Dengue in the Americas

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What is Dengue?

Arbovirus
Flavivirus
in the family Flaviviridae

4 Serotypes:
DEN-1, DEN-2, DEN-3 & DEN-4
**Dengue viruses**

- Each serotype provides specific lifetime immunity but only short-term cross-immunity
- All serotypes can cause severe and fatal disease
- Genetic variation within serotypes; some appear to be more virulent or have greater epidemic potential
Dengue Hemorrhagic Fever

Dengue Shock Syndrome
Vector(s)

Aedes aegypti

Aedes albopictus
**Aedes aegypti**

- Lives around human habitations in urban areas
- Lays eggs and produces larvae preferentially in artificial containers
- Strong preference for human blood; primarily a daytime feeder often found indoors
- Most important vector of dengue viruses in the world
Transmission Cycle
Viremia
3-12 days
(Avg. 4-5)

Extrinsic incubation period
8-10 days

Intrinsic incubation period
3-12 days
(Avg. 4-5)
Aedes aegypti
Eradication Program

What? and Why?
What?
To eradicate *Aedes aegypti* from the Americas based on findings in Brasil in the early 1940’s that this species was eradicable.
Why?
1700s
1780 dengue-like disease Philadelphia

1793 Yellow Fever epidemic in Philadelphia killing 5,000 (10% of the population)

1824-28 PANDEMIC
1st recorded pandemic of dengue Pensacola; Charleston; Savannah and New Orleans
1900s

1900 Walter Reed Proves Carlos Finlay's Theory that *Aedes aegypti* transmits the Yellow Fever Virus
1903 Graham shows mosquito transmission of Dengue

1906 Bancroft shows *Ae. aegypti* transmission of Dengue
Note: 1954 DHF appears in Asia
1981 1st major epidemic of dengue hemorrhagic fever (DHF) in the Americas -- in Cuba
344,203 cases of dengue
10,312 cases of DHF
158 deaths reported

25 years after DHF first appeared in Asia

2001
http://www.paho.org/English/AD/DPC/CD/dengue_finaltime.doc
Reinfestation of *Aedes aegypti*
The first eradication campaigns were successful

- Internal and external financing for personnel, equipment, and materials.
- Emphasis on source reduction.
- Efficient residual insecticide.
- Centralized vertical programs, with military-style organization, strict supervision, and a high level of discipline.
Reasons Why the Eradication Failed

- Not all countries were willing to eradicate *Aedes aegypti*.
- The program lost political importance in the majority of the countries that achieved eradication.
- Constant re-infestation and once re-infestation was observed reaction was too late.
- High cost of materials, equipment, salaries and social benefits.
- *Aedes aegypti* resistance to organochloride insecticides.
- Rapid and uncontrolled growth of urban centers.
- Poverty.
1970
Megacities 2000

- Mexico City: 18.1
- Bogota: 6.8
- Lima: 7.4
- Sao Paulo: 18.0
- Rio de Janeiro: 10.7
- Buenos Aires: 12.0

National Geographic Magazine. Nov. 2002
Hemispheric eradication of *Aedes aegypti* is no longer realistic.

- The problem is larger than it was prior to the previous campaigns.
- Lack of resources.
- Resistance to vertical programs and the use of insecticides.
- Lack of effective insecticides.
- Low priority and lack of sustainability.
Complicating Factors

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  - Reproductive capacity.
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• Persistence of tires and plastics.
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- Disorganized urbanization of large metropolitan centers.
- Industrialization of disposable packaging.
- Persistence of tires and plastics.
- Deterioration or lack of basic services.
The Problem: Dengue

- It is a *growing* problem.
- The number of cases in the Americas has gone from *66,011 in 1980*, to over *1,000,000 in 2002*.
- The control activities that are being carried out are *not working*. 
Dengue in the Americas
1980 – 2005*

* Source: PAHO (Jan. 31, 2007)
Dengue Fever

Dengue Hemorrhagic Fever
The Problem: DHF

• The tendency of DHF in the Americas is increasing.
• The situation is going to get worse before it improves.
Dengue Hemorrhagic Fever

Prior to 1981

1981 - 2003

Source: WHO/PAHO/CDC, Aug. 2004
Cases of DHF, <1980 to 2006*

*To Sept 28, 2006
Cases of DHF in Asia, 1955–1998
If we take the first 18 years that DHF was reported in Asia (1955–1973) and the first 18 years that it occurred in the Americas (1984–2001) after the Cuban epidemic of 1981, and we compare the data, what we get is:
Cases of DHF in Asia and in the Americas
First 18 Years of DHF in *Asia* and in the *Americas*


First years DHF was reported
The majority of the obstacles for dengue control continue to be the same as they were in the past.
Obstacles for Dengue Control

Present-day dengue programs are not progressing because:

- *Community participation in dengue prevention and control is limited to official demands and never attains community ownership;*
• Local health services, now politically and administratively responsible for the prevention and control programs are not sufficiently established;
• **Individual and community behavioral change strategies are weak and are not incorporated into the programs;**
• Water supply and solid waste management are limited in high-risk areas;
• Sustainability and continuity of control actions are constantly compromised by other health demands and policies that compete with them;
• Little capacity for intersectoral coordination

The dengue problem is not the sole responsibility of the Health Sector
• Operational research strategies have not been sufficient.
What is the solution?

The Dengue Decalogue
The Dengue Decalogue

- Integrated Epi. & Ent. Surveillance
- Outreach and Education
- Community Participation
- Environmental Management – Source Reduction
- Patient Care
- Case reporting
- Incorporation of Dengue in Formal Education
- Judicial use of insecticides
- Formal Health training of Professionals & Workers
- Emergency Preparedness
Should we expect to see Dengue in the United States

Courtesy Dr. G.G.Clark
Critical Factors Needed for Local Transmission of Dengue in the Southern U.S.

- Presence of a competent vector (*Aedes aegypti* and/or *Aedes albopictus*)
- Frequent introductions of dengue viruses (in humans) during periods when vectors are active and abundant
Aedes aegypti
Reported distribution of *Aedes aegypti* in the U.S., 2005

Current Status:
- Positive (69)
- Status unknown (1)
- Negative/No report (3224)

Courtesy: Dr. Chester Moore
Aedes albopictus

Photo: Courtesy Oklahoma State University
 Reported distribution of *Aedes albopictus* in the U.S., 2005

Courtesy: Dr. Chester Moore
Factors Favoring Dengue Transmission in Southern U.S.

- Good vectors (*Aedes aegypti* & *Ae. albopictus*) are widely distributed in domestic environment
- Human population is highly susceptible
- Frequent vector-host contact
- Virus endemic in “nearby” countries
- Absence of clinical diagnosis
Factors Mitigating Dengue Transmission in Southern U.S.

- Relatively short viremia (ave. 5-7 days) in infected person
- Housing conditions and lifestyles minimize vector-human contact
- Vector distribution is variable and uneven
- Critical vector density for secondary transmission may not exist
Worst Case (Human)/ Best Case (Virus) Scenario Leading to Dengue Transmission in Southern U.S.

- Several viremic travelers arrive in an area without mosquito control
- One or both dengue vectors are present
- Housing conditions/lifestyles permit ready access to viremic and later to susceptible hosts
- Initial infections are inapparent or not clinically-diagnosed promptly
Indigenous Dengue in the Continental U.S., 1980-2005*

* Source: CDC (n = 64)
A Dengue Vaccine?

- There is no licensed vaccine at present.
- An efficient vaccine has to be tetravalent.
- Several vaccines are in the pipeline.
- An effective, safe, low-cost vaccine will not be available in the near future.