Climate Change and Vector-Borne Diseases in Toronto

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BACKGROUND

Climate change is expected to impact the incidence of vector-borne diseases (VBDs). Previously inhospitable regions in Canada are becoming more suitable for arthropod vectors in a warming climate. In Toronto, the immediate concern for VBDs includes West Nile virus (WNV) and Lyme disease (LD).

OBJECTIVE

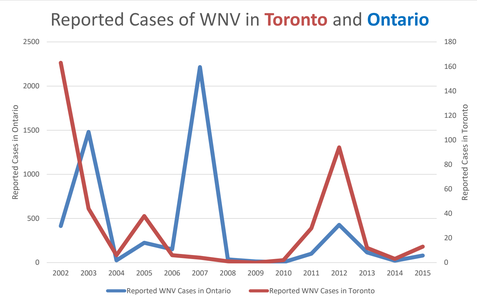
The objective of this research was to conduct a vulnerability assessment of vector-borne diseases (VBDs) in Toronto, utilizing the Ontario Climate Change and Health Vulnerability and Adaptation Assessment Guidelines (Ministry of Health and Long Term Care, 2016). The purpose of the tool is to support adaptive and resilient public health systems that anticipate, address, and mitigate the emerging risks associated with climate change.

METHODS

- A literature search was conducted on the current and projected health risks of VBDs in relation to climate change in Toronto and Ontario.
- The grey literature was reviewed to define adaptation programs and policies currently in place at the federal, provincial, and local levels.
- Key informant interviews with Toronto Public Health (TPH) staff were conducted to address gaps in knowledge

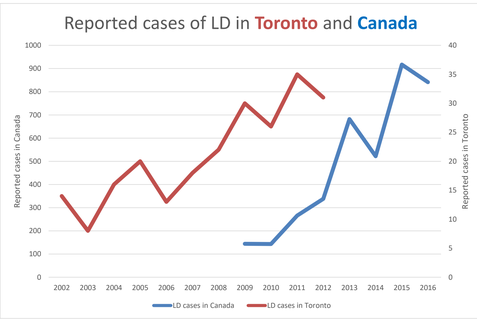
TRENDS OVER TIME

WNV



- Yearly fluctuations due to annual variation in temperature and precipitation
- 2001: WNV emerged in birds and mosquitos inn Ontario
- 2002: Most severe year in Toronto
- 2007: Low incidence in Toronto associated with cool summer and high rainfall

LD



- Emergence in North America in 1970's
- Continuous increase in reported cases since the establishment and spread of black legged tick population in Canada
- Current risk areas in Toronto: Rouge Valley Park & Morningside Park

VULNERABLE POPULATIONS

WNV & LD
- Immunocompromised individuals due to chronic illness
- Outdoor workers
  - Due to increased likelihood of exposure
- Individuals participating in outdoor leisure activities including golfing, hiking, camping
  - Due to increased likelihood of exposure

WNV
- Older adults (50+)
  - Approx. 26% of the Toronto population (2011 census data)

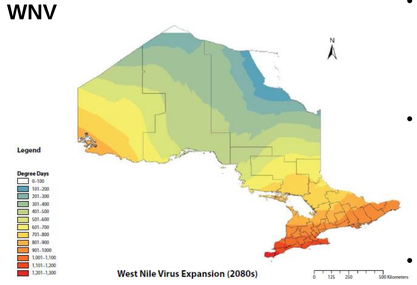
LD
- Children (5-14)
  - Approx. 10% of the Toronto population
- Older adults (55-74)
  - Approx. 19% of the Toronto population

WEATHER INDICATORS IMPACT ON VECTORS

Weather condition	WNV	LD
Increase in daily maximum temperature	• Increase larvae development • Reduced generation time • Increase vector abundance • Decrease extrinsic incubation period of virus	• Decrease time to establishment • Increase speed of development • Decrease extrinsic incubation period of bacterium
Extended hot days	• Increase oviposition success	• Decrease oviposition success • Decrease questing behaviour
Increase in daily rainfall volume	• Decrease oviposition success	• Decrease time to establishment • Increase mortality due to flooding
Increased winter temperatures	• Increase winter survivorship	• Increase winter survivorship
Longer growing season	• Increase larvae development • Reduced generation time • Increase abundance	• Decrease time to establishment

VECTOR RANGE EXPANSION TO 2080

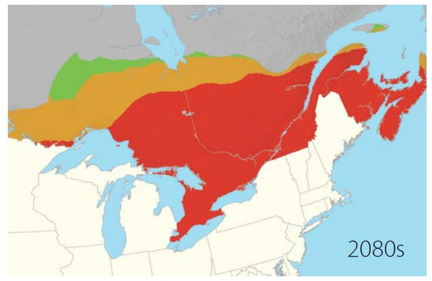
WNV



Source: Ministry of Health and Long Term Care, 2016

- Abundance of mosquito vectors (*Culex pipiens* & *Cx.Restauns* in Toronto) are impacted by temperature and precipitation events as these conditions impact the life cycle of mosquitos
- Number of degree days in Ontario expected to increase
  - Degree days: number of days greater than a reference temperature, for WNV this is 18.3 degrees Celsius
- 2080: approximately all of Ontario will have suitable weather for WNV vectors
- Greater issue may be the amplification of transmission cycles in urban centers

LD



Source: Berry, Clarke, Fleury, & Parker, 2014

- Geographic range expansion of black legged ticks (BLTs), vectors for LD
- Red/Orange: increasingly high risk for BLT population emergence
- Green: main extent to where BLTs may establish
- Geographic range of BLTs operates at sub continental level; the main driver for geographic range expansion is temperature
- Risk of exposure is generally where there are tick-suitable habitats

ADAPTATIONS PROGRAMS IN PLACE

	WNV	LD
Federal	• Nationally notifiable since 2002 • Mosquito, bird, and human surveillance	• Nationally notifiable since 2009 • Currently working on a national framework for LD to be released May 2017
Provincial	• Weekly analysis of mosquito and human surveillance for a surveillance report • Guidelines on best practices for surveillance and vector control	• Provincially reportable since 1988 • Risk maps are developed on the basis of local tick surveillance • BLTs submitted to National Microbiology Laboratory • Provide local level with guidelines on surveillance
Local	• Local MOH responsible for WNV risk assessment and undertaking measures to reduce risk • Healthy Environments directorate conducts mosquito surveillance and larviciding • Communicable Disease Control directorate conducts human case surveillance • Adulticiding may be considered when there are a significant number of human cases	• Healthy Environments directorate is responsible for tick surveillance activities • Communicable Disease Control directorate conducts human case surveillance • Healthy Environments is the lead on the response plant

PERSONAL PROTECTIVE BEHAVIOURS

- Use insect repellents DEET and Icaridin
- Perform tick check after spending time outdoors
- Remove any ticks found on body
- Long sleeved shirts and long pants are recommended

ADAPTATION OPTIONS

National Level
- Modifications and enhancements to current surveillance systems
- Research into diagnosis and treatment
- Tools for risk-based decision making on management of VBDs

Local Level
- Messaging to put VBDs in the broader context of climate change
- Co-harms/benefits associated with green/vegetated roofs and parks/trails

POTENTIALLY EMERGING VBDs

Mosquito-borne
- Eastern equine encephalitis virus
  - 33% fatality
  - Heavy rainfall increases vector abundance
- Rift Valley fever
  - Flexible in host and vector species
- Zika Virus

Tick-borne
- Babesiosis & Anaplasmosis
  - Share the same vector and host species as LD
  - Currently infection rates are low in Ontario vectors
- Erlichiosis
  - New pathogenic agent discovered in ticks in Midwestern U.S.