Malaria Modeling and Surveillance In Thailand and Indonesia

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Malaria Modeling and Surveillance In Thailand and Indonesia

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Meteorological & Climatological Parameters

Vector Ecology

Predator Ecology

Anthropogenic Factors

Local Environment

AGRICULTURAL PRACTICE
ROAD BUILDING
DEFORESTATION
MILITARY CONFLICT
REFUGEE
ECONOMIC CRISIS
MEDICAL CARE

THE PROBLEM

- 40% of the world’s populations at risk
- 300-500 million cases per year
- 1-3 million deaths per year
- Highest risks for children, pregnant women, and people with depressed immunorespose
- One death every 30 seconds
- Counterfeit and substandard antimalarials abound.
- ACT is becoming less sensitive.
- Previously unaffected regions may have outbreaks due to climate change.

OBJECTIVES

Risk detection
Detection of larval habitats
Textural-contextual classification

Risk prediction
Prediction of current and future endemicity
Neural network methods

Risk reduction
Identification of key factors that sustain or promote transmissions
Agent-based discrete event simulation

BENEFITS

Applying larval control as a preventive measure

Strengthening and mobilizing public health support

Cost-effectively curtailing malaria transmission

NASA’s Earth Observing System

https://ntrs.nasa.gov/search.jsp?R=20090006631 2019-07-12T19:26:43+00:00Z
The Greater Mekong Subregion is the world’s epicenter of multi-drug resistant falciparum malaria.

Most Thai provinces endemic with malaria are border provinces.

40% of the 245M Indonesians Live in Malarious Regions

Malaria Incidence in Aceh Increased Significantly After the Tsunami Disaster in December 2004
Classification Accuracy using Pan-Sharpened Ikonos Data (1 meter resolution)

Satellite-Observed Meteorological & Environmental Parameters For Four Thailand Seasons
- Surface Temperature
- MODIS Measurements
- Vegetation Index
- AVHRR & MODIS Measurements
- Rainfall
- TRMM Measurements

Actual Malaria Incidence
Hindcast Incidence

Dynamic Transmission Modeling Framework

Kong Mong Ti Test Site, Kanchanaburi, Thailand
In Collaboration with AFRIMS and WRAIR

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**Example: A Small Hamlet**

- 23 houses
- 2 cattle sheds
- 24 clusters of larval habitats
- 8 cows

**Modeled and Observed Prevalence**

![Graph showing modeled and observed prevalence over time]

**Modeled and Observed Sporozoite Rates**

![Graph showing modeled and observed sporozoite rates over time]

**Modeled and Observed Entomological Inoculation Rates**

- **Wet season**
  - A. minimus Pf
  - A. minimus Pv
- **Cool season**
  - A. minimus Pf
  - A. minimus Pv

**Well Placed Farm Animal Sheds and Zoonotic Prophylaxis May Significantly Reduce Malaria Transmission**

- Sheds at original locations
- Sheds relocated to where mosquitoes are more abundant
- Zoonotic prophylaxis also used

**Sensitivity Studies and Simulations Performed**

**Using Agent-Based Discrete Event Simulation Model**

- Abundance of larval habitats
- Access to health care and appropriate treatment
- Asymptomatic cases
- Acquired immunity
- Active and passive case detections
- Bednets or personal protections
- Improved dwelling construction
- Parasite infectivity in mosquitoes
- Zoonotic prophylaxis
- Arrival of non-immune populations (such as migrant workers, refugees, foreign military forces)
With over 18,000 islands and a decentralized government, it is challenging to implement malaria control policy.

Rainfall Pattern, Which Drives Malaria Transmission, Varies Significantly from Island to Island

Average Monthly Precipitation for the Major Cities on the 8 Islands 2000-2005

Precipitation Based on TRMM Measurements

Hindcasting Malaria Cases in Jawa Tengah, Indonesia

Actual (red), Modeled (blue), and Hindcast (green) Malaria Cases

Districts Involved in Menoreh Hills Project

- A MOH-WHO-NAMRU2-USAID Collaboration

Comparison of Kulong Progo and Purworejo ACD Cases (blue) with Jawa Tengah PCD Cases (red)
Thank you!

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