Economic Impact of Dengue in LAC and the World

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Importance of economic and disease burden studies

• Help define public health priorities

• Better allocate limited health resources and choose between competing interventions based on evidence

• Use comparable, rigorous measures
Economic burden of dengue: components

Cost of illness + Prevention + Other costs

Cost of illness:
Total dengue episodes $\times$ average cost per episode

Prevention:
Disease surveillance + vector control + other strategies

Other costs:
Tourism revenues lost
Co-morbidities and complications
Health system congestion
Others
Assess economic burden of dengue illness: Empirical approach

• Considered 141 countries and territories with evidence of dengue transmission+

• Numerous data sources for burden estimates*
  – Institute of Health Metrics and Evaluation
  – World Bank indicators
  – Published literature
  – Delphi panel of experts

+Source: Bhatt et al. 2013, Nature
Component 1: Cost of illness

Elements of cost of dengue illness

Settings
- Hospitalization
- Ambulatory
- Non-medical (e.g., pharmacies, home, local healers, etc.)

Types of costs
- Direct: medical care and travel
- Indirect: value of lost time and productivity

Time frames
- Year of illness
- Subsequent years (fatal episodes only)
58.4 million (M) symptomatic dengue episodes (95% CI: 23.6 - 121.9)

- 10.5 M hospitalized (18%)
- 28.1 M ambulatory (48%)
- 19.7 M outside healthcare system (34%)

13,586 fatal episodes (95% CI: 4,199 – 34,672)

Number of dengue cases in 2013
(Top 5 countries in Latin America & Caribbean, LAC)

LAC total: 5,600,000 cases
9.7% of 58,400,000 globally

Total annual costs of illness: **US$ 8.89 billion**

(95% CI: US$3.6 – 19.0 billion)

Aggregate costs of dengue illness ($8.9 billion)

By Super Region

- Southeast Asia, East Asia, and Oceania: 54.0%
- Latin America and Caribbean: 19.5%
- South Asia: 19.1%
- Saharan Africa: 3.5%
- High-income (Argentina, Australia, Brunei, Singapore, USA): 2.9%
- North Africa and Middle East: 0.9%
- Central Europe, Eastern Europe, and Central Asia: 0.1%

By setting and outcome

- Ambulatory: 33.6%
- Non-medical: 8.5%
- Hospitalized: 46.0%
- Fatal cases: 11.9%

Top 10 countries with the highest aggregate cost of dengue illness (US$ million)

Indonesia: $2,195
India: $1,509
Brazil: $728
Philippines: $643
Malaysia: $608
Thailand: $425
Mexico: $324
Taiwan: $320
China: $317
Nigeria: $187

Represent 82% of global cost of $8.9 billion

Per capita cost of dengue illness in 2013 (US$)

**US$1.56 per capita** across 141 dengue endemic countries and territories

Per capita cost of dengue illness (US$)
(Top 5 countries in the Americas with the most dengue cases)

Component 2: Prevention

- Conventional strategies – often outdoor fogging
- Costly, but few economic evaluations
  - Median cost per capita (across 11 sites) US $1.80
  - Brazil US$ 505 million (2013)
  - Mexico US$ 89 million (2012)
  - Higher during outbreaks (e.g. 50% in 2013 in Brazil)

Challenges
- Public pressure for visible activity
- National focus prevents a rigorous evaluation

Photo: GOVERJ
Aggregate cost of dengue in Brazil and Mexico, including prevention (US$ million)

Data from 2013
Component 3a: Other costs – persistent dengue

• Persistent dengue officially recognized by WHO in 1997.+

• 10 months after acute illness about 10% of patients still have symptoms *

• Major symptoms: fatigue and depression

• Persistent dengue adds 23% over previous estimates of economic burden in Mexico

+WHO, Dengue Haemorrhagic Fever: Diagnosis, Treatment, Prevention and Control, 1997
Component 3b: Other costs – co-morbidities

Co-morbidities and complications associated with dengue

Neurological manifestations of dengue infection


Rhabdomyolysis Associated with Dengue Virus Infection
CID 2004:38 (15 May) • BRIEF REPORT
Joshua S. Davis1 and Peter Bourke2
1Infectious Diseases Department, John Hunter Hospital, Newcastle, and 2Medical Department, Royal Darwin Hospital, Darwin, Australia

Liver Involvement Associated with Dengue Infection in Adults in Vietnam
Dinh The Trung,* Le Thi Thu Thao, Tran Tinh Hien, Nguyen The Hung, Nguyen Ngoc Vinh, Pham Tran Dieu Hien, Nguyen Tran Chinh, Cameron Simmons, and Bridget Wills

Outcome of Dengue Hemorrhagic Fever—Caused Acute Kidney Injury in Thai Children
Kanokwan Laoratasopawatana, MD, Pornpimol Pueaikpratert, MD, Pornsak Dissaneewate, MD, Alan Geater, PhD, and Prayong Vachvanichsanong, MD

Dengue Infection and Miscarriage: A Prospective Case Control Study
Peng Chiong Tan1, May Zaw Soe1, Khaing Si Lay1, Seok Mui Wang2, Shamala Devi Sekaran2, Siti Zawiah Omar3
**Component 3c: Other costs – congestion**

**Health system congestion during dengue outbreaks***

- Outbreaks create surges in numbers of hospitalized dengue patients
- Study underway in Philippines to quantify impact

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Component 3d: Other costs – tourism

Effects on tourism

- Sparse scientific evidence
  - Mavalankar et al. 2009 Quantifying the impact of Chikungunya and Dengue on tourism revenues. Indian Institute of Management, Ahmedabad, India
- Abundant anecdotal evidence
Need for an experimental design for introduction of vaccination and integrated vector management (IVM)

- The vaccine clinical trials did not assess the indirect benefits of vaccination through lower transmission

- Models suggest this impact is substantial

- Introduction of the vaccine through an experimental design with a comparison group is essential

- Measure effectiveness, herd effect, safety, cost-effectiveness and impact of IVM and its incremental value
Proposed design for introduction of vaccination and IVM

Structure
• Cluster randomized trial (CRT) with 320 eligible municipalities

Criteria for municipalities:
• Medium size: population of 10,000–300,000 (average 40,000)
• High number of dengue cases (years 2002, 2008-2014)
• Coverage at least 70% in the Family Health Program (PSF)
• In the 6 highest states (total population 13.4 million)
Proposed design for introduction of vaccination and IVM

Structure
• Cluster randomized trial (CRT) with 320 eligible municipalities

Implementation of program
• Vaccinate children aged 9 to 16 years in vaccine arms, 0.94 million children
• Randomize municipalities in groups of 4, among the 4 study arms
• Strengthen routine surveillance and use it to measure dengue cases by arm

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Conclusions

• At $8.9$ billion per year, global cost of dengue illness is substantial

• New control measures could save billions of dollars annually

• Introduction of vaccine and IVM through cluster randomized design is essential to assess their cost-effectiveness
Thank you

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