Climate Change and Vector-Borne Diseases: At the Interface of Public Health and Family Medicine

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Learning Objectives:

1) To learn about some of the emerging issues related to mosquito-borne diseases (e.g. Zika virus) and their impact on population health

2) To understand how the successive migrations of four viruses may reflect the possibility of a new emergent patterns of diseases

3) To understand why and how the precautionary principles are apply under the current situation
This is about mosquito-borne diseases.....

- Malaria (350-500 million people/year*)
- Dengue virus (400 million people/year)
- West Nile virus (1999)
- Japanese Encephalitis virus
- Chikungunya virus (2014)
- Yellow Fever virus
- Zika virus (2015)
- Next......

* People infected

“Over 1 million people die from mosquito-borne diseases every year, and hundreds of millions more experience pain and suffering from illnesses transmitted by mosquitoes”
Vector-borne diseases rely upon organisms, named vectors, such as mosquitoes, ticks or sandflies that have an active role in the transmission of a pathogen from one host to the other, and also, in a broader sense, upon animals such as rodents, bats or pets, acting as reservoirs/carrier of pathogens of concern to human beings.
One vector (*Aedes* mosquito) → 3 viruses
Climate Change – Travel - Trade

Many factors such as **climate change, travel and trade** may facilitate the introduction and establishment of **disease vectors, reservoirs or pathogens** in new geographic areas and could lead to the emergence of a disease in **Canada**. These factors include **international travel and trade**, e.g. legal and illegal trade in animals and animal products, new agricultural practices and land-use patterns, socio-demographic evolution and climatic changes.
History of an Emerging Virus
The Zika Forest, 1947

The first known case of Zika fever was isolated in 1947 from a rhesus macaque in the Zika forest (a relatively small forest) of Uganda, Africa in 1947 (zika means “overgrown” in the Luganda language).

The Zika forest acts as a virus research field station for the East African Virus Research Institute in Entebbe, Uganda.

The monkey developed a fever, and researchers isolated from its serum a transmissible agent that was first described as Zika virus in 1952. The first human cases were reported in Nigeria in 1954.

Outbreaks of Zika virus disease have been recorded in Africa, the Americas, Asia & the Pacific.
Zika virus

- Detected in Americas in 2014 (Brazil)
- Feb 2014 – 1st case of indigenous transmission on Easter Island (Chile)
- May 2015 – PH authorities in Brazil confirmed autochthonous transmission of ZIKv in northeastern part of country
- Oct 2015 – Brazil (14 states)
- Followed by Colombia - health authorities reported 1st autochthonous case of ZIKv infection in the state of Boliva
- Recent outbreaks of ZIKv different regions of the world spread through territories where (Aedes) vector is found

- 62 Countries and territories have reported transmission of Zika virus since 1 January 2007 (WHO)
The spread of the Zika virus

- 2007: Yap Island (MICRONESIA)
- 2013: Tahiti (FR. POLYNESIA)
- 2014: New Caledonia (FRANCE)
- 2015: Cook Islands
- 2015: Easter Island (CHILE)

Source: THE WASHINGTON POST
Countries and Territories in the Americas with Active Zika Virus Transmission
## Cumulative Zika suspected and confirmed cases reported by countries and territories in the Americas, 2015-2016

Updated as of 7 April 2016

<table>
<thead>
<tr>
<th>Sub-Region</th>
<th>Country / territory</th>
<th>Suspected Zika</th>
<th>Confirmed Zika</th>
<th>Deaths among Zika cases</th>
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<tr>
<td>North America</td>
<td>Mexico</td>
<td>0</td>
<td>201</td>
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<td><strong>644</strong></td>
<td><strong>0</strong></td>
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<td>0</td>
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<td>Dominican Republic</td>
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<td>Guyana</td>
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<td>0</td>
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<td>Jamaica</td>
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<td>0</td>
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<td>Saint Lucia</td>
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<tr>
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<td>Saint Vincent and the Grenadines</td>
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<td>Saint Maarten</td>
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<td>Suriname</td>
<td>3,440</td>
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<td>4</td>
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<td>Trinidad and Tobago</td>
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<td>0</td>
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<tr>
<td></td>
<td>United States Virgin Islands</td>
<td>42</td>
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<td>0</td>
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<td><strong>Subtotal</strong></td>
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<td><strong>3,798</strong></td>
<td><strong>528</strong></td>
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</table>

**Total** 199,922 5,869 10

**Source:** Cases reported by the IHR National Focal Points to the WHO IHR Regional Contact Point for the Americas and through the Ministry of Health websites, 2016.

**Notes:** The suspected cases in Brazil are unofficial (media monitoring). Brazil Ministry of Health reported minimum 467,533 and 1,482,701 as maximum estimated cases. Report Available at [http://www.who.int/mediacentre/news/releases/2016/zika-20-mar-2016/en/](http://www.who.int/mediacentre/news/releases/2016/zika-20-mar-2016/en/). Data is shared in an effort to transparently disseminate available information reported by Member States. Any subsequent interpretation and analysis of this data should consider differences in surveillance systems and reporting requirements.


Suspected and confirmed Zika cases reported by countries and territories in the Americas, 2015-2016

New cases by Epidemiological Week. Updated as of 7 April 2016

Source: Cases reported by the IHR National Focal Points to the WHO IHR Regional Contact Point for the Americas and through the Ministry of Health websites, 2016.

Notes: The suspected cases in Brazil are unofficial (media monitoring). Brazil Ministry of Health reported minimum 497,523 and 1,482,701 as maximum estimated cases. Report Available at: http://www.who.int/csr/don/2016_02_02-brazil-zika-virus-country-declaration-26-february-2016/en/

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So why should we be concerned?
Public Health Concerns: Potential or Real

✓ Implication for pregnant women
  - Congenital Malformations
  (neurological: microcephaly and calcifications)
✓ Guillain-Barré syndrome (GBS)
✓ family planning / contraception
✓ breastfeeding
✓ sexually transmission
✓ blood donation
✓ acute myelitis
✓ meningoencephalitis
✓ strategies for mosquito control
✓ ..........
Differential diagnosis for Rash febrile syndrome of unknown etiology

- Dengue virus
- Chikungunya virus
- **Zika virus**
  - Leptospirosis
  - Malaria
  - Rickettsia
  - Other alphavirus infections (e.g., Mayaro, Ross River, Barmah Forest, O‘nyong-nyong, and Sindbis viruses)
- Parvovirus B19 (Fifth disease or "slapped cheek syndrome")
- Enterovirus
- Group A streptococcus
- Rubella
- Measles
- Adenovirus
- Post-infectious arthritis
- Rheumatologic conditions
Zika virus

International Public Health Emergency

« ... am now declaring that the recent cluster of microcephaly cases and other neurological disorders reported in Brazil, following a similar cluster in French Polynesia in 2014, constitutes a Public Health Emergency of International Concern."

WHO Director-General, 1 February 2016
Zika Virus Mosquitoes May Spread Farther North Than Thought

New study by CDC shows possible range extending to San Francisco and New York City

By Kat Long

Updated March 30, 2016 6:49 p.m. ET

Two mosquito species that carry the dangerous Zika virus may inhabit a wider range of North America than previously thought.
(Source: Wall Street Journal)
An emerging (or re-emerging) infectious disease generally is a disease (i) that arises through evolution or change in existing pathogens, (ii) was previously unrecognised or (iii) is already known but spreads to new geographic areas, or new populations, or reappears after having been eradicated.

![Diagram of emerging and re-emerging infectious diseases worldwide.](image)

Clinical Manifestations of ZIKV
Clinical Manifestations

- Asymptomatic infections are common
- Only 1 in 4-5 people (20-25%) infected with Zika virus are believed to develop symptoms

The main symptoms of Zika virus disease include:
- **low-grade fever** (short term and low grade: 37.5°C to 38°C)
- **maculo-papular rash** - often spreading from the face to the body
- Transient arthritis or **arthralgias** with possible joint swelling mainly in the smaller joints of the hands and feet
- **Conjunctival hyperaemia** or bilateral non-purulent conjunctivitis
- retro-orbital pain
- General non-specific symptoms: **myalgia – asthenia – headaches - pruritus**
Clinical Manifestations (2)

- The incubation period ranges from 3 to 12 days
- Blood viremia from 3 to 5 days
- Symptoms are usually mild and last for 2 to 7 days
- Most people recover fully without severe complications
- Hospitalization rates are low
- Rare cases reported:
  - trombocytopenia
  - subcutaneous hematomas
  - sickle cell disease (1 fatality reported)
Clinical Manifestations (3)

Infection may go unrecognized or be misdiagnosed as:

- Dengue virus (I to IV)
- Chikungunya virus
- West Nile virus
- Tick-borne encephalitis virus
- Yellow fever virus
- Other viral infections causing fever and rash

* member of the virus family *Flaviviridae* and the genus *Flavivirus*
Treatment

- Currently, there is no prophylaxis, vaccine or treatment for Zika virus

Treatment may be directed toward symptom relief, such as:
- rest
- fluids
- antipyretics

- analgesics (avoid acetylsalicylic acid and other nonsteroidal anti-inflammatory drugs until dengue infection has been eliminated as a possibility)
Precautionary Principle

The precautionary principle denotes a duty to prevent harm, when it is within our power to do so, even when all the evidence is not in. This principle has been codified in several international treaties to which Canada is a signatory.
In October 2015, an investigation was prompted in the State of Pernambuco, Brazil. This was due to reports of an unusual increase of cases of microcephaly (abnormally small head) among newborns.

Epidemiological data available as of November 2015 indicate, on average, a twenty-fold increase in the incidence of microcephaly among newborns.

This reflects a range of 0 to 77 cases among the 14 Brazilian states with Zika virus circulation that investigate microcephaly.
ZIKV and Pregnancy

Mild clinical symptoms for pregnant women

BUT

... grave outcomes such as:
- Fetal death
- Placental Insufficiency
- Fetal Growth Restriction
- CNS injury (cerebral calcification)

Isolated in:
- **Amniotic fluid** (of pregnant women with infants who have confirmed microcephaly)
- **Brain** of a foetus with CNS abnormalities
- **Placenta**
Pregnancy and ZIKV

- Women **should avoid becoming pregnant** during travel and for **two months after return** from a risk area.

- Men who have travelled to an area with an ongoing Zika virus outbreaks should **use condoms with any partner who could become pregnant for the duration of pregnancy**.

- After a male partner returns from an area of risk, it is reasonable **to delay trying to become pregnant for six months**.

- Men that have returned from Zika-affected areas should postpone **semen donations for 28 days** after their return.
Guillain-Barré Syndrome (GBS)

- **Rare disorder** in which the body’s immune system attacks the nerves
- The sensations can quickly spread, paralysing the entire body
- The exact cause is still unknown, but it is often preceded by an infectious illness such as respiratory infection or stomach flu
- No known cure but there are treatments that ease symptoms and reduce duration of the illness
- Most people recover, although some may experience lingering effects such as weakness, numbness or fatigue
- A possible link between Zika and increased cases of GBS is currently being investigated
- **GBS is rare** - An estimated 3,000 to 6,000 people, or **1-2 cases for every 100,000 people**, develop GBS each year in the US. Most cases of GBS tend to occur for no known reason, and true “clusters” of cases of GBS are very unusual.
Breastfeeding in the context of Zika

Some highlights from WHO:

- Mothers with Zika and children with microcephaly should "receive skilled support to adequately breastfeed their infants"

- "Zika virus RNA has been detected in breast milk from mothers with confirmed Zika virus infection, but no replicative virus was identified in cell culture"

- WHO – « the benefits of breastfeeding for the infant and mother outweigh any potential risk of Zika virus transmission through breast milk »

- There are currently no documented reports of Zika virus being transmitted to infants through breastfeeding

* systematic review of evidence will be conducted in March 2016 to revise and update these recommendations
Conclusion / Take-home messages

☑ Precautionary principle / approach
☑ Mosquito-borne, vector-borne, tick-borne diseases ↑
☑ Risk communication
☑ Prevention
Questions? Comments?