have established policies that outline their roles with respect to rabies. In general:

- The RRAV will conduct a rabies risk assessment and direct trained veterinarians to submit samples from any suspect rabid domestic animal, and any suspect wild animal that has been in contact with a human or a domestic animal.
- Emergency submissions on weekends and holidays are only accepted in the case of a bite to the head or neck, when ordered by the MHO and when there is a weekend contact number for health provider. For some veterinary offices and locations, there is no means of getting samples to the lab over a weekend; in these cases it is recommended to start treatment if can't wait 3-4 days and submit the sample as soon as possible. Treatment can be stopped if results are negative. .
- In the case of healthy domestic animals (dogs, cats or ferrets) biting or scratching, a 10 day observation period is preferred and should be encouraged/emphasized to the animal owner over euthanasia and sampling.

Treatment/Supportive Therapy

Immediate flushing of the wound with soap and water is imperative and is probably the most effective procedure in the prevention of rabies (Public Health Agency of Canada, 2006). If available, a viracidal agent such as a povidone-iodine solution should be used to irrigate the wounds (Centers for Disease Control, 2010). Suturing the wound should be avoided if possible.

Rabies Post-exposure prophylaxis (RPEP)

When the risk assessment deems necessary, the MHO will authorize RPEP involving the administration of Rabies Immune Globulin (RabIg) and/or rabies vaccine. RPEP should be provided as per Table 2.

The WHO considers the intradermal (ID) regime an acceptable alternative to IM pre-exposure rabies vaccination. However, due to the precise nature for ID administration and the potential consequences of improper administration, post-immunization antibody titres should be determined at least 2 weeks after completion of ID vaccine series to ensure that an acceptable level of protection has been achieved. Refer to Attachment – Post Exposure Management of Individuals Who Received Pre-Exposure Intradermal Rabies Vaccine for guidance based on results of titres following ID administration.

Table 2 – RPEP Recommendations based on Previous Rabies Immunization History

Vaccination Status	Regimen[1]
1. Previously Unimmunized Individuals	**(1A) Unimmunized immunocompetent**[2] individuals to receive **RabIg and a 4 dose series of Rabies Vaccine:** • **1 mL IM on days 0 – 3 – 7 – 14.** • **Day 0**[3]: 1 mL IM as soon as possible after exposure **PLUS RabIg.**[4] • **Days 3, 7**, and **14**: 1 mL IM.
	(1B) Unimmunized immunocompromised[2] individuals to receive **RabIg and a 5 dose series of Rabies Vaccine**: • **1 ml IM on days 0 – 3 – 7 – 14 – 28.** • **Day 0**[3]**:** 1 mL IM as soon as possible after exposure **PLUS RabIg.**[4] • **Days 3, 7, 14** and **28:** 1 mL IM.
2. Previously Immunized Individuals	**(2A)** For individuals with a history of previous immunization with an approved course of either pre- or post-exposure prophylaxis with either human diploid cell culture vaccine (HDCV) or purified chick embryo cell vaccine (PCECV), the procedure is as follows: • Rabies Immune Globulin (RabIg) - not necessary. • Rabies vaccine – 2 doses: on day 0[3] and day 3.

Vaccination Status	Regimen[1]
2. Previously Immunized Individuals	**(2B)** For individuals with a history of previous immunization with an unapproved schedule or with a vaccine other than HDCV or PCECV, but has had an acceptable level of antibodies demonstrated in the past, the procedure is the same as above.
2. Previously Immunized Individuals	**(2C)** For individuals with a history of previous immunization with an unapproved schedule or with a vaccine other than HDCV or PCECV, but who did not have an acceptable level of antibodies demonstrated in the past, the following applies: • A sample for serology may be drawn at the time of exposure (before RabIg or vaccine is administered) to potentially reduce the number of doses of vaccine needed. • RabIg is to be administered. • Rabies vaccine – Refer to 1. Previously Unimmunized Individuals above. **The MHO may recommend discontinuing additional doses of rabies vaccine provided that 2 doses have been administered if serology indicates adequate immunity (≥ 0.5 IU/mL).**
[1] Regimens are applicable for all age groups, including children. [2] Includes those taking antimalarials and/or any immunosuppressants (e.g., corticosteroids) that can result in immunosuppression. Refer to Saskatchewan Immunization Manual[2] for details on determining immune status of individuals. [3] Day 0 is the day the 1st dose of vaccine is administered. [4] Vaccine-induced antibodies begin to appear within 1 week of beginning vaccination with an approved course, therefore there is no benefit of administering RabIg more than 8 days after vaccine has been initiated.	

Source: *Rabies Post Exposure Prophylaxis Recommendations.* Memo from Saskatchewan Ministry of Health Chief Medical Health Officer to MHOs, December 20, 2007.

Rabies Immune Globulin (RabIg)

- Administer 20 IU/kg body weight. Calculate dose with the following formula:

20 IU/kg x (client wt in kg) ÷ 150 IU/mL = dose in mL

[2] http://www.ehealthsask.ca/services/manuals/Pages/SIM.aspx.

- If anatomically feasible, *the full dose* should be infiltrated into the wound(s) and surrounding tissues; any remaining volume should be administered intramuscularly (IM) at an anatomic site distant from that of vaccine administration.
- RabIg should not be administered in the same syringe or location as the vaccine.
- Because RabIg may interfere with active production of antibody, no more than the recommended dose should be given.
- Vaccine-induced antibodies begin to appear within 1 week of beginning vaccination with an approved course, therefore there is no benefit of administering RabIg more than 8 days after vaccine has been initiated.

Rabies Vaccine

Rabies vaccine should be administered as outlined in Table 2. Refer to Saskatchewan Immunization Manual[3] for details about immunocompromised individuals.

It has been documented that subjects with severe immunodeficiency (very low CD4 counts) will not respond well to rabies vaccination. Some may not develop neutralizing antibody at all. Careful wound cleansing and the use of immunoglobulin is thus of great importance in such patients. Vaccination must be administered at the usual dose. A serum specimen should be collected at the time when the last dose of vaccine is administered and tested for rabies antibodies. If sensitization reactions appear in the course of immunization, consult the medical health officer for guidance.

Refer to Rabies Immunization Fact Sheet to guide discussion about immunization.[4]

Immunization

There is no treatment for human rabies so appropriate and timely management of potential or confirmed exposures is vital. Immunization is the only measure that can prevent human rabies.

[3] http://www.ehealthsask.ca/services/manuals/Pages/SIM.aspx
[4] http://www.saskatchewan.ca/immunize

The vaccination schedule for post-exposure prophylaxis should be adhered to as closely as possible (especially the first 2 doses) and it is essential that all recommended doses of vaccine be administered (CD Subcommittee of Medical Health Officers of Saskatchewan, Mar 2016).

Early Dose:

- If a dose of vaccine is given at less than the recommended interval, that dose should be ignored and the dose given at the appropriate interval from the previous dose. This is especially important for the first 3 doses in the series (day 0, 3, 7)
- Observe the appropriate spacing between rabies vaccines, to optimize immunogenicity
- Example:
    - Doses received on days 0, 3 and 5
    - Ignore dose received on day 5 and repeat at appropriate interval on day 9 (i.e. appropriate spacing of 4 days which would normally be observed between 2nd and 3rd doses), with dose #4 on day 16.

Late Dose:

- If the recommended rabies vaccine schedule is interrupted or delayed, the series should be continued ensuring that the recommended time intervals between remaining doses are maintained.

Serologic Testing:

- If repeating an invalid dose or providing a delayed dose results in an interval *more than 3 days longer* than the recommended interval, immune status should be assessed by performing serologic testing 7-14 days after administration of the final dose in the series (Centers for Disease Control, Ask the Experts, 2017).

Administering a 5th dose:

Should the results for the serological testing under the circumstances mentioned above not be back at the time of the 5th dose (day 28), proceed with providing the 5th dose.

Individuals should also be offered the appropriate tetanus vaccine based on their immunization history and eligibility based on the Saskatchewan Immunization Manual.[5]

[5] http://www.ehealthsask.ca/services/manuals/Pages/SIM.aspx

II. Contacts/Contact Investigation

Contact Definition

Anyone who has had direct contact with the saliva or infectious material of an animal confirmed to have rabies.

Contact Management

All contacts of a suspected or proven rabid animal should be followed up and a risk assessment completed to determine the extent of exposure; only those with skin or mucosal contact with the animal's saliva should be considered for post-exposure treatment.

Testing/Prophylaxis

Individuals who have been previously vaccinated should be followed as outlined in Table 2.

III. Environment

Child Care Centre Control Measures

In-house pets should be kept up-to-date on vaccinations.

Institutional Control Measures

Refer to the following website for more information on bat proofing human dwellings: http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/09pdf/acs-dcc-07.pdf.

Epidemic Measures

Establish control area under authority of laws, regulations, and ordinances, in cooperation with appropriate human, agricultural and wildlife conservation authorities.

Immunize dogs and cats in defined areas of risk though officially sponsored intensified mass programs that provide immunizations at temporary and emergency stations. For protection of other domestic animals, use approved vaccines appropriate for each animal species.

In urban areas of industrialized countries, strict enforcement of ownerless and stray dogs, and of non-immunized dogs found off owners' premises; control of the dog population by castration, spaying or drugs have been effective in breaking transmission cycles.

Immunization of wildlife through baits containing vaccine has contained red fox rabies in Western Europe and southern Canada coyote, gray fox, and raccoon rabies in the USA (Heymann, 2008). Programs to control raccoon rabies through trap-vaccinate-return (TVR) programs have been successfully implemented in New Brunswick and Quebec. There is a lack of effective oral vaccines for skunks, although a new adenovirus-rabies recombinant vaccine (ONRAB® is showing promise). TVR programs are not appropriate for all species (i.e., bats). Any wildlife control programs would be established in partnership with the Ministry of Environment, Agriculture and other authorities.

Revisions

Date	Change
July 2017	Included reference to anti-malarial medications in Table 2 to align with the Saskatchewan Immunization Manual.
April 2017	Incorporated recommendations for CD Subcommittee of Medical Health Officers of Saskatchewan on managing schedule interruptions of early or late doses of rabies post-exposure prophylaxis vaccine. Updated hyperlinks on page 7. Incorporated into new CDC Manual format.

Notification Timeline for Human Rabies Confirmed Cases:

From Lab/Practitioner to Public Health: Immediate.
From Public Health to Saskatchewan Health: Immediate.

Public Health Follow-up Timeline: Immediate.

Information

Table 3 - Case Definition of Human Rabies (Public Health Agency of Canada, 2008)

Confirmed Case	Clinical evidence of illness[1] with laboratory confirmation of infection: • detection of viral antigen in an appropriate clinical specimen, preferably the brain or the nerves surrounding hair follicles in the nape of the neck, by immunofluorescence **OR** • isolation of rabies virus from saliva, cerebrospinal fluid (CSF), or central nervous system tissue using cell culture or laboratory animal **OR** • detection of rabies virus RNA in an appropriate clinical specimen.
Probable Case	Clinical evidence of illness[1] with laboratory evidence: • demonstration of rabies-neutralizing antibody titre ≥ 5 (complete neutralization) in the serum or CSF or an unvaccinated person.
Clinical evidence of illness[1]- Rabies is an acute encephalomyelitis that almost always progresses to coma or death within 10 days after the first symptom.	

Causative Agent

RNA virus classified Lyssaviruses, such as rabies virus, are in the family *Rhabdoviridae* in the genus *Lyssavirus*.

Symptoms

Human Rabies – Onset is generally heralded by a sense of apprehension, headache, fever, malaise and sensory changes (paresthesia) at the site of an animal bite. The most frequent symptoms include excitability, aero-and/or hydrophobia often with spasms of swallowing muscles. Delirium (sudden severe confusion and rapid changes in brain function) with occasional convulsions follows. Such classic symptoms of furious rabies are noted in two-thirds of the cases, whereas the remaining present as paralysis of limbs and respiratory muscles with sparing of consciousness. Phobic spasm may be absent in this paralytic form. Coma and death ensue within 1-2 weeks, mainly due to cardiac failure (Heymann, 2008).

Complications
Illness almost invariably progresses to death. The differential diagnosis of acute encephalitic illnesses of unknown cause with atypical focal neurologic signs or with paralysis should include rabies (American Academy of Pediatrics, 2009).

Incubation Period
The period is highly variable but usually 3-8 weeks; very rarely as short as a few days, or as long as several years. Length of incubation depends in part on wound severity, wound location in relation to nerve supply, and relative distance from the brain; the amount and variant of virus; the degree of protection provided by clothing and other factors.

Period of Communicability
Not well defined for human cases.

Diagnosis
Human rabies diagnosis is made through specific fluorescent antibody (FA) staining of brain tissue or made by specific FA staining of viral antigens in frozen skin sections taken from the back of the neck at the hairline, detection of viral antibodies in serum and CSF, and specific amplification of viral nucleic acids in saliva or skin biopsies by reverse transcriptase PCR (RT-PCR). Serological diagnosis is based on neutralization tests in cell culture or in mice (Heymann, 2008).

Methods of Control/Role of Investigator

Prevention and Education
Refer to the Vector-Borne and Zoonotic Diseases - Introduction and General Considerations section of the manual that highlights topics for client education that should be considered and as well as provides information on high-risk groups and activities.

Immunization
Pre-exposure vaccination
Vaccinate individuals who are potentially at high risk of contact with rabid animals (e.g., veterinarians, veterinary technicians, animal control staff, wildlife workers, spelunkers, laboratory and field personnel working with rabies virus and travellers to rabies endemic areas where there is poor access to adequate and safe post-exposure management). These people should consider pre-exposure immunization with either human diploid cell culture vaccine (HDCV) or purified chick embryo cell vaccine (PCECV) (Public Health Agency of Canada, 2006).

Post-immunization serological testing is advisable every 2 years for persons with continuing high risk of exposure, such as certain veterinarians. Those whose titres fall below protective levels (0.5 IU/mL) should receive a pre-exposure booster dose of vaccine (Public Health Agency of Canada, 2006).

Vaccination of Animals

The public should be aware of the benefits of vaccinating animals and take measures to protect their pets or other domestic animals (i.e., horses). The public can also help reduce the spread of rabies through informing authorities when an animal is suspected of having the disease (*The Health of Animals Act*[6] requires individuals who have knowledge of or who suspects rabies in an animal to notify CFIA). The public can also report animals suspected on having rabies to the provincial rabies hotline number at: 1-844-7-RABIES (1-844-772-2437). The veterinary profession can educate individuals regarding the value of vaccinating pets, and the vaccination requirements for pets travelling to other countries or importing into Canada.

Various wildlife departments are involved in vaccinating wildlife species, surveying the extent of wildlife rabies in certain geographic areas, as well as surveying the extent of rabies in certain species (Canadian Food Inspection Agency, 2009).

Animal Control Measures

The management of rabies in domestic animals falls under the jurisdiction of the Ministry of Agriculture in in Saskatchewan as follows:

- The RRAV and private veterinarians investigate all cases of suspected rabies in any domestic animal;
- Ministry of Agriculture veterinarians (including the RRAV) institutes appropriate control actions such as revaccination, observation periods, quarantine or euthanasia of any domestic animal that is known or suspected to have had contact with a rabid animal.

Education

Keeping pets under control, teaching children not to play with wild animals or pets they do not know, keeping a safe distance from wildlife and not trying to raise orphaned or injured wildlife all contribute to preventing rabies (Canadian Food Inspection Agency, 2009). Children should be cautioned against provoking or attempting to capture stray or wild animals and against touching carcasses.

[6] http://laws-lois.justice.gc.ca/eng/regulations/C.R.C.%2C_c._296/index.html

International travelers to areas with endemic canine rabies should be warned to avoid exposure to stray dogs, and if traveling to an area with enzootic infection where immediate access to medical care and biologicals (e.g., vaccine and immunoglobulin) is limited, pre-exposure prophylaxis is indicated (American Academy of Pediatrics, 2009). Refer to Saskatchewan International Travel Manual for travel-related recommendations.

Pet owners should be reminded of the importance of vaccinating their pets.

Children, pet owners and the general public should be made aware of how to act/behave around animals such as dogs and cats and be informed how to interpret body language of an animal.

Dog owners should be educated on preventing their animals from biting people.

Personal Protective Measures
It is important for individuals to take appropriate personal protective measures and to use appropriate protective equipment when handling unknown animals or animals that are seemingly unwell. Standards exist for veterinarians and other occupational groups to prevent exposure to rabies and other zoonotic illnesses. Refer to the Western College of Veterinary Medicine (WCVM) infection control manual for details.

Environmental Measures
Inadvertent contact of family members and pets with potentially rabid animals, such as raccoons, foxes, coyotes and skunks, may be decreased by securing garbage and refuse to decrease attraction of domestic and wild animals. Similarly, chimney and other potential entrances for wildlife, including bats, should be identified and covered. Bats should be excluded from human living quarters. Bat exposure is considered to be high-risk. Refer to the following website for more information on bat-proofing human dwellings: http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/09pdf/acs-dcc-07.pdf.

I. Contacts/Contact Investigation

Contact Definition

Individuals who have had direct contact with the saliva or infectious material of an individual confirmed to have rabies. Routine delivery of health care to a patient with rabies is not an indication for RPEP (Centers for Disease Control and Prevention, 2008).

Contact Management

Rabies post-exposure prophylaxis (RPEP) is indicated for contacts (e.g., household, health care workers) who are reasonably certain they were bitten by the patient or had mucous membrane or non-intact skin directly exposed to potentially infectious saliva or neural tissue (Centers for Disease Control and Prevention, 2008). Refer to Table 2 in Part I – Follow-up of Animal Bites/Exposures for the RPEP regime.

A risk assessment should be conducted for all contacts of a human rabies case and RPEP should be provided as necessary.

Testing/Prophylaxis

Individuals who have been previously vaccinated should be followed as outlined in Table 2 in Part I – Follow-up of Animal Bites/Exposures for the RPEP regime.

Treatment

Rabies has the highest case fatality rate of any infectious disease. There is not proven effective medical treatment for human rabies cases once clinical signs have developed. Provision of rabies vaccine after development of clinical symptoms is not recommended as it may be detrimental to the individual (Centers for Disease Control and Prevention, 2008).

II. Environment

Institutional Control Measures

Human rabies cases do not pose any greater risk of infection to health care workers than more common bacterial or viral infections. Medical staff should adhere to standard and droplet precautions. Staff should wear gowns, goggles, masks, and gloves, particularly during intubation and suctioning (Centers for Disease Control and Prevention, 2008).

Additional precautions, such as wearing face shields when performing higher-risk procedures that can produce droplets or aerosols of saliva (i.e., suction of oral secretions), might be warranted (Centers for Disease Control and Prevention, 2010). Aerosol transmission of rabies has occurred only in laboratory settings.

The Centers for Disease Control and Prevention (2010) identified measures to avoid risk of transmission at autopsy of a suspected rabies cases:

- Require appropriate personal protective equipment including an N95 or higher respirator, full face shield, goggles, gloves, complete body coverage by protective wear, and heavy or chain mail gloves to help prevent injury from instruments or bone fragments.
- Minimize aerosols by using a handsaw rather than an oscillating saw when cutting bone, and by avoiding contact of the saw blade with brain tissue.
- Use a 10% solution of sodium hypochlorite for disinfection of all exposed surfaces and equipment during and after the autopsy.
- If injury or mucous membrane contamination occurs during an autopsy, provide rabies post-exposure prophylaxis.

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Please see the following pages for the Animal Bite Investigation Form.

Government of Saskatchewan
Ministry of Health

Animal Bite Investigation Form

Shaded areas are mandatory for reporting to Saskatchewan Ministry of Health
[Indicates field in iPHIS]
Please use yyyy/mm/dd for all dates

Date: _____

Client Information

Victim's Name:		☐ Male ☐ Female	DOB: Age:
PHN:			
Parent/Guardian (if victim is a minor):		Phone number: H: W:	
Mailing Address:	Postal Code:	First Nation:	
Attending Physician or Primary Care Nurse:	Attending Physician/Nurse Phone number:	Date first attended by Physician:	
Previously immunized for Rabies: Yes ☐ Unknown ☐ No ☐	Date immunization completed:		

Incident & Initial Assessment

Date of Exposure:	Unique Animal ID Number:[1]
Place of Exposure: Name of town/city (if within city limits) **OR** RM (rural) **OR** First Nations Community:	
Type of Exposure:[2] Bite ☐ Scratch ☐ Saliva on intact skin ☐ Saliva on existing lesion ☐ Saliva on mucous membranes ☐ Occupational - Bite ☐ Occupational - Scratch ☐ Occupational - Saliva on intact skin ☐ Occupational - Saliva on existing lesion ☐ Occupational - Saliva on mucous membranes ☐ No known contact ☐ Other ☐, specify:	
Type of attack: Provoked ☐ Unprovoked ☐ Unknown ☐	
Wound Location: Head/Neck ☐ Face ☐ Arm ☐ Hand/Finger ☐ Torso ☐ Leg ☐ Foot/Toe ☐ Mucosa ☐ Unknown ☐ Other ☐, specify:	
Animal Species: Dog ☐ Cat ☐ Bat ☐ Cow ☐ Horse ☐ Skunk ☐ Racoon ☐ Hog ☐ Fox ☐ Other ☐, specify:	
Animal Type: Pet (indoor) ☐ Pet(outdoor) ☐ Pet(indoor/outdoor) ☐ Outdoor Farm Animal ☐ Wild ☐ Stray ☐ Unknown ☐ Animal healthy at time of incident: Yes ☐ Unknown ☐ No ☐	
Symptoms:	
History of Incident/Exposure:	

[1] This is a unique animal identifier that should be used in each case report on iPHIS that involves the same animal in the following format: *<health region 3-4 letter acronym>-<four digit calendar year>-<R to indicate Rabies>-<three digit sequential number beginning at 001> (e.g. SCHR-2007-R-001.* This is to be documented in iPHIS in the "Animal Services Incident Number" field.
[2] Occupational exposures are when the person is exposed through performing job duties (i.e. a mail carrier bitten would not be an occupational exposure, however a veterinarian handling a sick animal would be).

Animal Vaccinated: No ☐ Unknown ☐ Yes ☐, please provide details/dates:		
Veterinarian:		Vet Phone number:
Owner Name:	Address:	Phone Number H: W:
Observation Following Exposure: No ☐ Yes ☐ Where?		Date Observation Completed:
Animal Retention Result: Became ill ☐ Released ☐ Natural death ☐ Destroyed ☐ Escaped ☐		
Brain Sent for Testing? Yes ☐ Date sent:		No ☐ Why not?
Primary Lab Results: Positive ☐ Negative ☐ Final Lab Results: Positive ☐ Negative ☐		

Immunization Recommendation

Tetanus Indicated? Yes ☐ No ☐ Administered? Yes ☐ Date: No ☐ Why not?
Rabies Immune Globulin & Vaccine: Recommended ☐ Not recommended ☐ Unknown at this time ☐ If recommended, complete immunization record (below)

Date received:	Date MHO Review:	Date sent to CFIA:

Immunization Information

RIG Dosage: Weight in kg = _____ × 20 IU / kg = _____ I U (2 mL vial contains 300 IU = 150 IU/mL)
= _____ mL

Date:	Site(s)/Amount (ml)	Administered by:

Prior to initiation of Rabies Post Exposure Prophylaxis, all persons must be screened for immunosuppressive disorders which may include: • Asplenia; • Congenital immunodeficiencies involving any part of the immune system; • Human immunodeficiency virus infection (HIV); • Immunosuppressive therapy; • Haematopoietic stem cell transplant (HSCT) recipient; • Islet cell transplant (candidate or recipient); • Solid organ transplant (candidate or recipient); • Chronic kidney disease; • Chronic liver disease including hepatitis B and C; and • Malignant neoplasms including leukemia and lymphoma. (http://www.ehealthsask.ca/services/manuals/Documents/sim-chapter7.pdf). **Consultation with the MHO should be done in case of any significant illness or for clarification if a candidate for rabies vaccine may be immunosuppressed due to the clinical condition or therapy.**

Vaccine	Series	Date	Administered by	
	1st Dose			If series not completed, why not? ☐ Animal well after observation period ☐ Animal results negative ☐ Victim previously immunized ☐ Victim refused further doses ☐ Lost to follow-up ☐ Referred out of province ☐ Other
	Day 3			
	Day 7			
	Day 14			
	Day 28*			

Remarks (e.g. vaccine reactions):

*Only required for immunocompromised individuals

RETURN COMPLETED FORM TO REGIONAL MHO

Health Region/Authority: _____

Reported by: _____

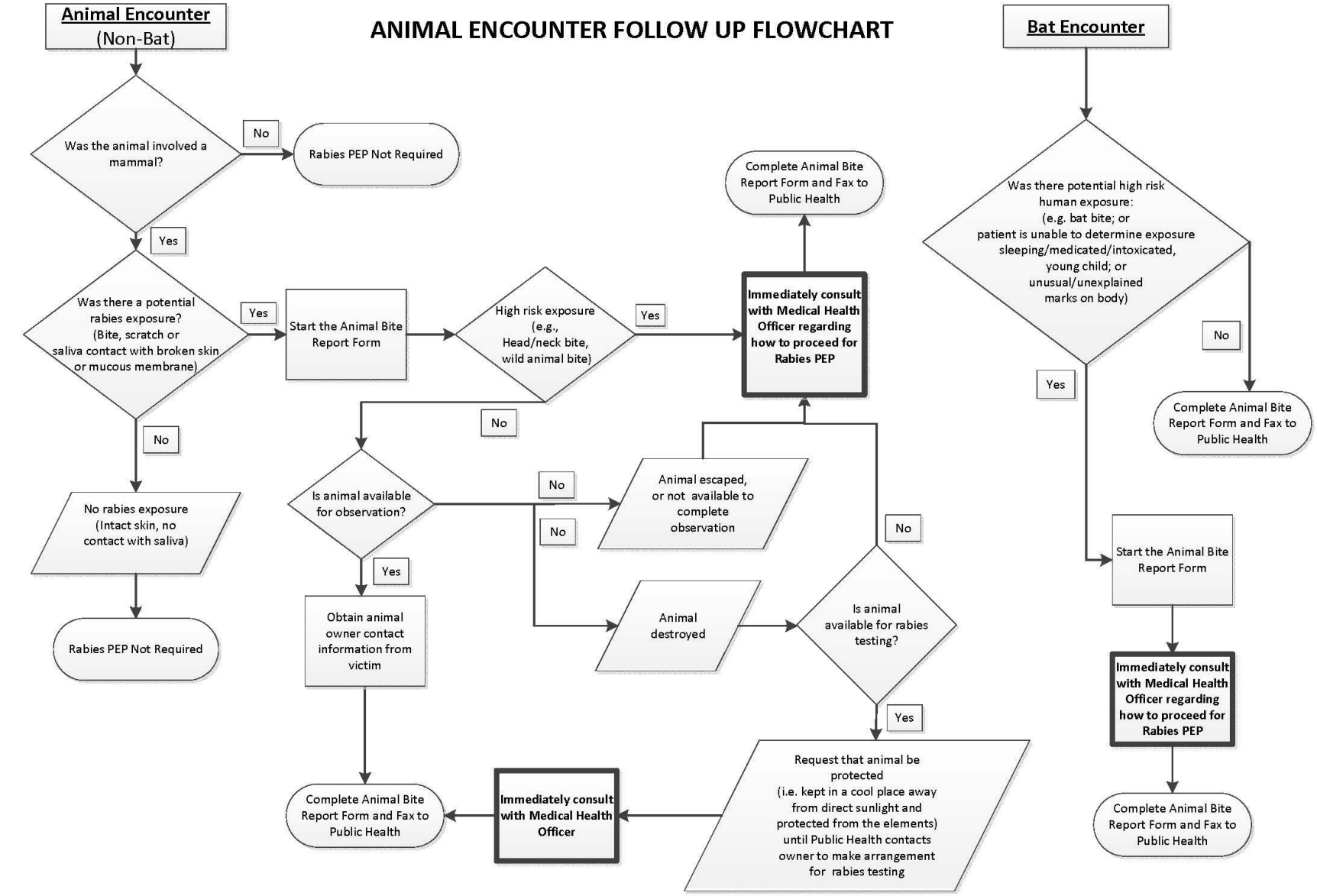
Job Designation: _____

Phone: _____ **Fax:** _____

MHO or Designate Signature: _____ Date: _____

Please see the following page for the Animal Encounter Follow up Flowchart.

ANIMAL ENCOUNTER FOLLOW UP FLOWCHART



Note: This flowchart is to be used as a general guideline. Please contact the Medical Health Officer directly with specific questions regarding administering Rabies PEP.

Please see the following pages for the Interjurisdictional Referral Following an Animal Exposure form.

Government of Saskatchewan
Ministry of Health

DATE OF REFERRAL: _____

Interjurisdictional Referral Following an Animal Exposure

- ❑ **Action Required:** ❑ **Victim AND Animal Require Follow-Up (Complete All Sections)**
  - ❑ **Victim Requires Follow-Up (Referring Jurisdiction complete I and II)**
  - ❑ **Status of Animal Required (Referring Jurisdiction complete II and III)**
  - ❑ **Assess Other Humans for Exposure (Referring Jurisdiction Complete II and III)**
- ❑ **For Information Only**

FROM (Health Region)	**TO (Health Region/Jurisdiction)**

I. Demographic Details of Exposed Person (Complete only if victim requires follow-up)

Name:	Date of Birth (YYYY/MM/DD):
Address:	Health Services Number:
Contact Information Home phone : Cell: E-mail:	

II. Exposure and Assessment Details (Complete in all referrals)

Date of Exposure (YYYY/MM/DD):	Type of Animal:	Body Site/Type of Exposure (eg. head/arm; eg. bite/scratch)
Assessment of Exposure[1]: ❑ High Risk Exposure ❑ Low Risk Exposure		
Has Rabies Post-Exposure Prophylaxis (RPEP) been recommended ? ❑ No ❑ Yes Date Started (YYYY/MM/DD):_____ ❑ Awaiting Animal Observation/Testing Results – Date Expected (YYYY/MM/DD):_____ ❑ Assessment Not Completed – Please Assess for Possible Exposure		

III. Contact Information of Owner of Animal (Complete if animal requires follow-up)

Name of Owner:		Relationship of owner to the exposed person: ❑ Same ❑ Family Member ❑ Unknown ❑ Friend ❑ Other: _____
Phone Number(s):		Address:
Name of Animal:	Type of Animal (eg. dog/cat/other)	Status of Animal: ❑ Alive ❑ Deceased ❑ Unknown
Additional details related to the animal (e.g. description of animal) Include rabies status if known:		

IV. Public Health Contact Details – Receiving Agency direct inquiries to:

Name/Title:	Phone Number:
Results of the completed assessment required? ❑ No ❑ Yes Fax Number: Fax Attention To:	

[1] High Risk (unprovoked, stray animals or animals with unusual behavior, significant exposure); Low Risk (provoked, vaccinated animal or animal known to victim, etc.)

Additional Details of Incident That May Assist the Investigator:

Intramuscular (IM) administration of pre-exposure rabies vaccine is the gold standard, however the World Health Organization (WHO) considers the intradermal (ID) regime an acceptable alternative as it uses less vaccine and produces a comparable degree of protection against rabies (Canadian Immunization Guide, Evergreen).

Due to the precise nature for ID administration and the potential consequences of improper administration, post-immunization antibody titres should be determined at least 2 weeks after completion of ID vaccine series to ensure that an acceptable level of protection has been achieved.

The following scenarios may arise when managing clients who have received 3 doses of pre-exposure ID rabies vaccine at the appropriate intervals as outlined in the Canadian Immunization Guide (CIG)[1]. Post-exposure management is outlined for each scenario.

Titre done following ID pre-exposures Rabies vaccine

1. Titre conducted at least 2 weeks after the last dose indicates <u>immunity</u>[2]

- ***Post-exposure***:
  - RabIg not needed (as per CIG evergreen[1]).
  - Give 2 IM doses of rabies vaccine on days 0 and 3.

2. Titre conducted at least 4 weeks after 3rd dose and after one additional dose indicates <u>non-immune</u>

- ***Post exposure:***
  - Give RabIg.
  - Give full post exposure vaccine course (as per 1. Previously Unimmunized Individuals [Table 2]).

Titre *<u>not</u>* done following ID pre-exposures Rabies vaccine

1. Routine management when client did not have titre conducted 4 weeks after final dose

- ***Post-exposure***:
  - take rabies titre.
  - Give RabIg (assuming titre will not be immediately available as it currently takes up to 8 weeks which will be after the entire course is done).
  - Give 2 IM doses of rabies vaccine on days 0 and 3.

[1] http://www.phac-aspc.gc.ca/publicat/cig-gci/p04-rabi-rage-eng.php
[2] at least 0.5 IU/mL by the rapid fluorescent-focus inhibition test

- Continue series until titre results are received indicating immunity
- If titre results are not available or are non-immune/suboptimal: complete post-exposure vaccine course (as per 1. Previously Unimmunized Individuals [Table 2]).

2. Alternate management for low risk exposures if acceptable to the client and the MHO if the following criteria are met.

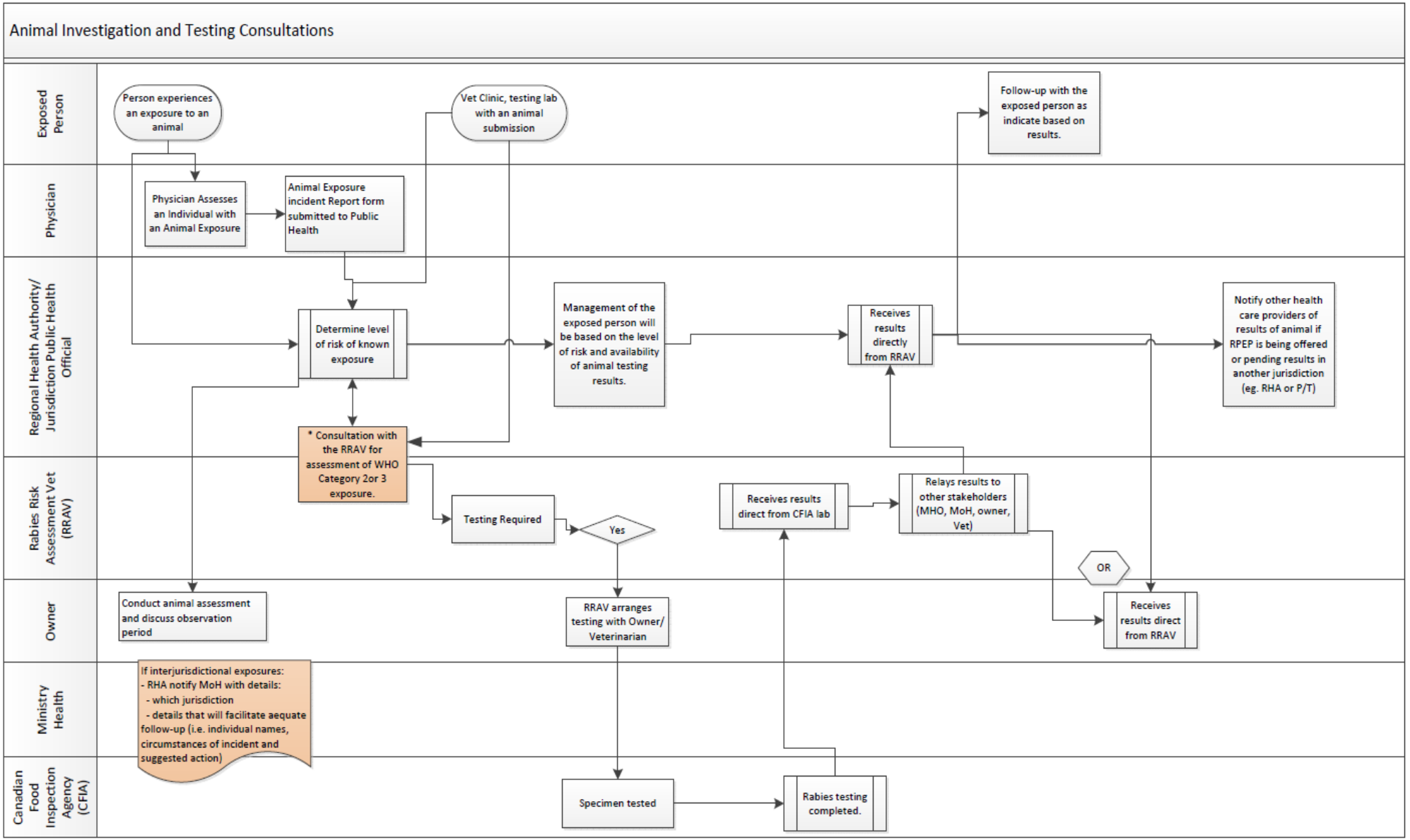
i. No risk factors for a poor response to ID vaccine
AND
ii. Risk of rabies in animal is low
AND
iii. Likelihood of transmission from exposure is low
AND
iv. Other individuals in ID vaccine group were tested and were immune.

- ***Post-exposure:***
  - take rabies titre
  - RabIg not needed
  - Give 2 IM doses of rabies vaccine on days 0 and 3.

Individual did not complete the series of pre-exposure ID vaccine

- ***Post-exposure:***
  - give RabIg and rabies vaccine (as per 1. Previously Unimmunized Individuals [Table 2])

The diagram on the following page highlights the process for consulting with animal health experts in the investigation of human exposures to animal potentially infected with rabies.


Animal Investigation and Testing Consultations
Exposed Person
Physician
Regional Health Authority/ Jurisdiction Public Health Official
Rabies Risk Assessment Vet (RRAV)
Owner
Ministry Health
Canadian Food Inspection Agency (CFIA)
Person experiences an exposure to an animal
Vet Clinic, testing lab with an animal submission
Follow-up with the exposed person as indicate based on results.
Physician Assesses an Individual with an Animal Exposure
Animal Exposure incident Report form submitted to Public Health
Determine level of risk of known exposure
Management of the exposed person will be based on the level of risk and availability of animal testing results.
Receives results directly from RRAV
Notify other health care providers of results of animal if RPEP is being offered or pending results in another jurisdiction (eg. RHA or P/T)
* Consultation with the RRAV for assessment of WHO Category 2or 3 exposure.
Testing Required
Yes
Receives results direct from CFIA lab
Relays results to other stakeholders (MHO, MoH, owner, Vet)
OR
Conduct animal assessment and discuss observation period
RRAV arranges testing with Owner/ Veterinarian
Receives results direct from RRAV
If interjurisdictional exposures:
- RHA notify MoH with details:
- which jurisdiction
- details that will facilitate aequate follow-up (i.e. individual names, circumstances of incident and suggested action)
Specimen tested
Rabies testing completed.

Vector-borne and Zoonotic Diseases

West Nile Virus

Notification Timeline:

From Lab/Practitioner to Public Health: As soon as possible (not more than 48 hours)
From Public Health to Ministry of Health:
West Nile Virus Neuroinvasive Disease (WNND) – Within 72 hours.
West Nile Virus Non-Neuroinvasive Disease (WN Non-ND) – Not required.

Public Health Follow-up Timeline:

West Nile Virus Neuroinvasive Disease (WNND) – Within 72 hours.
West Nile Virus Non-Neuroinvasive Disease (WN Non-ND) – Not required.

Information

Case Definitions – West Nile Virus Neuroinvasive Disease (WNND) (Adapted from Council of State and Territorial Epidemiologists, 2013)

Confirmed Case –WNND	Clinical criteria **AND** at least one of the following laboratory criteria: • Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, CSF, or other body fluid, **OR** • Four-fold or greater change in virus-specific quantitative antibody titers in paired sera **OR** • Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or a later specimen **OR** • Virus specific IgM antibodies in serum with confirmatory avidity test* in the same or later specimen **OR** • Virus-specific IgM antibodies in CSF and a negative result for other IgM antibodies in CSF for arboviruses endemic to the region where exposure occurred.
Probable Case – WNND	Clinical criteria **AND** the following laboratory criteria: • Virus-specific IgM antibodies in CSF or serum but with no other testing.

Clinical Criteria – WNND	• history of exposure in an area where West Nile virus (WNV) activity is occurring[†] **OR** • history of exposure to an alternative mode of transmission[‡] **AND** • Meningitis, encephalitis, acute flaccid paralysis, or other acute signs of central or peripheral neurologic dysfunction, as documented by a physician **AND** • Absence of a more likely clinical explanation.

[*] The presence of both IgM antibody and low avidity IgG in a patient's convalescent serum sample is consistent with current cases of viral-associated illness. However, test results that show the presence of IgM and high avidity IgG are indicative of exposures that have occurred in the previous season.
[†] History of exposure when and where West Nile virus transmission is present, or could be present, or history of travel to an area with confirmed WNV activity in birds, horses, other mammals, sentinel chickens, mosquitoes or humans or other plausible explanation of exposure to infected mosquitoes.
[‡] Alternative modes of transmission, identified to date, include laboratory acquired; in utero; receipt of blood components; organ/tissue transplant; and, possibly, through breast milk.

Case Definition – West Nile Virus Non-Neuroinvasive Disease (WN Non-ND) (Adapted from Council of State and Territorial Epidemiologists, 2013)

Confirmed Case – WN Non-ND	Clinical criteria **AND** at least one of the following laboratory criteria: • Isolation of virus from, or demonstration of specific viral antigen or nucleic acid in, tissue, blood, or other body fluid, excluding CSF **OR** • Four-fold or greater change in virus-specific quantitative antibody titers in paired sera **OR** • Virus-specific IgM antibodies in serum with confirmatory virus-specific neutralizing antibodies in the same or later specimen. **OR** • Virus specific IgM antibodies in serum with confirmatory avidity test* in the same or later specimen
Probable Case – WN Non-ND	Clinical criteria **AND** the following laboratory criteria: • Virus-specific IgM antibodies in serum but with no other testing.

Clinical Criteria – WN Non-ND	• history of exposure in an area where West Nile virus (WNV) activity is occurring[†] **OR** history of exposure to an alternative mode of transmission[‡] **AND** • fever or chills as reported by the patient or a health care provider **AND** • Absence of neuroinvasive disease **AND** • Absence of more likely clinical explanation

[*] The presence of both IgM antibody and low avidity IgG in a patient's convalescent serum sample is consistent with current cases of viral-associated illness. However, test results that show the presence of IgM and high avidity IgG are indicative of exposures that have occurred in the previous season.
[†] History of exposure when and where West Nile virus transmission is present, or could be present, or history of travel to an area with confirmed WNV activity in birds, horses, other mammals, sentinel chickens, mosquitoes or humans or other plausible explanation of exposure to infected mosquitoes..
[‡] Alternative modes of transmission, identified to date, include laboratory acquired; in utero; receipt of blood components; organ/tissue transplant; and, possibly, through breast milk.

Case Definition – Asymptomatic Blood Donors (Public Health Agency of Canada, 2008)

• Demonstration of West Nile Virus-specific nucleic acid amplification test on positive donor screen test result.
Canadian Blood Services perform a nucleic acid amplification test (NAT) on all blood donations to detect all viruses in the Japanese encephalitis (JE) serocomplex ─ WNV and 9 other viruses, most of which are not endemic to Canada. Confirmatory testing using a WNV-specific NAT is then performed on donor blood that has screened positive..

Canadian Blood Services (CBS) reports all cases of positive blood donors to the regional MHO as per Section 32 of *The Public Health Act*. No follow-up by public health is required on these reports.

Causative Agent

The West Nile virus (WNV) is a single-stranded RNA Flavivirus.

Symptoms

The vast majority of WNV infections are asymptomatic.

Approximately 20% of persons experience an acute systemic febrile illness that often includes headache, weakness, myalgia, or arthralgia; gastrointestinal symptoms and a transient maculopapular rash also are commonly reported. This form of illness is called WNV non-neuroinvasive disease (previously West Nile non-neurological syndrome)

Less than 1% of infected persons develop WNV neuroinvasive disease (previously West Nile neurological syndrome), which typically manifests as meningitis, encephalitis, or acute flaccid paralysis. For every case of neuroinvasive disease, there are approximately 150 WNV infections.

Meningitis generally presents with fever, headache and nuchal rigidity (neck stiffness).

Encephalitis generally presents with fever and altered mental status, seizures, focal neurologic deficits, or movement disorders such as tremor or parkinsonism.

Acute flaccid paralysis due to WNV is clinically and pathologically identical to poliovirus-associated poliomyelitis. It often presents as an isolated limb paresis or paralysis and can occur with or with fever or apparent viral prodrome. It may progress to respiratory paralysis requiring mechanical ventilation.

WNV-associated Guillain-Barré syndrome and radiculopathy have also been reported.

Rarely, cardiac dysrhythmias, myocarditis, rhabdomyolysis, optic neuritis, uveitis, chorioretinitis, orchitis, pancreatitis, and hepatitis have been described in patients with WNV disease.

Complications
Most persons with WNV non-neuroinvasive disease recover completely, but fatigue, malaise, and weakness can last for weeks or months. Persons with WNV neuroinvasive disease presenting with meningitis generally recover completely but persons presenting with encephalitis or acute flaccid paralysis often have residual neurologic deficits. Among persons with WNV neuroinvasive disease, the overall case-fatality ratio is approximately 10% (U.S. Centers for Disease Control and Prevention, 2013).

Incubation Period
Typically 2 to 6 days, ranging up to 14 days but can be several weeks for immunocompromised individuals (U.S. Centers for Disease Control and Prevention, 2013).

Reservoir/Source
Wild birds are the predominant reservoir including > 300 different species found in North America. Mammals, including humans, are considered incidental or dead-end hosts because viral concentrations are not high enough to create the infection in mosquito vectors. It is unclear how West Nile virus is maintained in Saskatchewan, but is most likely re-introduced through migrating birds, present in over-wintered or hibernating *Culex* mosquitoes, or maintained in resident bird or other mammal, amphibian, or reptile populations. Squirrels have been implicated as competent reservoirs for WNV in California and other arboreal animals may contribute to maintenance and transmission ecology of WNV in North America (Platt et al. 2008).

Mode of Transmission
Enzootic cycle involving mosquitoes, primarily *Culex* sp., and birds or birds eating other birds. Mosquitoes acquire the virus after feeding on infected birds or to a lesser extent, through transovarial transmission from an infected mother. Viremia in birds tends to peak 1 to 4 days after exposure. The extrinsic incubation period (EIP) of the virus within the mosquito varies and is dependent on temperature and a number of other factors.

The minimum developmental temperature for West Nile virus incubation and replication within the mosquito is 14.3°C and 109 accumulated Degree Days above this base temperature are required to complete the EIP for the virus within the mosquito and for that mosquito to become fully infective and efficiently transmit the virus to another bird, or to a human. The female must complete at least one biting/egg-laying cycle before she can effectively transmit the virus. The EIP can be quite short during warm weather (5-7 days) and quite long (> 2-3 weeks) under cooler conditions.

The risk of transmission to humans increases when there are high numbers of infected "bridge" species (mosquitoes that bite both birds and other animals) such as *Culex tarsalis* and there are hot, humid conditions during the evening and night-time period.

Alternative modes of transmission exist although they are extremely rare. Those identified to date, include laboratory acquired; in utero; receipt of blood components; organ/tissue transplant; and, possibly, through breast milk.

Risk Groups

- Individuals who work outside or participate in outdoor activities are at higher risk of acquiring infection because of greater exposure to mosquitoes
- Individuals with chronic illnesses, such as cancer, diabetes, hypertension and kidney disease, are at higher risk of serious illness

Period of Communicability

Not applicable.

Specimen Collection and Transport

The following specimens should be submitted on persons presenting with meningitis, encephalitis, acute flaccid paralysis, or other acute signs of central or peripheral neurologic dysfunction (with or without fever) may have West Nile virus (WNV) neuroinvasive disease:

- serum sample for WNV IgM antibodies
- CSF for WNV PCR[1]

When a plasma PCR is indicated, send EDTA plasma, separated[1].

With paired sera, convalescent samples should be taken 14 days after the initial sample.

Methods of Control/Role of Investigator

Prevention and Education

Refer to the Vector-borne and Zoonotic Diseases – Introduction and General Considerations section of the manual that highlights topics for client education that should be considered as well as provides information on high-risk groups and activities. Prevention measures are where the most emphasis should be placed.

Refer to the Government of Saskatchewan website for information on West Nile Virus Awareness and Prevention.[2]

[1] If the sample can reach SDCL within four hours, send on ice packs. If it will take longer than four hours to reach the SDCL, send the sample frozen on dry ice.

[2] http://www.saskatchewan.ca/live/health-and-healthy-living/health-topics-awareness-and-prevention/seasonal-health-concerns/west-nile-virus/west-nile-virus-awareness-and-prevention

Surveillance
Various activities to determine the presence and risk of West Nile virus transmission can be undertaken including:

- avian and equine morbidity/mortality surveillance;
- larval and adult mosquito collection and testing;
- surveillance of weather and other environmental risk factors;
- surveillance of human illness locally and in neighbouring provinces/states.

Immunization

- There is no human vaccine currently available.
- Equine (horse) vaccines are available.

Communication/Education
Population health communication strategies should include a combination of risk communication and implementation of environmental and personal protective measures. This information should be disseminated prior to the emergence of mosquitoes and repeated during the summer months as the transmission risk begins to increase.

Key preventative measures include:
Environmental Prevention Measures

- Clean eaves troughs and regularly empty bird baths and other items that might collect water.
- Ensure rain barrels are covered with mosquito screening or are tightly sealed around the downspout.
- Clear yards of old tires or other items that collect water.
- Improve landscaping to prevent standing water around the home.
- Remove decaying debris such as fallen leaves, grass clippings, and dense shrubs that provide shelter for adult mosquitoes.
- Areas with shallow standing water, particularly those with high organic matter content that cannot be drained can be treated with a larvicide to kill mosquitoes in their larval stage.
- Municipal mosquito control programs that use integrated pest management (IGM) principals should be encouraged. These programs include: larval and adult mosquito surveillance, source reduction, larval and in some cases, adult mosquito control, and public education.

- Refer to Government of Saskatchewan handout "West Nile Virus and Your Property"[3].

Personal Protective Measures

- Wear loose fitting, light color clothing that covers as much exposed skin as possible.
- Reduce the amount of time spent outdoors during times when mosquito activity is the greatest (between dusk and dawn).
- Individuals who are highly active with outdoor activities or who work outdoors can be at greater risk of infection.
- Use DEET containing personal insect repellents on exposed skin. Refer to the Government of Canada website for guidelines on DEET use: http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/life-vie/insect-eng.php. Repellents with Icaridin and oil of eucalyptus are also effective. See Health Canada website for more information: http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/life-vie/insect-eng.php
- Maintain door and window screens so they fit tightly and are free of holes.
- Refer to Government of Saskatchewan brochure "Protect Yourself: West Nile Virus"[3]

Management

I. Case

History

Physicians are required to report to Public Health if:

- the patient is a donor or recipient of blood or blood products or is a tissue recipient
- the patient has clinical presentation of neuroinvasive disease

Human case investigation will be performed by the attending physician and Public Health. Information collected includes:

- clinical manifestation;
- clinical information (onset dates, hospitalization, outcome of illness, etc.);
- travel history;
- history of suspected exposures/mode of transmission;
- blood/plasma donor or recipient or tissue recipient information.

[3] http://www.saskatchewan.ca/live/health-and-healthy-living/health-topics-awareness-and-prevention/seasonal-health-concerns/west-nile-virus/west-nile-virus-awareness-and-prevention

See Attachments:

- Physician Reporting Form for West Nile Virus;
- West Nile Virus Case Investigation Form;
- Decision-Making Algorithm for Notification.

Treatment/Supportive Therapy

Supportive therapies only. Clinical trials to evaluate proposed treatments are ongoing.

Immunization

Not applicable.

Exclusion

There is a deferral period for donating blood or blood products to Canadian Blood Services (CBS). CBS should be contacted directly for detailed information.

Referrals

CBS is to be notified when a case has identified any history of receiving or donating blood or blood products. See Appendix K – Notification to Canadian Blood Services for the template form for making these referrals.

The Saskatchewan Transplant Program is to be notified when a case has identified receiving a tissue transplant in the 8 weeks prior to onset of symptoms. See Appendix M – Notification to Saskatchewan Transplant Program for the template form for making these referrals.

II. Contacts/Contact Investigation

Contact Definition

Not applicable.

III. Environment

See Environmental Prevention Measures above. Refer to the Government of Saskatchewan website for information on mosquito control.[4]

[4] http://www.saskatchewan.ca/live/health-and-healthy-living/health-topics-awareness-and-prevention/seasonal-health-concerns/west-nile-virus/west-nile-virus.

The risk of human disease is calculated weekly according to an empirical risk assessment framework using numbers of vector mosquitoes, infection rates, age structure of the mosquito population, human population at risk, and other surveillance indicators (bird, horse, human, and environmental risk factors such as degree day accumulations, night-time temperatures, amount of mosquito habitat, etc.). The risk assessments help guide the WNV response in terms of risk communication, mosquito control, and other prevention activities.

Dead birds are a potential source of transmission however the risk is minimal. Special handling considerations are required for all dead animals regardless of suspected WNV infection. The following procedure should be used:

- Do not handle the bird, its blood, or secretions with bare hands.
- If possible, use a shovel to handle the carcass and bury it if a location is convenient.
- Use durable plastic gloves or, at minimum, several plastic bags. Bags should be inverted prior to grabbing the animal. Fold the bag back around the carcass so it ends up inside.
- Take care not to grab the claws or beak or allow these parts to puncture the bag or gloves.
- Double bag the carcass and tie it off tightly. The animal can be disposed of with municipal waste.
- Once disposed of, wash hands thoroughly.

Larval Mosquito Control

Larviciding is the application of chemical/biological agents to areas where mosquito larvae are present. Thorough identification of larval development sites is critical to a successful larviciding program.

Adult Mosquito Control

During periods of high transmission risk determined from thorough analysis of the surveillance and environmental risk factors, targeted adult mosquito control may be considered as part of the WNV response program. This is used to quickly reduce the number of infected mosquitoes in an area and to break the transmission cycle.

Reduction of Occupational Exposures

- Steps to limit occupational exposure to the West Nile virus can be taken by applying the general prevention strategies to worksites and workplaces.

- Refer to "Protecting Outdoor Workers from West Nile Virus" available at http://www.lrws.gov.sk.ca/ohs-booklets-brochures-guides.

Child Care Centre Control Measures

- Considerations to minimize exposure to mosquitoes should be given to children playing outside or taken on field trips.
- Openable windows in child care centres should have tight fitting screens to prevent insect entry.
- See Prevention and Education above.

Institutional Control Measures

- Staff within institutional settings should be aware of the signs and symptoms of West Nile virus infection so residents, particularly those with compromised immune systems can be assessed medically without delay.
- Openable windows should have tight fitting screens to prevent insect entry.
- See Prevention and Education above.

Epidemic Measures

- Public education regarding prevention activities is essential.
- Chemical/biological control of mosquitoes in larval and adult stages should be maintained or increased during epidemic periods.
- Immunize livestock.
- Refer to Government of Saskatchewan website for information on WNV risk.[5]

[5] http://www.saskatchewan.ca/live/health-and-healthy-living/health-topics-awareness-and-prevention/seasonal-health-concerns/west-nile-virus/west-nile-virus

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West Nile Virus
Attachment – Physician Reporting Form for West Nile Virus

Please see the following pages for the Physician Reporting Form for West Nile Virus.

The following form must be completed within 48 hours of receiving positive laboratory reports (eg. IgM, PCR) for WNV for either:

- Individuals with a history of:
  - Donation of blood or blood products to Canadian Blood Services in the 2 weeks prior to onset of symptoms;
  - Receipt of blood or blood products within the 8 weeks before onset of symptoms;
  - Receipt of tissue within the 8 weeks before onset of symptoms

OR

- Individuals with neuroinvasive disease and the absence of a more likely explanation

Physician Reporting Form for West Nile Virus

Report to public health within 48 hours if the criteria in Section C or D apply.

SECTION A. PATIENT INFORMATION

Health card number (PHN): __ __ __ __ __ __ ___ __ __

Last name: _____ First name: _____

DOB: _____/____/____ (yyyy/mm/dd) Phone: (_____) _____

Address: _____

SECTION B. EVIDENCE OF INFECTION

Laboratory evidence of West Nile Virus infection? ☐ No ☐Yes

Indicate onset date for first sign/symptom: _____/____/____ (yyyy/mm/dd)

Symptoms: _____

SECTION C. BLOOD/TISSUE DONOR OR RECIPIENT

Has this individual received a blood transfusion/blood product in the 8 weeks prior to onset of symptoms? ☐ No ☐ Yes

Has this individual donated blood in the 2 weeks prior to the onset of their symptoms?
☐ No ☐ Yes

Has this individual received a tissue in the 8 weeks prior to the onset of their symptoms?
☐ No ☐ Yes

SECTION D. NEUROINVASIVE DISEASE

Check the appropriate manifestation of West Nile Neuroinvasive Disease:

☐ Meningitis ☐ Encephalitis ☐ Acute Flaccid paralysis

☐ Other acute signs of central or peripheral neurologic dysfunction

Hospitalized? ☐ No ☐Yes Where:_____

Deceased? ☐ No ☐ Yes Date of Death: _____/____/____ (yyyy/mm/dd)

Has a more likely explanation of illness has been ruled out (i.e. stroke)? ☐ No ☐Yes

Physician (Please print or stamp)	Phone number	Date (yyyy/mm/dd)

Fax the completed form back to <*health region confidential fax number goes here*>
An electronic version of the form can be obtained http://www.ehealthsask.ca/services/manuals/Documents/4-150-WNV-Physician-Reporting-Form.doc

Revised 2014

West Nile Virus
Attachment – WNV Case Investigation Form

Please see the following pages for the West Nile Virus Case Investigation Form.

West Nile Virus Case Investigation Form

Data should be entered and updated in iPHIS immediately. Saskatchewan Ministry of Health will take the information from iPHIS.

The bolded data fields with asterisks are mandatory for surveillance. The shaded, bolded and bracketed information indicates where the data is entered in iPHIS. Please use yyyy/mm/dd for all dates.

SECTION A. PATIENT INFORMATION (*Demographics Module*):

1. *Health card number (PHN): ___ ___ ___ ___ ___ ___ ___ ___ ___

2. *Last name: _____

3. *First name: _____ **Middle name:** _____

4. *Date of birth: _____/____/____ (yyyy/mm/dd) **5. *Age:** _____ **6. *Sex**: ☐ Male ☐ Female

7. *Street Address OR **Legal Land Description:** _____

Apartment number: _____

8. *City/town: _____ **9. *Postal code:** |__|__|__| |__|__|__|

10. Telephone number: Home (____) ____-_____ **11.** Work (____) ____-_____

12. *If the primary residence is on a First Nations reserve enter in First Nations section ☐**Yes** ☐**No**
***(First Nations, Status*)**

13. Attending physician: _____ **14.** Physician phone number: (____) ____-_____

SECTION B. CASE MANIFESTATION:
(Please consult the Case Definitions for West Nile virus (WNV) in the Vector-borne and Zoonotic Diseases – West Nile Virus section of the Saskatchewan Communicable Disease Control Manual for explanation of these categories), *The Case Status or Manifestation in iPHIS should be updated if further available information warrants.*

15. Identify case manifestation in table below. (***CD Module/Case tab/Subtype field***)

***Manifestation – as per the attending physician**	
West Nile Virus Neurological Disease (to be used for reporting **West Nile Virus Neuroinvasive Disease(WNND)**)	☐
West Nile Virus Non-Neurological Syndrome (to be used for reporting **West Nile Virus Non-Neuroinvasive Disease (WN Non-ND)**)	☐
Asymptomatic **(**to be used for documenting **Asymptomatic Blood Donors)**	☐

16. *Date lab specimen was collected: _____/____/____ (yyyy/mm/dd) (***Lab Module***)

SECTION C. CLINICAL INFORMATION:
17. *Onset date of signs and symptoms_____/____/____ (yyyy/mm/dd) **confirmed by the attending physician (*CD Module/Signs&Symp*)**

Signs and Symptoms must be documented when WNND is reported. These symptoms MUST be related to WNV infection or have worsened in a case with a previous underlying neurological condition.

☐Fever (≥ 38°C or 100°F)
☐Acute demyelinating encephalomyelitis
☐Acute Flaccid Paralysis
☐Arthralgia
☐Encephalitis
☐Facial paralysis
☐Fatigue
☐Headache
☐Lymphadenopathy
☐Maculopapular rash
☐Meningitis
☐Movement disorders
☐Mylagia
☐Optic neuritis
☐Parkinson–like symptoms
☐Peripheral neuropathy
☐Polyradiculopathy

18. If the patient is of childbearing age, is she **pregnant**? ☐ Yes ☐ No ☐ Not asked (***CD Module/Risks – Medical Risk***)

19. *Hospitalized: ☐ Yes ☐ No (***CD Module/Outcome***) Hospital name: _____

20. Date of admission: _____/____/____ (yyyy/mm/dd) **21.** Date of discharge: _____/____/____ (yyyy/mm/dd)

22. *Outcome of illness (at time of interview): (***CD Module /Outcome***)

☐ Alive
☐ Deteriorating
☐ Fatal ***Date of death** _____/____/____ (yyyy/mm/dd)
☐ Recovered
☐ Recovering
☐ Stable

23. *If Died, how did West Nile Virus relate to the <u>cause of death</u>: (***CD Module /Outcome***)

☐ Underlying cause of death
☐ West Nile Virus contributed to the death, but was not the underlying cause
☐ West Nile Virus did not contribute to the death, and was an incidental finding
☐ Unknown

SECTION D. TRAVEL HISTORY: (*CD Module/Exposure*)

24. *Ask this question for ALL cases with onset of symptoms prior to July 31. If the onset of symptoms is on July 31 or later, ask only for cases with an out-of-province travel history.

In the 10 days before onset of symptoms, was there travel to an area in Canada or the USA where WNV is currently active, or to the tropics where other flavivirus diseases exist (e.g., Dengue)?

☐ No ☐ Yes If yes, where _____

Exposure Category	Case Event/Location	Comments
☐ Travel inside province	Location by health region:	Further details if available:
☐ Travel outside province/country	Type province/state/country:	Further details if available

25. For health regions wishing to evaluate the effect of larvaciding in their jurisdiction, ask this question:

In the 10 days before onset of symptoms, name the places where you spent your early mornings or evenings out of doors (e.g., name of lake, golf course, park, sports field)?

_____
_____
_____

***SECTION E.** 23**. Likely mode of transmission (*CD Module/Exposure*)**	Check those that apply
Mosquito bite	☐
Non-Mosquito transmission, including:	☐
Blood transfusion recipient (After 1985) NOTE - use this category for tissue recipients as well)	☐
Blood product recipient (After 1985)	☐
Breastfed Infant	☐
Infant born to case	☐
Laboratory-acquired infection	☐
Occupational Exposure (Medical) or Occupational Exposure (Non-Medical) If Yes, please specify:	☐

*SECTION E. 23. Likely mode of transmission (*CD Module/Exposure*)	Check those that apply
Exposure to birds 10 days prior to symptom onset If Yes, please specify:	☐
Other, please specify:	☐

SECTION F. BLOOD/PLASMA DONORS AND RECIPIENTS
If patient/client was a *donor* and/or *recipient* of blood/plasma/blood components, **local public health will notify the Canadian Blood Services using the referral form in the CDC Manual - http://www.ehealthsask.ca/services/manuals/Documents/AppendixK.pdf.**

Blood, plasma or blood components	***Donated*** in past 2 weeks? ☐ No ☐ Yes ☐ Unknown	***Received*** in past 8 weeks? ☐ No ☐ Yes ☐ Unknown	Date: _____/____/____ (yyyy/mm/dd City: _____ Prov/Territory: _____

SECTION G. TISSUE RECIPIENTS
If patient/client was a *recipient* of a tissue as defined below, **local public health will notify the Saskatchewan Transplant Program using the referral form in the CDC Manual - http://www.ehealthsask.ca/services/manuals/Documents/AppendixM.pdf.**

Tissues	**Indicate the tissue the client received below:** ☐ bone ☐skin ☐ tendon ☐cornea ☐ heart valve ☐sclera	***Received*** in past 8 weeks? ☐ No ☐ Yes ☐ Unknown	Date: _____/____/____ (yyyy/mm/dd City: _____ Prov/Territory: _____

Investigator's signature: _____

Date of interview: _____/____/____ (yyyy/mm/dd)

Date entered to iPHIS: ____/____/_____ (yyyy/mm/dd)

West Nile Virus
Attachment – Decision Making Algorithm for Notification