

# Dengue and other vector-borne infections

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## Some medically important arthropod vectors

- Class Insecta
  - Mosquitoes
  - Blackflies
  - Sandflies
  - Tsetse flies
  - Flies
  - Fleas
  - Lice
  - Biting midges
  - Triatomine bugs
  - Bedbugs
- Class Arachnida
  - Ticks
  - Mites

## Arthropods as biological vectors of infectious diseases

Vector	Infectious agent
Tsetse fly	<i>Trypanosoma brucei</i>
Reduviid bug	<i>Trypanosoma cruzi</i>
Sandflies	<i>Leishmania</i> spp. Toscana virus <i>Phlebovirus</i> (sandfly fever virus, Bunyaviridae) <i>Bartonella bacilliformis</i>
Blackflies	<i>Onchocerca volvulus</i>
Biting midges	<i>Mansonella perstans</i> <i>Mansonella ozzardi</i> Oropouche virus
Tabanid flies	<i>Loa loa</i>
Body louse	<i>Rickettsia prowazekii</i> <i>Bartonella quintana</i> <i>Borrelia recurrentis</i>
Rat fleas	<i>Yersinia pestis</i> <i>Rickettsia typhi</i>

## Mosquitoes and ticks

- Mosquitoes
  - *Plasmodium*
  - *Filaria*
  - *Dirofilaria*
  - Togaviridae
    - EEE, VEE, WEE, Chikungunya, O'nyong-nyong, Ross River
  - Flaviviridae
    - Dengue, yellow fever, St. Louis encephalitis, Murray Valley encephalitis, Japanese encephalitis, West Nile
  - Bunyaviridae
    - Rift Valley fever
- Ticks
  - Babesiosis
  - Tick-borne encephalitis
  - Kyasanur Forest disease
  - Colorado tick fever
  - Crimean-Congo HF
  - Rocky Mountain spotted fever
  - Boutonneuse fever
  - Ehrlichiosis
  - Lyme disease
  - Tick-borne relapsing fever
  - Tularaemia
  - Q fever

## Arthropod-borne diseases in travellers

- What are the arthropods / arthropod-borne diseases present in the destination(s) at that season?
- What are the possible syndromes caused by those agents?
- Does the patient have risk factors for acquiring the diseases?
- Are the patient's manifestations compatible with the arthropod-borne diseases?
- What are the diagnostic tests?
- Are there specific antimicrobial therapies?
- What are the infection control concerns?

## Remember

- Many arthropod-borne infections have subclinical or mild / non-specific manifestations.

	Symptomatic cases
– Dengue	1 in 6–15 (14–87% asymptomatic)
– Japanese encephalitis	1 in 200–300
– West Nile fever	1 in 5 (1 in 150)
- Often no pathognomonic signs / symptoms.

## Undifferentiated fever

- Malaria
- Dengue
- Rickettsioses
- Relapsing fever
- Leptospirosis
- Enteric fever
- Brucellosis ... ..

## Rash / skin lesions

- Dengue
- Rickettsioses
- Lyme disease
- Chikungunya
- West Nile fever
- African trypanosomiasis
- American trypanosomiasis
- Leishmaniasis ... ..

## Arthralgia / arthritis

- Dengue
- Chikungunya
- West Nile fever
- O'nyong-nyong
- Lyme disease
- Loasis ... ..

## Neurological symptoms

- Japanese encephalitis
- West Nile encephalitis
- Tick-borne encephalitis
- Toscana virus
- Murray Valley encephalitis
- St. Louis encephalitis
- Venezuelan equine encephalitis
- Western equine encephalitis
- Eastern equine encephalitis
- African trypanosomiasis
- Meningococcal infection ... ..

## Haemorrhagic fevers

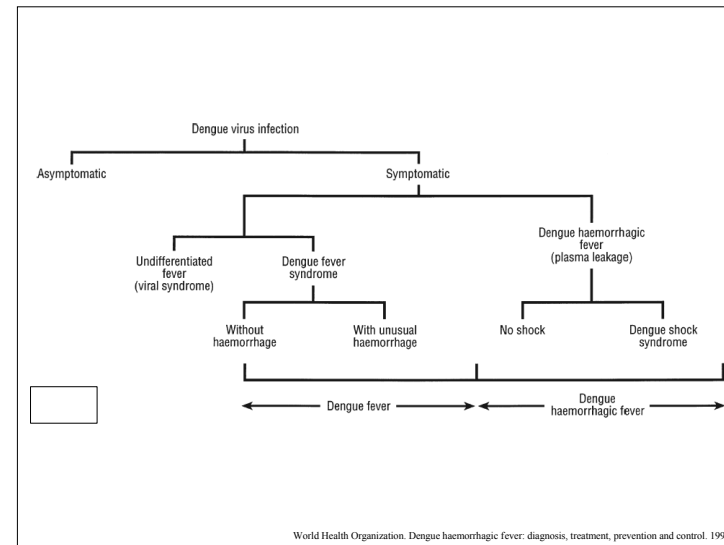
- Yellow fever
- Dengue haemorrhagic fever
- Crimean-Congo haemorrhagic fever
- Omsk haemorrhagic fever
- Kyasanur Forest disease
- Rift Valley fever
- Ebola / Marburg haemorrhagic fevers
- Lassa fever
- Haemorrhagic fever with renal syndrome
- Argentine haemorrhagic fever
- Bolivian haemorrhagic fever
- Venezuelan haemorrhagic fever
- Brazilian haemorrhagic fever
- Leptospirosis
- Meningococcal infection ... ..

## Vector-borne viral haemorrhagic fevers

Disease	Virus family	Reservoir hosts	Vector
Dengue HF	Flaviviridae	Primates, human	<i>Aedes</i> spp.
Yellow fever	Flaviviridae	Primates, human	<i>Aedes</i> spp.
Rift Valley fever	Bunyaviridae	Sheep, goat, cattle	<i>Aedes, Culex</i>
Crimean-Congo HF	Bunyaviridae	Small mammals, livestock, birds	<i>Hyalomma marginatum, (Rhipicephalus, Ornithodoros, Boophilus, Dermacentor, Ixodes)</i>
Omsk HF	Flaviviridae	Rodents, muskrats	<i>Dermacentor, Ixodes</i>
Kyasanur Forest disease	Flaviviridae	Mammals, birds	<i>Haemophysalis spinigera, other ticks</i>

## Dengue

- Dengue virus
  - Flaviviridae.
  - DEN-1, 2, 3, 4.
- Vectors
  - *Aedes aegypti*
  - *Aedes albopictus*
  - *Aedes polynesiensis*
  - *Aedes scutellaris* complex
- Urban cycles
  - Human → mosquito → human.



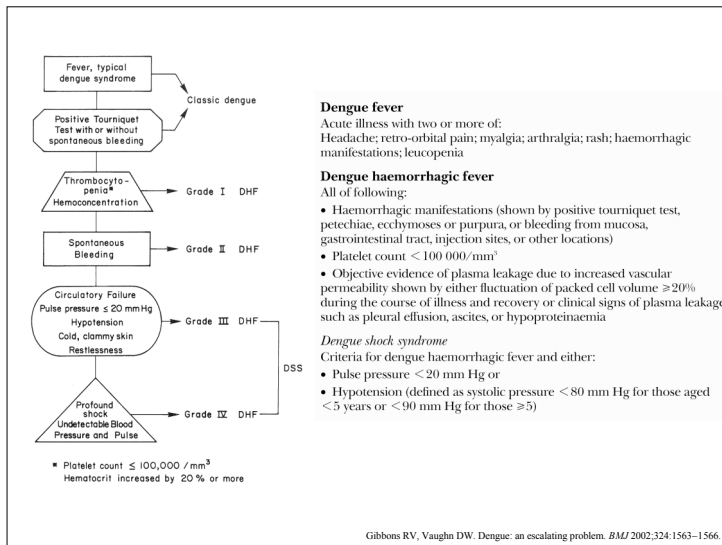
## Dengue fever

- Incubation period
  - 5–7 days (range 3–14 days).
- Days 1 to 2      Transient rash, fever, myalgia, arthralgia, relative bradycardia.
- Days 3 to 5      Fever subsides, morbilliform centrifugal rash (~50%); leukopenia, neutropenia, thrombocytopenia; recrudescence of fever.
- Can have bleeding manifestations.

## Dengue haemorrhagic fever and dengue shock syndrome

- Characterized by vascular leakage, not just by bleeding tendency.
- Antibody-dependent enhancement.
- One third develops shock.
  - Progressive drop in platelet count and rise in haematocrit.
- Warning signs of shock
  - Restlessness, lethargy, acute abdominal pain, cold extremities, oliguria, persistent vomiting.
  - Rapid rise in haematocrit, sudden drop in platelet count.
- Critical period typically after third day of illness.

	DHF	DSS
• Primary DF	0.18%	0.007%
• Secondary DF	2.0%	1.1%



## Management of dengue

- Supportive.
- Fluid replacement.
- Antipyretics and analgesics.
  - Avoid aspirin and NSAIDs.

## Dengue in travellers

Population	Number	Year	Destinations	Outcome
German travellers	2259 patients	1996–1998	SEA, India	Acute infection 4.6%
			Sub-S Africa	0.7%
			Latin Am	2.2%
UK travellers	250 patients	2000–2002	India, SEA, Caribbean, Africa	Acute infection 6.4%

- Overall, 4–8% febrile returned travellers had evidence of dengue.
- Highest risk: Southeast Asia  
India  
Latin America and Caribbean

## Dengue or not dengue?

- Concurrent outbreaks with:
  - Leptospirosis
    - 1996, Salvador, Brazil.
    - 2000, Dhaka, Bangladesh.
    - 2002, Mumbai, India.
  - Chikungunya
    - 2005–2006, Indian Ocean.

## Chikungunya

- Togaviridae, *Alphavirus*.
- Transmission
  - Sylvatic cycle: primates
  - Urban cycle: humans
    - *Aedes aegypti*, (*A. albopictus*).
    - Explosive outbreaks.
- Incubation period: 2–4 days
- Clinical features
  - Fever, chills, headache, photophobia, backache, nausea, vomiting, arthralgia, rash (truncal, MP), bleeding.
  - Severe arthralgia (70%) + swelling + reddening.
  - Persistent / recurrent arthralgia and stiffness  $\geq$  1 year.

## West Nile fever

- *Flaviviridae*.
- *Culex* and other mosquitoes.
- 80% asymptomatic.
- 20% West Nile fever.
  - Incubation period: 2–6 days, up to 14 days.
  - Fever, myalgia, arthralgia, centrifugal rash.
- 0.67% encephalitis.

## Japanese encephalitis: risk to travellers

- Overall risk
  - $< 1$  case / 1,000,000 travellers (CDC).
- “High risk” travels
  - 1 case in 5,000–20,000 travellers per week (CDC).

## Rickettsioses

- Typhus
  - *Rickettsia prowazekii*
  - *Rickettsia typhi*
  - *Orientia tsutsugamushi*
- Spotted fevers
  - *Rickettsia rickettsii*, *R. conorii*, *R. japonica* etc.

## Typhus

- Incubation period: 10–14 days; abrupt onset of fever, chills, headache, myalgia.
- Eschar
  - Absent in epidemic and murine typhus.
- Centrifugal rash
  - Macular, maculopapular, or petichial.
  - Occurs on D2–4 of fever.
- CNS manifestations
  - Meningism, seizures, confusion, drowsiness, coma.
  - Common in epidemic typhus (~50%).
- Myocarditis, interstitial pneumonitis, thrombocytopenia, liver derangement.
- Mortality
  - Epidemic typhus: 10–50% (without treatment).
  - Murine typhus: 1–2% (without treatment).
- Treatment
  - Tetracyclines; chloramphenicol; (fluoroquinolones, azithromycin).

## Scrub typhus

- Incubation period: 5–10 days.
- Fever, headache, drowsiness, myalgia, lymphadenopathy, hepatosplenomegaly, nausea, vomiting, tinnitus, deafness, constipation, dry cough.
- Meningoencephalitis, myocarditis, renal failure in severe cases.
- Illness lasts 2–3 weeks.
- Rash
  - In ~50% of cases.
  - Similar to epidemic typhus but rarely petichial.
- Eschar
  - Seen in 50–80% cases.
  - May appear before onset of systemic symptoms.
- Treatment
  - Tetracyclines; rifampicin; (fluoroquinolones, azithromycin).
- Doxycycline prophylaxis if necessary.

## Rickettsial spotted fevers

Agent	Disease	Vector	Other mammals
<i>R. rickettsii</i>	Rocky Mountain SF	<i>Dermacentor andersonii</i> , <i>Dermacentor variabilis</i> , <i>Rhipicephalus sanguineus</i> , other ticks	Rodents, small mammals, dogs
<i>R. conorii</i>	Boutonneuse fever (Mediterranean SF)	<i>Rhipicephalus sanguineus</i>	Dogs
<i>R. japonica</i>	Japanese SF	<i>Haemaphysalis longicornis</i> <i>Haemaphysalis flava</i> <i>Haemaphysalis formosensis</i> <i>Haemaphysalis hystrix</i> <i>Dermacentor taiwanensis</i> <i>Ixodes ovatus</i>	Rodents and dogs

## Japanese spotted fever

- Fever 100%
- Malaise 90%
- Headache 80%
- Skin rash (100%)
  - Becomes petichial after 3–4 days. Peaks in 7–10 days, disappears in 2 weeks.
- Eschar (90%)
  - Lasts for 1–2 weeks.
- Lymphadenopathy not remarkable.

Mahara F. *Emerg Infect Dis* 1997;3:105–111.

## Rickettsioses, Hong Kong, 1995–2004

	Spotted fever	Scrub typhus	Murine typhus
Total	67	58	51
Imported	2 (3%)	4 (7%)	16 (31%)
Outdoor activities	51%	54%	10%

*Public Health and Epidemiology Bulletin 2005;14:1–5.*

## Arthropod-borne diseases not transmitted by arthropods

- Dengue virus
  - Needlestick, exposure to blood (6)
  - Transfusion (1?)
  - Bone marrow transplantation (1)
  - Intrapartum / perinatal (5)
- West Nile virus
  - Transfusion
  - Transplantation
- Chikungunya virus
  - Exposure to blood

## Prevention of vector-borne diseases in travellers

- Risk appraisal
- Personal protection
- Chemoprophylaxis
- Vaccines

## Personal protection

- Behavioural
- Mechanical
  - Clothing
  - Building, window screens, etc.
- Chemical (insect repellents)
  - DEET
  - Others, e.g. citronella.