### Reducing the impact of mosquitoes on Pulau Tekong, Singapore

- Success of a comprehensive vector control program

Lam HY, Heah HW, Lee VJ, Seet HY, Sofian Azirun Singapore Armed Forces, HQ Medical Corps, Force Medical Protection Command, Biodefence Centre

# Scope

- Introduction
- Approach to achieving "Malaria-free"
- Vector Control Methods
- Results
- Conclusion

- Vector-borne diseases remain a major challenge to healthcare throughout the centuries
- 19<sup>th</sup> & 20<sup>th</sup> century Singapore, 2 mosquito-borne diseases that have resulted in significant morbidity and mortality are **Dengue** and **Malaria**
- Since 1970s and 80s, vector control efforts have resulted in much improvements in Dengue control and also in Singapore attaining Malaria-free status by WHO<sup>1,2</sup>

- 1. Ooi EE, Goh KT, Gubler DJ. Dengue prevention and 35 years of vector control in Singapore. Emerg Infect Dis 2006; 12: 877-93
- 2. Goh KT. Eradication of malaria from Singapore. Singapore Med J 1983; 25(5): 255-268







- Conventional Mosquito Control
  - AM oil
  - Thermal Fogging
  - Granular Insecticides
  - Residual Spraying
- Chemoprophylaxis
- Known Vectors on Pulau Tekong
  - Anopheles sundaicus
    - Brackish Water Mosquito
    - Efficient Vector of Malaria
  - Aedes albopictus
    - Fresh Water
    - Efficient Vector of Dengue and Chikungunya

- Pulau Tekong remained malariareceptive due to the continued presence of known malaria vectors.
- Although there were no indigenous outbreaks, there continued to be clusters of imported cases.
- A program was initiated to negate the requirement for malaria chemoprophylaxis.

- Malaria chemoprophylaxis

   Effective but also possible adverse reaction<sup>1,2</sup>
- How to sufficiently mitigate the risk of malaria and allow the lifting of the requirement for malaria chemoprophylaxis?

 AKH Tee, HML Oh, IYJ Wee, BP Khoo. Dapsone Hypersensitivity Syndrome Masquerading as a Viral Exanthem: Three Cases and a Mini-Review. Ann Acad Med Singapore 2004; 33:375-8
 Hussein O AlKadi. Animalarial Drug Toxicity: A Review. Chemotherapy 2007; 53: 385-391

### Approach

- Prevent import of malaria
  - 8 week quarantine period
  - Screening via PCR testing of blood for malaria parasite
- Prevent vector transmission of malaria
  - Vector control and surveillance
  - Personal protective measures

### Vector Control Program Dec 06 – Current

- Initial Surveillance Dec 06
- Mapping Jan 07
- Environmental works Jan 07 current
- Conventional insecticide fogging 1 3<sup>rd</sup> week Jan 07
- Biological larvicide 3<sup>rd</sup> week Jan 07 current

#### **Adult Mosquito Surveillance**

- 2 supervisors + 20 men
- 60 sentinel sites island wide
- 2 Methods:
  - •Human landing catches 1800 – 0700 h
  - Ovitraps
- •Frequency
  - •Weekly for first 2 months
  - •Fortnightly for the next 4 months
  - Quarterly thereafter







Based on mosquitoes caught 21 Dec 06 to 10 Jan 07 (n = 5197)

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**Target Mosquito Species :** 

Malaria Vectors An. sundaicus\*; An. letifer

#### **Other mosquito sp.**

Cx. sitiens\* ; Ae. amessi\* ; Ae. albopictus ; Ae. vexans ; Ae. butleri ; An. sinensis; Ae. pseudoalbopictus ; Cx. gelidus;etc.

Target Habitats : Brackish & Fresh Water

#### **Mapping**

- 2 supervisors + 10 men (in 5 teams)
- •Utilising handheld GPS units
- •Systematic mapping of actual and potential larval habitats





#### TIDAL DRAINS



#### TIDAL DRAINS



#### CRAB HOLE



#### NIPAH PALMS



#### NIPAH PALMS



#### MANGROVE





#### **Bird's Nest Fern**

#### **Dried Leaves**

#### Ae. albopictus





### Infrastructure and Maintenance



# **Vector Control**

- *Bacillus thuringiensis israelensis* (Bti), VectoBacWG
  - Efficacy
  - Target specific
  - Environmentally friendly
- Conventional insecticide fogging
- Indoor residual insecticide application



### • 500g/Ha

- Weekly x 4weeks, fortnightly thereafter
- 2 supervisor + 10 men (day)
- 3 supervisor + 6 men (night)

### **Bti application**

- VectorBac®WG
- Dispersal via ultra-low volume (ULV) mist blowers
  - Vehicle-mounted
  - Back packed





#### **BAMBOO CLUMPS**

Ae. pseudoalbopictus



- Mixture back pack : 4 kg in 120 L water . Discharge 500 mL/min
- Mixture ULV generator : 9 kg in 120 L water. Discharge 1 L/min.. Optimum swath in dense vegetation is 15 m. Top up after 1 h run (60 L).



### **Intensified fogging**

- Initial phase
- Targeted to reduce adult populations
- Using Pyrethroid insectides





### **Residual Spraying**

- Perform quarterly
- Added layer of protection for residents
- Using Pyrethroid insecticides

# **Results**

- Surveillance results
  - Human landing catches
  - Ovitrap data



















#### 2007 Tekong Island : Adult Mosquito Collection

Mean Number Of Mosquitoes (+ S.E.) Per Site Against Time (Weeks)



Weeks 1 to 3 : Pre treatment . Average of 74 – 102 adult mosquitoes per site

Weeks 4 to 52 : Bti Treatment. Number of mosquitoes reduced with time to an average of 3 – 6 mosquitoes per site

#### 2008 Tekong Island : Adult Mosquito Collection Mean Number Of Mosquitoes (<u>+</u> S.E.) Per Site Against Time (Weeks)



Weeks 1 to 30 : Bti Treatment. Number of mosquitoes remains at an average of 2 - 3 mosquitoes per site



# Conclusion

- Impact on mosquito density
  - Human landing catch counts fell from mean of 74 102/site ▶ 3 6/site ▶ 2 -3/site
- The comprehensive vector control program involving:
  - a. Regular application of biological larvicide
  - **b. Indoor residual spraying**
  - c. Environmental work.
- Has been effective in reduction and maintaining mosquito population at low levels.
- This program effectively mitigates the risk of mosquito-borne diseases and the requirement for malaria chemoprophylaxis.

# **Thank You**