Climate Change and Infectious Diseases

Mark Birch
Depts Infectious Diseases and General Medicine
Canterbury District Health Board, New Zealand

Hosted by Jane Barnett
jane@webbertraining.com

Overview

- Overview of Climate Change
- Green house gases
- Mosquitoes
- Diseases (malaria, dengue fever, zika, chikungunya)
- NZ impact
- US impact

2016: The hottest year

SA drought not broken after driest year in history

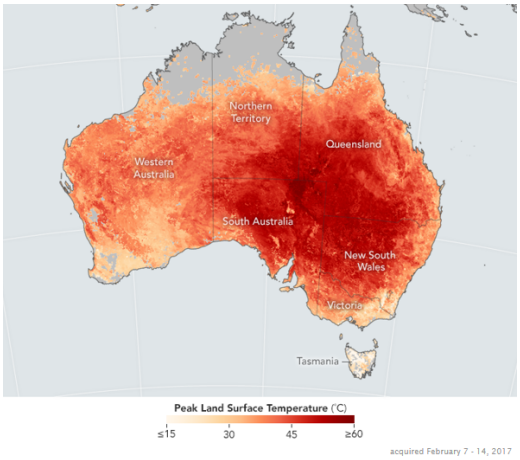
Jan-Jan Joubert | 2016-09-08 16:08:11.0

Dry crops.
Image by: Getty Images

The drought in South Africa is set to continue after the lowest rainfall year ever recorded, and amidst scientific predictions that there is no guarantee there will be sufficient rain during the coming season.

3

21 Feb 2017: Australia



4

India's extreme heat wave. Asphalt melting in New Delhi. 1,400 deaths

5

Karachi Heat Wave Pictures 2015: Death Toll Rises As Pakistan Recovers From Power Cuts [PHOTOS]

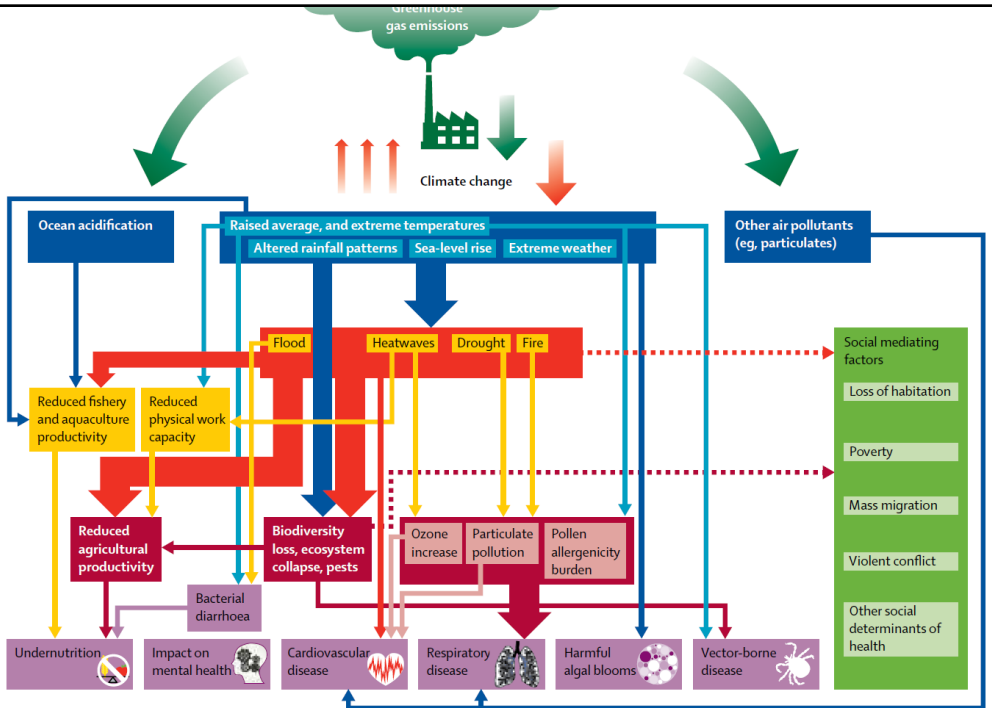
BY JULIA GLUM ON 06/22/15 AT 9:27 AM

6

In 2014, outgoing Texas Governor Rick Perry said that calling CO2 a pollutant was "a disservice to the country." (Photo: Ed Schipul/flickr/cc)

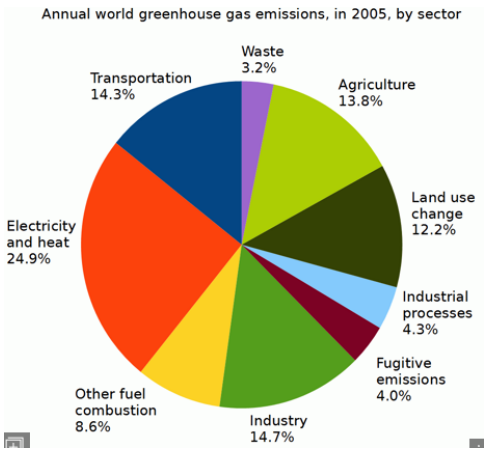
3) "Calling CO2 a pollutant is doing a disservice the country, and I believe a disservice to the world." Ex-Governor Rick Perry (R-TX), $977,624 from oil and gas for his 2012 Presidential Campaign

7



8

Greenhouse gases

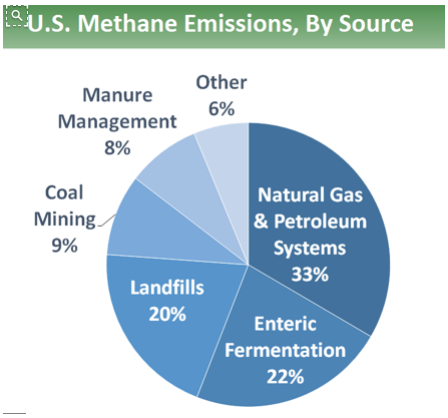


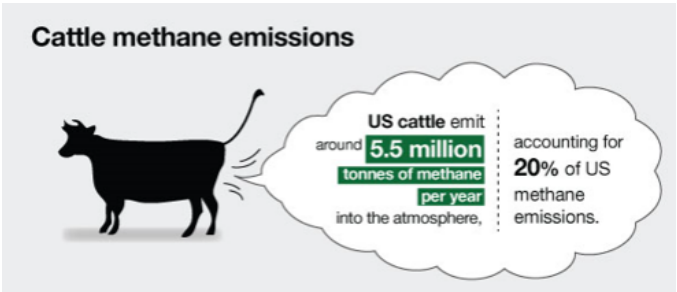
- Carbon dioxide (lasts thousands of yrs!)
- Oxides of nitrogen
- Methane
- Chlorinated hydrocarbons (CFCs)

- Fossil fuels (oil, coal, natural gas)
  - Energy generation accounts for approx. **25% GHGs**
- Destruction of forests (15-20%), agriculture, industry and transportation

9

Methane





10

CO2 levels

- Last 420,000 years = 180-280 ppm in troposphere
  - Vostok ice core Antarctica
  - Measure of 400,000 years
- Now: **360 ppm**!!

Antarctic Ice-Core Stations

11

Weather Extremes

- Warming of land surface intensifies monsoons
  - Associated with mosquito and water borne diseases in Bangladesh and India
- Flooding
  - Increases in mosquito breeding sites
  - Water borne diseases eg cryptosporidium
  - Increase in algal blooms (bad for birds, fish and mammals)

12

The Costs of Climate Change

- Present day
  - $1.2 trillion/year
  - 1.6% global GDP
- By 2030
  - 3.2% global GDP
  - Poorest countries = 11% GDP

13

Estimated deaths

- Between 2030-2050: increased 250,000 deaths/yr
- Malnutrition, malaria, diarrhea, heat stress
- Low – middle income countries most affected
  - Food and water insecurity
  - Population displacement
  - Increased diseases-vector borne, diarrheal, respiratory

14

Climate in Numbers

- 1.1°C global warming
- 2.0°C maximum warming Paris Climate Deal (Dec 2015)
- 2020 when annual emissions must peak for us to hit only 2°C
- 3.6°C likely warming on current government pledges

15

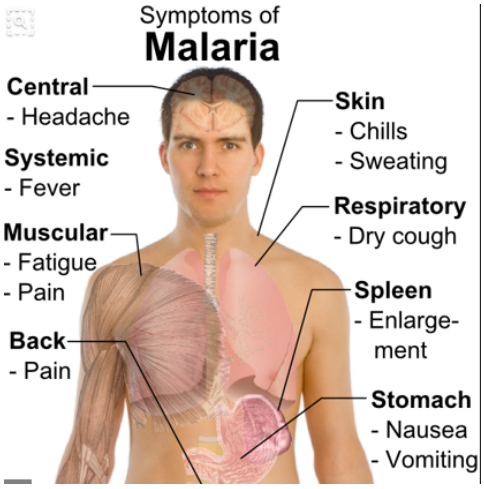
New Diseases since 1975

- WHO reports > 30 new diseases
- HIV
- Ebola
- Lyme disease
- Legionnaires disease
- Toxic E coli
- Hanta virus

16

Resurgence of old diseases

- Malaria
- Cholera



17

Mosquito Borne Diseases

- Protozoa eg malaria
- Viral eg dengue, chikungunya, zika, yellow fever
- Nematode eg filariasis

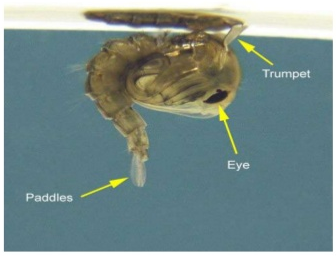
18

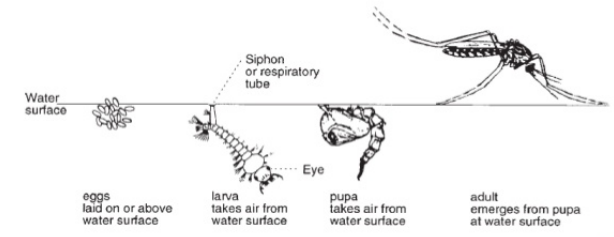
Malaria and climate change

- Warmer temps increase mosquito reproduction and biting
- Anopheles survives in temps > 16°C
- Increase rate of pathogen maturation
  - 20°C: Falciparum takes 26 days to incubate
  - 25°C: takes 13 days
- Anopheles survive for approx. 3 weeks -> parasites mature quicker, transferred to host

19

Mosquito life cycle





20

Anophelene mosquito

21

Spread of Anopheles

- Anopheles in N America
- 1980s: transmission only in California
- 1990s: new outbreaks in Texas, Florida, New York, Toronto

- Anopheles elsewhere causing malaria
  - S Korea, southern Europe, S Africa
  - Highland urban areas eg Nairobi
  - Rural highland areas eg PNG
- Not in NZ….yet!

22

Impact of malaria

- Today: 50% world's population exposed
- Impact of doubling of CO2: 60% exposed

- Other factors
  - Land clearing
  - Population movement
  - Drug and pesticide resistance

23

Dengue Fever and Yellow fever

- Aedes aegypti mosquito survives > 10°C
- Freezing kills
- Warmer winters and warmer nights -> greater survival
- Aedes limited by temp to 1,000m in elevation
- Now found at 1,100m in Mexico and 2,200m in Colombian Andes

24

Aedes aegypti and albopictus

25

Aedes mosquitoes

- Eggs withstand dessication (drying) for months
- Very difficult to eradicate
- Survive without water for several months
- Hatch once exposed to water-rainfall in wet season
- Humans provide great breeding sites

- A aegypti in Australia
- A albopictus-Australia free….but has been detected at airports, ie Sydney!!
- Aedes not in NZ…yet

26

Dengue Fever

- **Most common** arthropod borne viral diseases worldwide
- Endemic in > 100 countries
  - Africa, eastern Mediterranean, Americas, Asia, western Pacific, **northern Australia**
- Main vectors Aedes widely spread in Asia and Pacific
- In last 50 years estimated 30 fold increase in DF cases!
- 100 million clinically apparent cases/ year
- Mortality 25,000/year

27

Dengue Fever Distribution

28

Dengue haemorrhagic fever

- Epidemics DHF
- Causes deaths, usually kids
- Supportive care
- Epidemics of DF in Pacific in 1970s, associated with epidemics of DHF

29

30

Dengue in northern Queensland

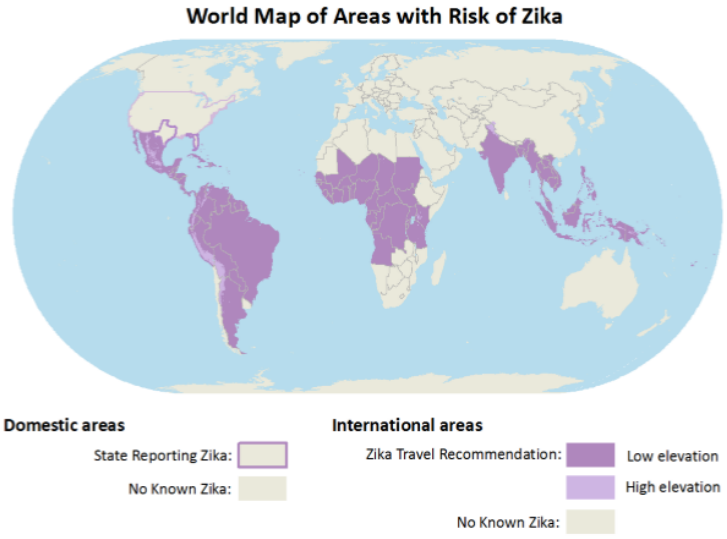
- Outbreaks in Townsville and above since 1990s
- Some deaths
- Research into prevention of dengue
  - Vaccination trials
  - Infecting mosquitoes with Wolbachia bacteria

31

Zika Virus: Re-emerging Disease

- 1st picked up during Dengue surveillance in Uganda 1947
- Later spread to India and SE Asia
- Subsequent outbreaks
  - Yap Is (Pacific) 2007
  - French Polynesia 2013
  - Brazil 2015

32


World Map of Areas with Risk of Zika
Domestic areas
State Reporting Zika:
No Known Zika:
International areas
Zika Travel Recommendation:
Low elevation
High elevation
No Known Zika:

33

Yap Is


Shanghai
CHINA
Sea of Japan
Tokyo
JAPAN
Hong Kong
South China Sea
Pacific Ocean
Manila
PHILIPPINE ISLANDS
Marianas
Mindanao
Guam
Yap
Caroline Islands
Truk
East Indies
NEW GUINEA

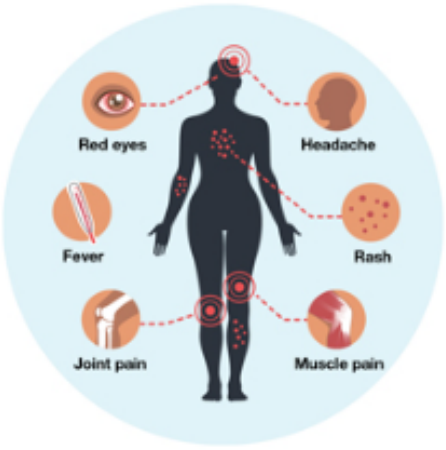
34

Zika transmission

- Via Aedes mosquitoes
- Modes of transmission
  - Sex, even if asymptomatic at time-virus persists in semen for months
  - Blood transfusion (Brazil)
  - To fetus in pregnancy
- Not transmitted via breast feeding
- Australia 2016: approx. 100 cases
- New Zealand: reported person to person/sexual transmission

35

Symptoms



- Usually mild illness
- ¾ cases asymptomatic
- Several days to a week
- Viraemia for 1 week
- Similar symptoms to dengue and chikungunya

36

CDC's Response to **Zika**

DOCTOR'S VISIT CHECKLIST:

For Pregnant Women Who Traveled to an Area with Zika*

If you are pregnant and have traveled to an area with Zika during your pregnancy or up to 8 weeks before becoming pregnant, you should talk to your healthcare provider, even if you don't feel sick.

Bring this checklist to your visit to make sure you don't forget to discuss anything important.

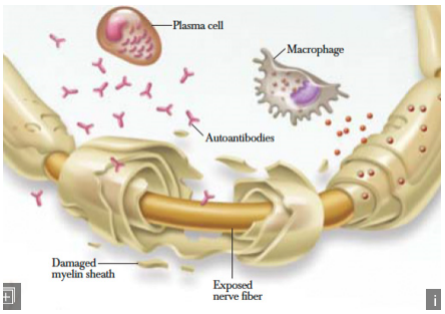
Here are some topics and questions you may want to discuss with your healthcare provider:

INFORMATION TO SHARE:	QUESTIONS TO ASK:
✓ When did you travel to an area with Zika? • Where did you travel? • How long did you stay? ✓ In what trimester was your pregnancy when you traveled to an area with Zika? ✓ Did you have any symptoms of Zika during your trip or within 2 weeks of returning? • The most common symptoms of Zika are fever, rash, joint pain, and red eyes. ✓ Did your partner travel to an area with Zika? • When and where did your partner travel?	✓ Should you be tested for Zika virus? • Pregnant women with possible exposure to Zika virus should be tested for Zika infection, whether or not they have symptoms. ✓ Do you need an ultrasound? ✓ Do you need to be referred to a maternal-fetal medicine specialist or a high-risk obstetrics specialist? ✓ How can you prevent sexual transmission of Zika virus? Be sure to ask any other questions or mention concerns you may have about Zika and your pregnancy.

37

Complications of Zika

- Guillain-Barre syndrome
- Congenital Zika Syndrome



38

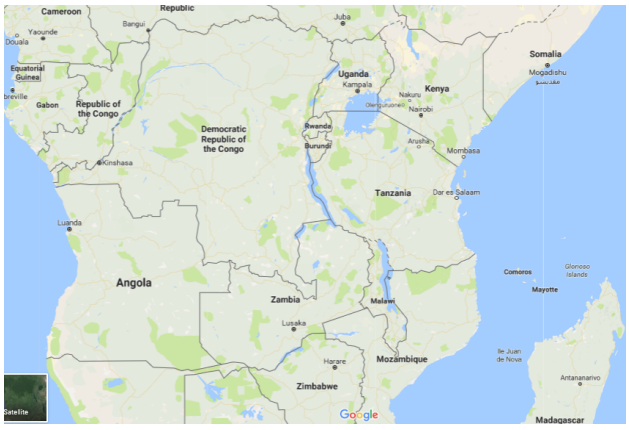
Congenital Zika

- Microcephaly
- Virus crosses blood brain barrier during 1st trimester
- Decreases normal replication of neurons and astroglial cells
- Small no. get abnormal limb development (arthrogryposis)

39

Chikungunya: Re-emerging disease

- 1952- 1st identified virus
- Outbreaks in southern Tanzania, Makonde plateau
- Derived from Makonde or Swahili word = "that which bends up"



40

Chikungunya: Re-emerging disease

- Virus, circulates between mosquitoes and non-human primates
- Aedes aegypti and albopictus
- Thought to have originated in Africa
- 1954: 1st reported in Philippines
- Before 2000: occasional outbreaks in Africa
- Since 2000: increasing outbreaks
- Spread to Asia via shipping

41

Subsequent Outbreaks

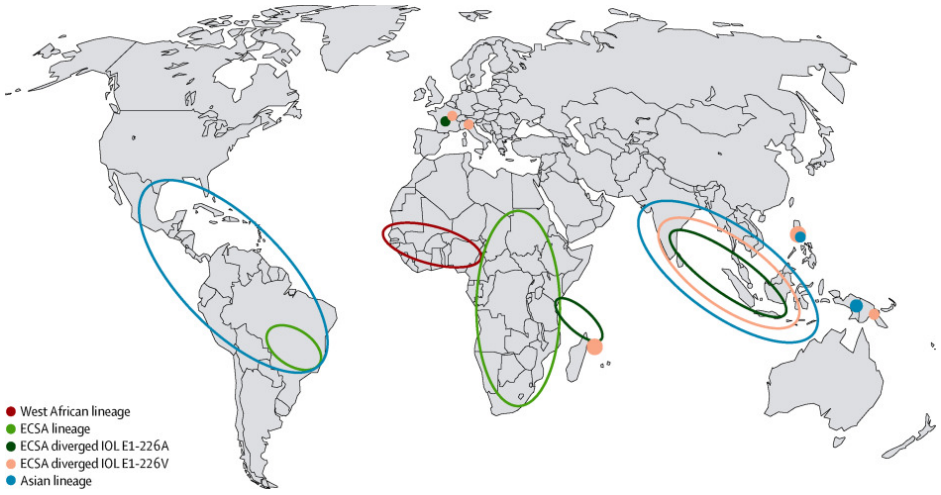
- 2004: epidemic in Kenya
- 2005-2006: outbreak in India
- Oct 2013: in Saint Martin Island (Asian genotype)
- Then transmission throughout Caribbean
- Since Aug 2016: spread to Americas
  - > 1 million suspected cases

42

St Martin Is and Caribbean

43

Chikungunya Distribution



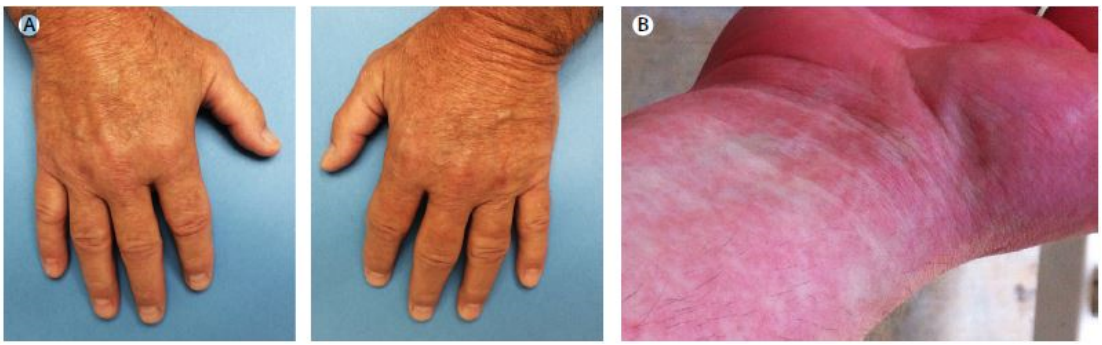
44

Symptoms

- Usually self limiting 7-10 days
- Severe joint pain/swelling-any joints, especially small joints
- Myalgias
- Fever
- Rash (up to 90%)
- Some get prolonged disability-joint sympts for 3 years!

45

Arthritis and rash



46

Complications

- Outbreaks in last 15 years seem to be associated with more severe disease
- Myocarditis
- Fulminant hepatitis
- Encephalitis-seizures and paralysis
- Fetal transmission
  - Baby gets encephalopathy
  - Microcephaly
  - Cerebral palsy
- Deaths < 1/1000

47

Treatment

- Supportive care
- No specific treatment
- No vaccine

48

Guidelines for Travellers

- Cover up
- Insect repellents-containing DEET, picaridin, oil of lemon eucalyptus (OLE), and others
  - Safe if pregnant
  - Most can use on kids > 2 months old
  - OLE **Not** kids < 3 years old
  - Take enough for trip!
- Permethrin treated clothing and gear
- Mosquito net (especially if outdoors)
- Screened rooms or air conditioning if possible

49

New Zealand Impact?

- Increased extreme weather events
- June 2015: flooding south Dunedin
- 2017: Edgecumbe floods
- 2017: Christchurch fires

NZ Impact: extreme temperatures

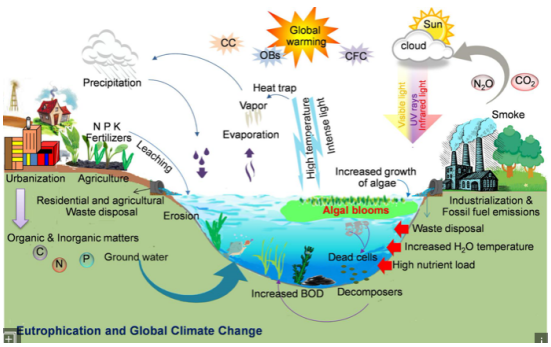
- Above 25°C for 20-40 days/year
- 2100: With warming predicted to increase to 80 days

- Heat related death rate when Temp > 20°C = 14 (ages over 65 yrs)
- Predicted death rate with increase by 1°C = 28

51

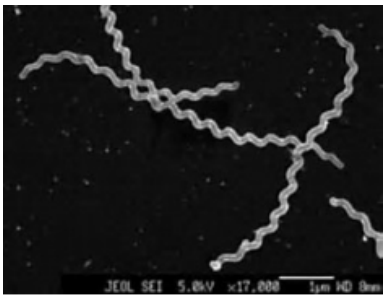
NZ Impact: Marine

- Increased algal blooms (cyanobacteria)
- Toxins
- Effect on human health-contact or ingestion
- Effect on commercial fishing and marine habitat
- 1998: warm water, algal blooms along east coast



NZ Impact: Fresh Water

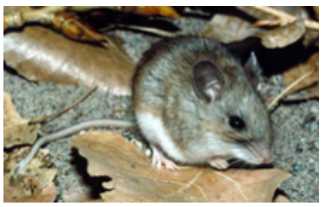
- Microbial contamination
- Salmonella and E coli in streams
- Leptospirosis
- Norovirus
- Contamination of groundwater wells
- Aug 2016: Campylobacter outbreak Havelock North

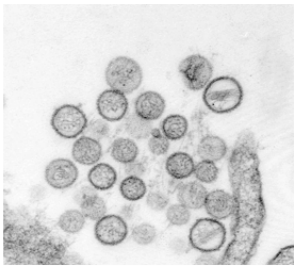


53

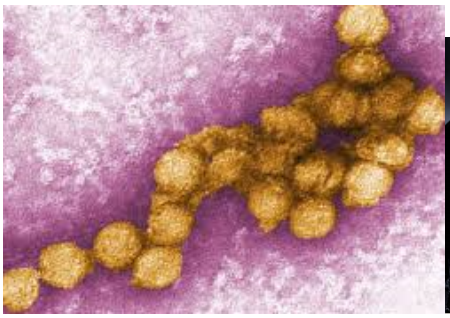
Emergence of new diseases in North America

- Hanta virus
- West Nile Virus





Thin-section electron micrograph of Sin Nombre virus isolate, a causative agent of hantavirus pulmonary syndrome (HPS). From the 1993 outbreak of HPS in the southwestern United States. *Image courtesy of Cynthia Goldsmith, Sherif Zaki, and Luanne Elliott*



54

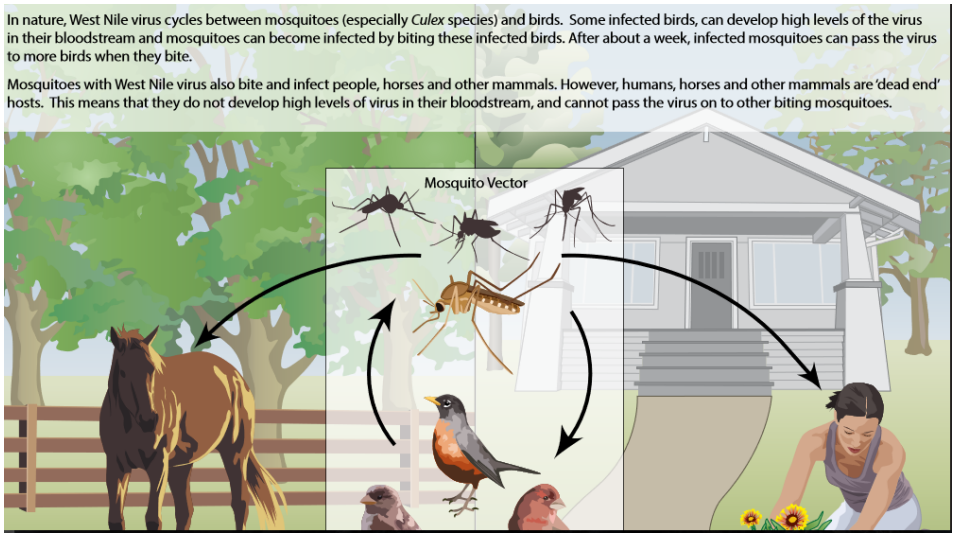
Hanta Pulmonary Syndrome (HPS)

- 1987-1992: prolonged drought in California and US southwest
- Decreased predators (owls, eagles, falcons, hawks etc), coyotes, snakes
- Increased rodent population
- 1993: intense rains-increase food for rodents
  (grasshoppers and pinon nuts)
- Emergence of rodent borne HPS

- Now in Latin America

55

West Nile Virus (WNV) transmission



56

West Nile Virus

- Sept 1999: small outbreak in New York city
- Warmer winters, followed by summer drought
- Increased cycling of WNV among birds, mossies-Culex pipiens (urban)
- Encephalitis in humans
- Mortality in birds

57

Take Home messages

- Interplay between climate, environmental changes, population of humans and our impact on environment
- Increasing outbreaks of serious illness across globe
  - Malaria
  - Arthropod borne disease-dengue, zika, chikungunya
- Limited or no treatment for some illnesses
- New Zealand not immune
- Need to act urgently

58

References

- Globalisation, Climate Change and Human Health. NEJM 2013;368(14), p1335-1343
- Climate Change and Emerging Infectious Diseases. Microbes and Infection 2001, p747-754
- Meeting report Climate Change and Infectious Diseases. International Journal of Medical Microbiology 302 (2012), p1-3
- Chikungunya virus: an update. Lancet Infectious Diseases 2017;17:e107-17
- Health and equity impacts of climate change in Aotearoa-NZ. New Zealand Med Journal 2014; vol 127, p16-23
- Climate Change, health and the role of nurses. Nursing for Womens Health 2017; vol 21, p79-83

59

Hosted by Jane Barnett jane@webbertraining.com
www.webbertraining.com


Thanks to Teleclass Education
PATRON SPONSORS
Diversey
www.diversey.com
VIROX
www.virox.com
GOJO
www.gojo.com
World Health Organization
Infection Prevention and Control Global Unit
www.who.int/gpsc/en