Dengue: The Global Health Challenge

Evan Shannon & D. Scott Smith, MD
Stanford University
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Dengue Overview

1. What is Dengue?
2. History
3. Epidemiology
4. Who is at risk?
5. Vector/Transmission
6. Pathology
7. Clinical Diagnosis
8. Clinical Management
9. Prevention/Control
10. Current Issues
What is Dengue?

- A virus in the *Flavivirus* genus that has 4 serotypes
  - Transmitted by *Aedes* mosquitoes
  - Causes an acute febrile disease
  - Infects rural and urban areas
- Infection can lead to Dengue Hemorrhagic Fever (DHF) and/or Dengue Shock Syndrome (DSS)
- Also known as: “Breakbone fever,” “Bonecrusher Disease,” and “Dandy Fever”

- Image Source: http://news.uns.purdue.edu/UNS/images/kuhn.dengue1.jpeg
• Earliest account in Jin Dynasty (AD 265-430), China
• First definitively described in 1779 by David Bylon
• Etiological agent discovered in 1907 by Drs. Ashburn and Craig
• Discovered that certain primate species can serve as reservoirs in 1929

http://www.sos-arsenic.net/english/environment/dengu.html
Photo from: http://www.ok.gov/health/images/AD-Dengue%20Vector%20Control.gif
Epidemiology

• Endemic in 112 countries
• Estimated 2.5 billion people are at risk
• Annual worldwide incidence:
  – 50 million get Dengue Fever
  – 500,000 get Dengue Hemorrhagic Fever
• Case fatality rate 0.5%-3.5%

Note: (Most asymptomatic cases of non-specific dengue febrile illnesses are unreported)

http://www.cdc.gov/ncidod/dvbid/dengue/
Notes on Epidemiology

From WHO: http://www.who.int/mediacentre/factsheets/fs117/en/
The incidence of dengue has grown dramatically around the world in recent decades. Some 2.5 billion people – two fifths of the world's population – are now at risk from dengue. WHO currently estimates there may be 50 million dengue infections worldwide every year. In 2007 alone, there were more than 890 000 reported cases of dengue in the Americas, of which 26 000 cases were DHF. The disease is now endemic in more than 100 countries in Africa, the Americas, the Eastern Mediterranean, South-east Asia and the Western Pacific. South-east Asia and the Western Pacific are the most seriously affected. Before 1970 only nine countries had experienced DHF epidemics, a number that had increased more than four-fold by 1995. Not only is the number of cases increasing as the disease is spreading to new areas, but explosive outbreaks are occurring. In 2007, Venezuela reported over 80 000 cases, including more than 6 000 cases of DHF.

Some other statistics: During epidemics of dengue, infection rates among those who have not been previously exposed to the virus are often 40% to 50%, but can reach 80% to 90%. An estimated 500 000 people with DHF require hospitalization each year, a very large proportion of whom are children. About 2.5% of those affected die. Without proper treatment, DHF fatality rates can exceed 20%. Wider access to medical care from health providers with knowledge about DHF - physicians and nurses who recognize its symptoms and know how to treat its effects - can reduce death rates to less than 1%. 
Figure 1. Average number of dengue and severe dengue cases reported to WHO annually in 1955–2007 and number of cases reported in recent years, 2008–2010
Figure 2. Distribution of global dengue risk (determination of risk status based on combined reports from WHO, the United States Centers for Disease Control and Prevention, Gideon online, ProMED, DengueMap, Eurosurveillance and published literature (Simmons CP et al, 2012).
Dengue occurs in tropical and subtropical areas in the world. The yellow areas are those at risk for epidemic dengue--that is, those areas infested with *Aedes aegypti* or other mosquito vectors of dengue. The red areas are those countries with recent dengue activity.

Epidemics

- First recorded epidemic in Philippines in 1954
- 1980s, first major epidemics in South/East Asia
- Major epidemics reported for the first time in 1982 in Kenya and Somalia, 1985 in Mozambique
- Several epidemics reported in Brazil since 1981
  - Brazil accounts for 70% of cases in Western Hemisphere in past 5 years
- 1998 worldwide pandemic, 1.2 million cases of Dengue and DHF in 56 countries worldwide
- Reasons for sporadic epidemics unclear

Dengue viral infections G N Malavige, S Fernando, D J Fernando, S L Seneviratne
Dengue Deaths

Note: Relative size of region indicates relative number of deaths
Notes on Dengue deaths

Source: http://www.worldmapper.org/display_extra.php?selected=397

Dengue or breakbone fever (dandy-fever) is a mosquito-borne disease caused by viruses of the family Flaviviridae. The mosquito, often the same type that causes Yellow Fever, becomes infected from biting a person who is in the first 3 days of suffering the illness. The mosquito can then spread the virus in its saliva to other people when they get bitten. The disease causes an acute illness with fever, weakness and pains. The joint and back pains give it the common name breakbone fever. It can be fatal when it causes widespread bleeding. There is no specific treatment, and control depends on mosquito control measures, including destroying the carrier mosquitoes' breeding grounds.
Dengue caused 0.03% of all deaths worldwide in 2002, with an average of 3 deaths per million people.
*International Classification of Diseases-10 codes: A90-A91,*

Territories are sized in proportion to the absolute number of people who died from dengue (breakbone fever) in one year.
Who’s at Risk?

• Pregnant women
  – Mild cases cause little harm
  – Hemorrhagic cases may kill unborn child, cause increased bleeding

• Curiously, severe protein-calorie malnutrition reduces risk of DHF/DSS
  – However, cellular immune response depressed

• Of those with DHF, 90% are children aged <15

Dengue viral infections G N Malavige, S Fernando, D J Fernando, S L Seneviratne
http://www.ehow.com/about_4615989_dengue-fevers-effects-pregnancy.html
http://209.85.173.132/search?q=cache:7o9D-GlmQ8gJ:www3.ha.org.hk/idctc/document/Powerpoint%2520file%2520present%2520by%2520Dr%2520Wilsom%2520Lam%2520QEH%2520(Updated%2520030603pm).ppt+dengue+malnutrition+risk&cd=1&hl=en&ct=clnk&gl=us&client=firefox-a
Dengue Vectors

**Aedes aegypti is:**

- Found between latitudes 35° N,S
- Primarily a daytime feeder
  - Bites indoors and outdoors
  - Early morning and last four hours of daylight
- A “nervous feeder” leading to higher transmission rates
- Dengue is transmitted by infected female mosquitoes

Source: http://www.tratamientoycura.com/blog/img/tramientoycura.com_Aedes_aegypti_l.jpg
Une femelle moustique « Aedes aegypti », le principal vecteur de la dengue, observée au microscope électronique. OLIVER MECKES/SPL/COSMOS
Notes on the mosquito


Brazil will produce 4M transgenic *Aedes aegypti* mosquitoes per week in order to fight the dengue fever.

“Dengue Fever is a virus spread by the bite of an infected mosquito. There is neither medication nor a vaccine to prevent Dengue Fever so effective measures to control the dengue mosquito *Aedes aegypti* are urgently required since the disease is becoming geographically more wide-spread, more prevalent and more virulent. The incidence of dengue has increased 30 fold in the last 50 years and, according to WHO, 2.5 billion people are now at risk. The severe form of dengue, known as Dengue Haemorrhagic Fever, was first recognized in the 1950s but has become a leading cause of hospitalization and death among children in Asian and Latin American countries.”
**Aedes aegypti (cont.)**

- Lives around human habitation
  - Rests in hidden places
- Flies < 200 meters generally
- Lays eggs and produces larvae preferentially in artificial containers
  - Large containers can amplify infection

Aedes albopictus

- Native to tropical/subtropical southeast Asia
- Has invaded other regions worldwide
- Restricted to rural areas
- Likes elbows of trees

Source: http://edis.ifas.ufl.edu/LyraEDISServlet?command=getScreenImage&oid=1396982

Ae. albopictus is characterized by its small, black and white body. It also has black and white striped legs but instead of a lyre pattern, it has a single silvery white scale stripe along the dorsal side of the thorax.
Vectors - Comparison schema of the major vectors of disease.

### Anopheles (malaria)
- **Eggs**: Laid singly, has floats
- **Larvae**: Rest parallel to water surface, rudimentary breathing tube
- **Pupae**: (differ only slightly)
- **Adult**: Proboscis and body in same straight line, maxillary palps as long as proboscis, wings spotted

### Aedes (dengue)
- **Eggs**: Laid singly, no floats
- **Larvae**: Rest at an angle to the water surface, short, stout breathing tube with one pair of hair tufts
- **Pupae**: (differ only slightly)
- **Adult**: Proboscis and body at an angle to one another, maxillary palps, maxillary palp shorter than proboscis, tip of female abdomen usually pointed

### Culex (filariasis, viral encephalitis)
- **Eggs**: Laid in rafts, no floats
- **Larvae**: Rest at an angle to the water surface, long, slender breathing tube with several pairs of hair tufts
- **Pupae**: (differ only slightly)
- **Adult**: Proboscis and body at an angle to one another, maxillary palps
Comparison: *Aedes* & *Culex* larvae

The body of the mosquito pupa remains curved. *Aedes* larvae are shorter than *Culex* larvae and have smaller heads. *Aedes* larvae are also less transparent than their *culex* counterpart.

Source: http://medent.usyd.edu.au/arbovirus/mosquit/photos/pupa_larvae.jpg
Aedes Larvae

Flaviviridae family

Single-stranded RNA virus

Four identified serotypes, designated DEN-1,2,3,4

- All dengue serocomplexes are associated with hemorrhagic fever
- Secondary infections (particularly with DEN-2) increase the risk of hemorrhagic fever
- No cross-immunity between serotypes

Dengue: an escalating problem Robert V Gibbons, David W Vaughan
http://www.cdc.gov/ncidod/dvbid/dengue/facts.htm
http://www.biken.osaka-u.ac.jp/rcc/Thai/virus/dengue/index.html
Dengue Pathology

- Viral replication occurs in macrophages, Langherans cells
- Focal central necrosis in liver tissue
- Virus and antibodies are identified in cerebrospinal fluid (CSF)
- DHF causes petechial hemorrhages in most organs


Large subcutaneous hemorrhage on the upper arm of a patient with DHF
Dengue Clinical Syndromes

The majority of Dengue infections are asymptomatic.

Asymptomatic infection

Classic Dengue Fever

DHF

DSS

Only a small percentage progress to Dengue Hemorrhagic Fever (DHF) or Dengue Shock Syndrome (DSS).
Clinical Characteristics of Dengue Fever

- Fever, often acute onset
  - May have two peaks
- Headache, retro-orbital
- Muscle and joint pain
- Prostration
- Nausea/vomiting
- Rash

Clinical Syndromes

Diffuse morbilliform rash with recovery from Dengue

Diffuse hemorrhagic rash with Dengue

http://history.amedd.army.mil/booksdocs/wwii/infectiousdisvolii/chapter3figure7.jpg
Clinical Case Definition for Dengue Hemorrhagic Fever (DHF)

4 Necessary Criteria (per WHO):

1. Fever, or recent history of acute fever
2. Hemorrhagic manifestations
3. Low platelet count (100,000/mm$^3$ or less)
4. Objective evidence of “leaky capillaries:”
   – elevated hematocrit (20% or more over baseline)
   – low albumin
   – pleural or other effusions

DHF is divided into 4 grades depending on severity
Laboratory observations in DHF

- Low platelet count
- Leukopenia (early in illness)
- Lymphocytosis (>15%)
- Reduced serum complement
- Low albumin
- Electrolyte disturbance
- Elevated liver enzymes
- Metabolic acidosis

Dengue viral infections. G N Malavige, S Fernando, D J Fernando, S L Seneviratne
Clinical Case Definition for Dengue Shock Syndrome (DSS)

- Must have 4 criteria for DHF and:
- Evidence of circulatory failure manifested indirectly by all of the following:
  - Rapid, weak pulse
  - Narrow pulse pressure (< 20 mm Hg) or hypotension for age
  - Cold clammy skin
  - Altered mental status
  - “Frank” shock

http://www.cdc.gov/ncidod/dvbid/dengue/slideset/set1/iii/slide08.htm
Dengue Diagnosis

Inset photo of hemorrhagic rash from dengue, from: http://staff.vbi.vt.edu/pathport/pathinfo_images/Dengue/positive-tourniquet-test-cdc.jpg

Photo of a child in Yangon, Myanmar being tested for dengue hemorrhage by the Hess test using a blood pressure cuff

D. Scott Smith
From Wikipedia: The Hess test or Rumpel-Leede test is a medical test used to assess capillary fragility.[1] It is also called the Tourniquet test. To perform the test, pressure is applied to the forearm with a blood pressure cuff inflated to between systolic and diastolic blood pressure for 10 minutes. After removing the cuff, the number of petechiae in a 5cm diameter circle of the area under pressure is counted. Normally less than 15 petechiae are seen.[2] 15 or more petechiae indicate capillary fragility, which occurs due to poor platelet function, bleeding diathesis or thrombocytopenia, and can be seen in cases of scurvy,[3] and Dengue fever. The test is named after Alfred Fabian Hess.

The tourniquet test (using a blood pressure cuff) is used to assess blood vessel fragility.
Hemorrhagic Rash in Dengue - demonstrating capillary fragility

Photo of hemorrhagic rash from dengue, from: http://staff.vbi.vt.edu/pathport/pathinfo_images/Dengue/positive-tourniquet-test-cdc.jpg
Dengue is only unequivocally diagnosed through laboratory tests

- Hemagglutination inhibition test
- Plaque reduction neutralization test
- ELISA ("Enzyme-linked immunosorbent assay, used to detect antibody or antigen")
- RT-PCR ("Reverse transcription polymerase chain reaction." a variant of PCR that can generate many copies of a DNA sequence)
- Complement fixation test
- Antigen capture enzyme immunosorbent assay

To Confirm Dengue Diagnosis

- At least one of the following is required:
  - Isolation of virus from serum
  - > 4 x increase in serum IgG or virus-specific IgM
  - Detection of virus in serum, tissue, cerebrospinal fluid by immuno assays
  - Detection of virus genomic sequences via PCR

Dengue: an escalating problem Robert V Gibbons, David W Vaughn
Dengue Diagnosis

July 2008, Myanmar.
Conclusion: Virus isolation, antigen-capture ELISA detects Dengue 3 days after infection; other tests cannot be used until 11 days after initial infection.

Halstead, Lancet 2007 370:1644
“Treatment” of Dengue Fever

There is NO CURE – thus, **symptom management**

- Fluid and electrolyte balance
- Rest
- Antipyretics
- Avoid salicylates (aspirin, ibuprofen)

NB: Avoidance of mosquitoes around infected individuals

Patient with Dengue treated with intravenous fluids

Photo Source: http://i.ehow.com/images/GlobalPhoto/Articles/4600547/83046_Full.jpg
Treatment: Dengue Fever

• Temperature control
  - Paracetamol 60 mg/kg/day
  - Tepid sponging

• Light diet

• Close monitoring
Treatment: Dengue Hemorrhagic Fever
(see WHO guideline)

- Temperature control (Paracetamol and sponging)
- Intravenous fluids (5% dextrose in saline)
- Electrolyte balance
- Monitor vital signs, urine output, level of consciousness, hematocrit, platelet counts, liver enzymes
- Observe hemorrhagic manifestations
- For advanced DHF/DSS,
  - use crystalloid and colloid IV fluids
  - monitor platelet count every 15 min
  - give oxygen

The most recent comprehensive guideline for managing dengue by WHO is from 1999.
Prevention and Control Methods

- Use impregnated net day time
- Bury water containers
- Use Abate in water jar
- Cover water jar closely

No Larvae- No Tiger Mosquito- No Dengue Fever
Effectively Protect You from Dangerous Mosquito
“Prevention” or “Control”? 

**What is prevention?**
- Measures designed to sharply reduce, or stop, people from becoming infected

**What is control?**
- Measures designed to reduce morbidity and mortality and therefore includes surveillance and curative approaches as well as prevention
Purpose of Vector Control

• Reduce female vector density to a level below which epidemic vector transmission will not occur
• Assumes that eliminating or reducing the number of larval habitats in the domestic environment will control the vector
• The minimum vector density to prevent epidemic transmission is unknown
Goals of Larval Surveillance

- Recognize mosquito bloom
- Identify species and the respective risk of different diseases
- Follow changes in species
- Target interventions
- Monitor effectiveness of interventions
Larval Surveillance

- Several indices
  - The *House Index* – the percentage of houses infected with larvae
  - The *Container Index* – the percentage of containers infested
  - The *Breteau Index* – the number of infested containers/100 houses
  - A house is one unit of occupation
  - *Pupal Index* predicts how many adults are coming
Collecting Larvae

- Some can be skimmed from the surface
- Some, like Aedes are **very active** and need to be “scooped”
- Some can be obtained by letting the water with larvae flow into the scoop
Collecting larvae

Photo: D. Scott Smith, students in the MENTOR class after cyclone Nagris, July 2008, Myanmar.
Collecting larvae

July 2008, Myanmar.
Collecting larvae

Students in the MENTOR class after cyclone Nagis, July 2008, Myanmar.

D. Scott Smith
Aedes larvae collected in a plastic cup, July 2008, Myanmar.
Vector Control Methods: Chemical Control

• Larvicides – primary means of Dengue control
  – Used only in conjunction with other methods
  – Requires widespread education
    • Improper use and limited coverage fail
    • Cultural reservations about treating drinking water
  – May be used to kill immature aquatic stage larvae
  – Temephos (formulated 1% with sand) – Widely used
    • Easily dosed
    • Safe, including in drinking water!!
    • Can last 6-8 weeks
Protocol for Temephos (Abate) Use

1. Inform the house owner about dengue

2. Describe the individual and the community actions that help to prevent dengue.

3. Explain why putting Abate in water containers is important; reassure them that treated water is safe for drinking, cooking and bathing purposes.

http://img.alibaba.com/photo/11435217/S_Bate_Temephos_1_Sand_Granular.jpg
Protocol for Temephos (Abate) Use (cont.)

4. Request permission to put Abate in the water containers and ask house owner to leave it there and not to clean the treated containers.

5. Determine quantity of Abate needed for each water container.

6. Put required quantity of Abate into each water container.

7. Express appreciation for their cooperation, and re-iterate that Abate-treated water is safe to drink and to use for cooking and bathing.

Treating water with temephos
Notes on Temefos or Temephos (trade name Abate)

Temefos is an organophosphate used to control mosquito larvae. As with other organophosphates, temephos affects the central nervous systems of insect larvae through inhibition of an enzyme called cholinesterase, resulting in death before reaching the adult stage. In many tropical countries where dengue is prevalent, temephos is widely used and applied by both private and public pest control in tanks and standing water where the Aedes aegypti mosquito breeds, in order to reduce the population of this disease-carrying insect.
Fogging

• Public loves it! But…
• Only for emergency outbreak control
• Expensive as it must be repeated several times at short intervals (e.g., 3 to 4 times in a week)
• Needs special equipment
• Must be followed immediately by more effective and durable interventions
• Possible role in crowded settings
Fogging

- Mosquitoes may have resistance to commercial aerosol sprays
- Very limited target
  - Only adult mosquitoes who contact a particle
  - Does not affect larvae, so replaced in 2-3 days
  - Time of day critical – Early am or late pm to avoid convection
  - Never apply with rain
  - If equipment applied incorrectly, it does not work
- Never apply with rain
Environmental Control

- Collect, clean up debris
- Turn over containers
- Make holes in other containers so water cannot accumulate
- Store containers under shelter
- Cover containers
- Fill holes in ground and trees
- Empty and clean once a week
- Copepods and fish (for malaria - other places)
Empty water, scrub inside and refill plant bowls, saucers, flower vases, once a week.
Pots covered with plastic sheeting – Myanmar, July 2008
 Appropriately discard, puncture or bury wastes
Individual Control

- Wear clothing that covers most parts of the body, especially the limbs, to reduce exposure to mosquito bites
- Treat clothing with permethrin, or other repellents

Source: http://media.rei.com/media/606355.jpg
Repellents

Use mosquito repellent during the day.

- Commonly used but expensive
- Not designed for mass use
- Not effective as a sole prevention approach
- No real application in emergency settings
  - May have a role during a dengue outbreak

Mosquito Nets and coils

- Prevent mosquitoes from biting people who are ill with dengue and then spreading dengue to healthy people
- Protect those who sleep during the day e.g., babies, young children, elderly people

Photo Source: http://www.syngenta.com/en/media/newstopics/images/Icon%20mosquito%20net.jpg
Current Issues

Beware of dengue fever

Recent Outbreaks

- Jan-Mar 2008, State of Rio de Janeiro, Brasil – 24,000 cases, 30 deaths
- Dec. 2008 – outbreak declared in Cairns, northern Australia, 993 cases, one death
- 2009 – Bolivia epidemic infected 59,900 cases, 25 deaths
- 2009 - Argentina, 25,000 infected
Vaccine Development

- **There is currently no vaccine available**
  - Lack of animal model and limited understanding of pathogenesis has impeded vaccine development
  - Will be necessary to protect against all 4 serotypes simultaneously
  - Live attenuated tetravalent vaccine most promising prophylactic method
- New DNA vaccine techniques being explored as well


**Immunization**: as of Jan 27, 2013:  http://www.who.int/mediacentre/factsheets/fs117/en/
There is no vaccine to protect against dengue. Developing a vaccine against dengue/severe dengue has been challenging although there has been recent progress in vaccine development. WHO provides technical advice and guidance to countries and private partners to support vaccine research and evaluation. Several candidate vaccines are in various phases of trials.
### Dengue Vaccine Development

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<th>Preclinical</th>
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Source: Update on dengue vaccine development: http://www.journals.uchicago.edu/doi/full/10.1086/518148?cookieSet=1
Climate change

• Warm ambient temperature critical to adult feeding behavior, larval development, speed of virus replication
  – In colder climates, viral development slow, mosquitoes don’t survive long enough to become infections
• Mathematical models that account for climate variables can accurately estimate change in transmission rates

Potential effect of population and climate changes on global distribution of dengue fever: an empirical model
Conclusion: Climate change will place more people at risk
Quiz

• Now we invite you to take the module quiz and test your recent learning with 15 questions covering the content of the Dengue Module

• Note down on paper your answers, A, B, C, etc., and compare them with the correct answers given on the slide following question #15

• After completing your quiz, come back for the summary of this module presentation.
Dengue quiz questions

1. Dengue Fever is also known as?
   A. Breakbone fever
   B. Bonecrusher disease
   C. Brokeback Fever
   D. Dandy Fever
   E. All of the above
   F. A, B and D

2. An estimated __________ people are at risk for Dengue Fever
   A. 100 million
   B. 500 million
   C. 1 billion
   D. 2.5 billion
   E. Everybody
3. Who is at the greatest risk for severe illness due to Dengue?
   A. Pregnant Women
   B. Children
   C. Men aged between 20-40
   D. All of the above
   E. A and B

4. Identify the vector (s) for Dengue.
   A. Culex annulirostris
   B. Anopheles gambiae
   C. Aedes aegypti
   D. Aedes albopictus
   E. C and D
5. How many different serotypes of Dengue have been identified?
   A. 1
   B. 2
   C. 3
   D. 4
   E. 5

6. The majority of Dengue infections lead to_____________
   A. Asymptomatic infection
   B. Classic Dengue Fever
   C. Dengue Hemorrhagic Fever
   D. Dengue Shock Syndrome
   E. Death
Dengue quiz questions

7. The diagnosis of Dengue
   Can be made clinically
   Requires lab testing for definitive diagnosis
   Worldwide is most often not made because fevers are non-specific or mild
   Can be assessed using a blood pressure cuff
   All of the above

8. Which of the following indexes is used for mosquito larval surveillance?
   A. House Index
   B. Breteau Index
   C. Container Index
   D. All of the Above
   E. None of the Above
9. Which of the following is the most effective larvicide used with Dengue management?
A. Culinex
B. Temephos
C. Aquabac
D. Teknar
E. Vectobac

10. Which country has recently experienced a large Dengue outbreak?
A. Brazil
B. USA
C. China
D. France
E. New Zealand
11. Potential Dengue vaccine candidates include:
A. Baculovirus subunit
B. Tetravalent
C. DNA vaccine
D. All of the Above
E. None of the Above

12. If climate change continues at its current rate, by the year 2080, people living as far North as ___________ and as far South as ______________ will be at risk for Dengue
A. Greenland; Antarctica
B. Norway; Chile
C. Canada; New Zealand
D. Siberia; Tasmania
E. Iceland; Falkland Islands
Dengue quiz questions

13. When and where was the earliest account of Dengue?
A. 3000 BC, Egypt
B. 100 BC, Rome
C. AD 300, China
D. 1500, Iraq
E. 1700, Bangladesh

14. Where and when was the first recorded major epidemic?
A. AD 300, China
B. 1812, India
C. 1907, Pakistan
D. 1954, Philippines
E. 2000, Brazil
15. Which of the following countries is infested with Dengue mosquito vectors, but does not have epidemic activity?
A. Brazil  
B. Mexico  
C. Egypt  
D. Angola  
E. Niger

Go now to the next slide which has the answers
Dengue quiz answers

Correct answers are:

1. F.
2. D.
3. E.
4. E.
5. D.
6. A.
7. E
8. D
9. B
10. A
11. D
12. C
13. C
14. D.
15. C.
Summary

• Dengue is a widespread and potentially deadly, misunderstood tropical disease
• Currently no curative treatment is available, only symptom management
• Vector control is essential to impeding Dengue transmission
  – Especially since climate change will most likely increase transmission
• There are several pending vaccine development initiatives
Credits

• Evan Shannon, AB Stanford University
  UCSF School of Medicine, MD candidate

• D. Scott Smith, MD, MSc, DTM&H
  Chief of Infectious Disease & Geographic Medicine, Kaiser Permanente, Redwood City, California
  Adjunct Assistant Clinical Professor
    Dept. of Human Biology and
    Dept. of Medical Microbiology & Immunology
  Stanford University Medical School
  ssmith@stanford.edu
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