Arbovirus Surveillance: Present and Future

Duane J Gubler, ScD, FAAAS, FIDSA, FASTMH Emeritus Professor Program in Emerging Infectious Diseases, Duke-NUS Medical School, Singapore, Chairman, Global Dengue & Aedes-Transmitted Diseases Consortium







Global Resurgence of Epidemic Arboviral Disease



2018



Major Infectious Disease Epidemics, 1990-2018

Dengue, 1990-2018

- Venezuelan equine encephalitis, 1992
- Pneumonic plague, 1994
- Avian influenza, 1997-2010
- Rift Valley Fever, 1998
- Nipah encephalitis, 1998-1999
- West Nile, 1999-2005
- SARS, 2003
- Zika, 2007-2016
- Swine origin H1N1 influenza, 2009-2010
- MERS-CoV, 2012 -2018
- Chikungunya, 2014-2015
- Ebola, 2014
- Yellow fever, 2016-2018
 We Live in a New Era

Principal Clinical Syndromes Caused by Arboviruses

- Systemic Febrile Illness
- Hemorrhagic Fever
- Meningoencephalitis

Challenges of Arboviral Disease Surveillance

- Differential diagnosis
- Laboratory Diagnosis
- Unpredictable epidemics
- Physicians low index of suspicion
 - Inter-epidemic period
- Mild Illness/Self Treatment
- No early warning system

2018



Surveillance for Arboviral Diseases

- Disease Surveillance
- Entomologic Surveillance

Surveillance for Arboviral Diseases

Entomologic Surveillance

- Species
- Geographic distribution
- Larval habitats
- Adult behavior
- Seasonal distribution
- Insecticide resistance
- Infection rate

Surveillance for Arboviral Diseases Entomologic Surveillance

- Can use entomologic surveillance data for multiple diseases, depending on geographic area
 - Dengue
 - Yellow fever
 - Zika
 - Chikungunya
 - Epidemic polyarthritis
 - Others

Disease Surveillance for Arboviral Diseases

Passive

Active

Disease Surveillance for Arboviral Diseases

Passive Surveillance

- Physician Reporting
- Case Definitions
- Mandated by Law
- Monitor Secular Trends
- Sensitivity

Hypothetical Dengue Fever Epidemic Curve



Problems with Passive Surveillance Systems

- Does not exist for most arboviruses
- Low Index of Suspicion
 - Inter-epidemic period, silent
- Misdiagnosis by physician
- Mild Illness/Self Treatment
- Insensitive

Active Surveillance for Arboviral Diseases

ACTIVELY MONITOR INFECTIOUS DISEASE TRANSMISSION IN CATCHMENT AREA

Time Location Etiology Disease Severity Inter-epidemic Period

Early Warning Surveillance for Arboviral Diseases

- Passive syndromic surveillance
 - Dengue fever-like disease
 - All hemorrhagic disease
 - All neurologic disease
 - Case definitions
- Active/proactive surveillance
 - Laboratory-based sentinel system
 - Algorithm on testing priorities/sequence
 - National Laboratories for QC
- Regional Reference Laboratories for QC

Hypothetical Dengue Fever Epidemic Curve



Components of Laboratory-Based, Active Surveillance for Arboviral Diseases with Emphasis on the Inter-epidemic Periods*

TYPE OF SURVEILLANCE	SAMPLES**	APPROACH
Sentinel Clinic/Physician	Clinical samples from representative cases of viral syndrome, taken 3-15 days of onset of illness	Representative samples taken year round and processed weekly for serology, virus isolation, and PCR**
Fever Alert	Clinical samples from representative cases during outbreaks of febrile illness	Increased febrile illness in community is investigated immediately
Sentinel Hospital	Clinical and tissue samples taken during hospitalization and/or at death	All hemorrhagic disease, neurologic disease, and viral syndrome with fatal outcome are investigated immediately***

* During an epidemic, after the etiology is known, the case definition should be more specific and surveillance focused on severe disease.

**All samples are processed weekly for serology and virology

***Serology, virus isolation, PCR and immuno-histochemistry on appropriate samples

Proactive Early Warning Surveillance Algorithm for Arboviral Diseases

Active, Laboratory-Based Syndromic Surveillance

Test for common pathogens





Need a Comprehensive Early Warning Arboviral Disease Surveillance Program

- Link clinical and epidemiologic disease detection networks to stateof-the-art basic research and diagnostics laboratory
- Regional Program
 - Country specific
 - Good lab & epidemiologic capacity
 - Communications
 - Leadership

What is Needed for Arboviral Diseases Surveillance?

- Investment in sustainable country programs
- Regional reference laboratories
- Standardized Reporting Requirements
 - Global
 - Regional
 - National
- Outreach Programs to Medical Community
- Regional Coordination of Surveillance Data

Comprehensive EID Surveillance



No disease was ever controlled by surveillance