Preparing for the Next Global Threat – A Call for Targeted, Decisive Action Now to Prevent The Next Pandemic

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Study districts in Phu Yen and Quang Tri Provinces (blue outlines)
**Current Situation**

- Historically, drug resistant strains
  - Emerge in Cambodia and then spread to Africa
  - CQ-resistant strains resulted in a 2-6 fold increase in mortality in Africa in the 1980’s

- The newest strains
  - Are not just artemisinin-resistant
  - They are nearly incurable (including all partner drugs)
  - Just a 2 fold increase would result in 7+ million deaths over a decade
  - Malaria resurgence will dwarf the highly publicized recent outbreaks

*Gains at risk of being reversed - history appears to be repeating itself*
Current Situation

• Regional artemisinin Initiative (RAI) mid-term review (1)
  - Attempts to contain artemisinin-resistant parasites not succeeded
  - Take urgent action to address the malaria situation in Cambodia
  - Improve the targeting, prioritization and rigor of interventions

• Vietnam
  - New strains crossed borders into Binh Phuoc Province
  - Many migrant workers in Angola
  - The same for needed interventions with shift to elimination

*Stop emerging incurable malaria to prevent the next global pandemic*
Current Situation

• Cambodian Army example
  - In 2010, 5% Pf+ in research screening
  - In 2016 10% Pf+ (doubled, see figure)
  - Prophylaxis stopped Pf transmission
  - Significant transmission reservoir
  - NGOs cannot provide ITNs or any support
  - Deploying to Africa for peacekeeping without PCR screening!
  - Mix with militaries from many endemic areas
  - Urgently need standard malaria prevention practices and effective screening

*Stop emerging incurable malaria to prevent the next global pandemic*
Current Situation

- Phu Yen Province, Vn (2015-6)
- Each household had 4.3 treated nets, < 20% use one in risk areas (2016)
- Not providing nets people want to use
- 30% own untreated zip-type hammock nets

*Despite high program coverage, poor net coverage in the actual transmission hot spots/foci*

Figure legend. Turquoise color is 4700 households mapped where there are 4.3 treated nets/household per Provincial Health records; dots are the forest sleeping locations 1-2 weeks earlier (incubation period for malaria) for 95% of 2015 cases. The color of the dots shows very low use of nets in actual transmission areas despite very high coverage in the village.
Alan Magill Recommended:

- Equation for eradication
- Easier equation – just enough of each box
- Eliminate malaria “east of Bangkok” by 2020
- “Accelerate to zero”
- We can do this!!

*“Bend the curve”*
Together we can “Bend the Curve”

1) Effective guidelines and recommendations
2) “Cutting edge” real time information
3) Targeting of foci and MMPs going there
4) Partners for “Red to green, keep it green”
1) Effective Guidelines and Recommendations

- WHO ✓
- MoHs ✓
- Alan Magill ✓
- Bill Gates ✓
- CSIS ✓


*Still need field operations manual (groups of specific execution SOPs)*
Figure legend. Smart phones with good data coverage are becoming ubiquitous; KoboToolBox is free for NGOs and for malaria they have classified it as a humanitarian crisis, allowing for unlimited pictures. Pictures linked to GPS coordinates and key data will allow malaria elimination staff, donors, and key leaders to understand what is happening where and when from anywhere in the world near real time for the first time – this “changes the game.”
3) Targeting of actual transmission locations

*Forest transmission hot spots are readily identifiable and targetable*

*Need trained partners for field operations*

Figure legend. The blue circles are transmission areas to prioritize; here classified as 2 cases within a 1 km radius, which captures 80% of cases. Within the blue circles is a small circle represents the prevention package and a triangle represents the treatment package. In this figure, the treatment package is only the use of a treated net or not, and the treatment package is only time to access effective malaria treatment. As you can see, treated net use is poor, but all but two triangles are green, illustrating that all but two hot spots are within 1 hour of a health center. This also means they are directly accessible for intervention when a new case occurs and for on-going monitoring of use of malaria elimination tools.
3.1) More can/should be done in the hot spots

- **Treatment**
  - Access within one hour by motorcycle
  - Targeted malaria posts to forest entry points
  - Screening with highly sensitive RDTs
  - Complete treatment of all cases

- **Prevention**
  - > 90% using a treated net
  - Treated uniforms for those working at night (1)
  - Safer sleeping, sitting and bathing areas
  - Minimizing exposure at night

(1) Figure legend. Treated uniforms substantially reduce *P. vivax* cases. Focal screen at and treat (FSAT) + insecticide treated uniforms (ITU, blue box vs red box); 13 failures may be relapses suggesting very high efficacy. These two interventions with and without malaria prophylaxis (MMP) stopped all *P. falciparum* transmission, strongly suggesting the Cambodian Army is the primary transmission reservoir in this area, see slide 4), JITMM, Poster 92, 2016
Goal = “Red to Green, Keep it Green”
(see example below)

*ConsortiumHA Motto – On the right is perfect, 60-70% is good enough!*
4) Partners for “Red to Green, Keep it Green”

- NMCPs/MoHs
- WHO
- Global Fund/ADB/BMGF
- NGOs (international and local)
- IOM
- US Government organizations
- APLMA
- Those who can execute in the field (provincial health, military, METFs)!

*Those who can stop malaria in transmission foci are critical*
Vietnam Border Defence Force (BDF)

- ~150,000 troops (source: Wikipedia) in border and costal areas
- Medical
  - Staff in the 1000’s
  - 150 joint medical clinics
- ~100,000 children vaccinated/year
- ~60,000 educated about family planning and HIV/AIDS prevention/year
- Dozens of medical teams with hundreds of participants to overcome natural disasters/year

Figure Legend: Medical Director (Dr. Long) celebrating the New Year with family & colleagues. BDF have impressive public health statistics.
Border Guard Forces Malaria Contributions (2005-2014)

- Educated 1,100,773 people
- Provided 779,657 treated bed nets
- Sprayed 3,343,700 m² of housing walls
- Diagnosed and treated 113,482 malaria cases
- Provided prophylaxis for 514,494 soldiers/civilians

*Vietnam BGF have amazing malaria intervention statistics!*
Binh Phuoc-Cambodia “Island*” – Top Priority in Vn!

Figure legend. Highest priority of seven remaining “forest and malaria islands” in Vietnam, because of the worst drug resistance. It covers 4 provinces in two countries currently with no coordination even between provinces in the same country. We believe we can eliminate here in 2 years with the principles set forth in this presentation, including one leader for the entire “island.” The remaining intact forest is only a national park on the Vietnam side and a wildlife refuge on the Cambodia side.
# Example Pay-for-Performance Plan to Rapidly Eliminate Malaria

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Description</th>
<th>Frequency</th>
<th>Unit Cost</th>
<th>Total Units</th>
<th>Unit Type</th>
<th>Interviewees</th>
<th>Cost/Intervention/Year</th>
<th>Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Rapid case report and initial investigation</td>
<td>Full interview at initial patient encounter</td>
<td>Each case</td>
<td>$4.80</td>
<td>1</td>
<td>Patient</td>
<td>1000</td>
<td>$4,800</td>
<td>1000 patients, cases will drop 80% in first year</td>
</tr>
<tr>
<td>2.1 Foci response (Village)</td>
<td>Screen* &amp; treat, treat nets, new nets, BCC**</td>
<td>Per case, prioritized</td>
<td>$3.60</td>
<td>300</td>
<td>Village responses</td>
<td>75</td>
<td>$81,000</td>
<td>Only those working in same risk area screened in the village</td>
</tr>
<tr>
<td>2.2 Foci response (Forest)</td>
<td>Screen &amp; treat, treat nets, new nets, BCC, LLIN-ASSA***</td>
<td>With each case, prioritized</td>
<td>$7.20</td>
<td>50</td>
<td>Forest foci responses</td>
<td>40</td>
<td>$14,400</td>
<td>1 km radius (assume 10 huts or 40 people); will be same teams doing foci monitoring and will overlap</td>
</tr>
<tr>
<td>3 Foci monitoring</td>
<td>On-going screen &amp; treat, monitor net use, BCC</td>
<td>Monthly to semiannually, prioritized</td>
<td>$6.60</td>
<td>120</td>
<td>Foci visited</td>
<td>40</td>
<td>$31,680</td>
<td>In accessible locations, 1 km radius (~80%), quarterly visits on average</td>
</tr>
<tr>
<td>4 Forest entry point interventions</td>
<td>On-going screen &amp; treat, monitor net possession, BCC</td>
<td>Continuous</td>
<td>$3.00</td>
<td>10</td>
<td>Forest entry points</td>
<td>548</td>
<td>$16,425</td>
<td>To capture people going beyond accessible locations (~20%), 15 people per check point per day</td>
</tr>
</tbody>
</table>

* Ideally with new ultrasensitive rapid diagnostic test (RDT)

**BCC = behavior change communication, potentially in the form of a "malaria visa" modeled after Exxon Mobile's malaria prevention program

***LLIN-ASSA = Long lasting insecticide treated net around sleeping and sitting areas (e.g. majority of sleeping locations are huts without walls)

Figure legend. Rapid malaria elimination boils down to doing five interventions well. We believe pay-for-performance linked to the smartphone information system will also “change the game” to finally get quality work done in the field. We have successfully tested components of this system. As you can see, this table is parameterized for 1000 patients with relatively small costs.
Specific Recommendations

• Address MDR malaria like the emergency it is!
• Target transmission foci and people who go there
• Utilize simple cutting-edge technology ("Red to Green, Keep it Green", should be “game-changing”), especially if linked to “pay-for-performance”
• Develop joint missions with the right leadership for each “island”
• Establish the right partners for coordinated action (Consortium of executers and funders)
• Apply military’s strengths (also should be “game-changing”)
• Prepare for the next threat together

*Targeted decisive action now*
ConsortiumHA

• 501(c)3 registered in USA 2016, approved in Vietnam 2017, Cambodia approval expected in 30 days.

• Mission
  • To eliminate emerging incurable malaria, to address related conditions and to tackle their underlying cause, poverty.
  • First objective per Alan Magill “East of BKK” by 2020

• Capabilities
  • Seven key Board of Directors members with critical expertise
  • Seven volunteer staff
  • Can execute concepts presented in here
  • Through partnership with already strong institutions (National Malaria Control Programs, Provincial Health, militaries, local NGOs, etc.)
ConsortiumHA’s Experience

• Founding Director
  • 25 years malaria experience
    • Research (laboratory and field)
    • Epidemiology (esp. attack rates)
    • Drugs (esp. tafenoquine)
    • Diagnostics quality improvement
    • ~ 60 peer reviewed publications

• Extensive field experience (Asia, Africa)

• Extensive partnership experience
  • 7 militaries (exp. Thai, Dutch, Indonesia, Tanzania)
  • Kenya Medical Research Inst./NIMR Tanzania
  • Several drug companies (esp. GSK, Pfizer)
  • Fio Corporation
  • NMCP (NIMPE, 3 years)
ConsortiumHA’s Experience

- Posted with Vietnam National Malaria Control Program (NIMPE) for 3 years
- Tested all components of a malaria elimination information system (see https://consortiumha.org/wp-content/uploads/2016/12/Thang_ASTMH_110816_NJM_SEC_Poster.pdf)
- Mapped households
  - ~ 6000 in 2015
- Conducted Household Survey
  - 100 cases with control HH
  - Established risk factors
  - Estimated net use
  - Defined which nets desired
  - Found treated nets protective

<table>
<thead>
<tr>
<th>Main Work Type</th>
<th>n</th>
<th>Percent interviewed population</th>
<th>Number of Malaria Cases</th>
<th>Percent Total Malaria (n=93)</th>
<th>Percent Risk Malaria</th>
<th>Nets Currently Used (n=186)</th>
<th>Nets Types Currently Used (n=189)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper plantation</td>
<td>94</td>
<td>49%</td>
<td>44</td>
<td>47%</td>
<td>47%</td>
<td>65%</td>
<td>11%</td>
</tr>
<tr>
<td>Agarwood harvesting</td>
<td>39</td>
<td>21%</td>
<td>14</td>
<td>15%</td>
<td>36%</td>
<td>95%</td>
<td>15%</td>
</tr>
<tr>
<td>Farmer</td>
<td>16</td>
<td>8%</td>
<td>12</td>
<td>13%</td>
<td>75%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Trapper</td>
<td>16</td>
<td>8%</td>
<td>6</td>
<td>6%</td>
<td>38%</td>
<td>44%</td>
<td>25%</td>
</tr>
<tr>
<td>Charcoal production</td>
<td>10</td>
<td>5%</td>
<td>8</td>
<td>9%</td>
<td>80%</td>
<td>70%</td>
<td>0%</td>
</tr>
<tr>
<td>Timber harvesting</td>
<td>9</td>
<td>5%</td>
<td>4</td>
<td>4%</td>
<td>44%</td>
<td>33%</td>
<td>11%</td>
</tr>
<tr>
<td>Hunter</td>
<td>3</td>
<td>2%</td>
<td>3</td>
<td>3%</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>2%</td>
<td>2</td>
<td>2%</td>
<td>67%</td>
<td>67%</td>
<td>67%</td>
</tr>
<tr>
<td><strong>Total or mean</strong></td>
<td><strong>190</strong></td>
<td><strong>100%</strong></td>
<td><strong>93</strong></td>
<td><strong>100%</strong></td>
<td><strong>49%</strong></td>
<td><strong>68%</strong></td>
<td><strong>19%</strong></td>
</tr>
</tbody>
</table>

- Any Net: At least a treated Net type
- At least a zip hammock type
- At least a LLIN type

Paper plantation 94 49% 44 47% 47% 65% 11% 41% 2%
Agarwood harvesting 39 21% 14 15% 36% 95% 15% 36% 8%
Farmer 16 8% 12 13% 75% 80% 80% 0% 40%
Trapper 16 8% 6 6% 38% 44% 25% 13% 6%
Charcoal production 10 5% 8 9% 80% 70% 0% 50% 0%
Timber harvesting 9 5% 4 4% 44% 33% 11% 11% 0%
Hunter 3 2% 3 3% 100% 0% 0% 0% 0%
Other 3 2% 2 2% 67% 67% 67% 0% 0%
**Total or mean** 190 100% 93 100% 49% 68% 19% 32% 6%
ConsortiumHA’s Experience

- Surveyed random sample of 1000 HH – preparing for “operations research”
- Mapped 140 forest transmission locations (2015-2016)
  - 95% 2015 cases (blue), 82% 2016 cases (pink)
  - See two main clusters of 2016 cases
  - Determined 80% directly accessible (< 1 hour)
  - Determined most remainder accessible through check points
- Successfully tested pay-for-performance system
- Published information in 4, 2016 ASTMH posters (see library at https://consortiumha.org/)
ConsortiumHA’s On-going Activities

- Treated uniforms for those working at night (<$0.5/year)
- Binder for net treatment ($0.03-$0.1/net) to make LLIN
- Evaluating products people want to use (Zip hammocks)
- Safer sleeping, sitting and bathing areas

Inexpensive permethrin produced by UK company in Vn
Binder in the no longer produced KO 1-2-3 tabs
The type of net most forest-goers buy through Vietnam and Cambodia (cost in Cambodia for good quality net ~$12).

Figure legend. Safer sleeping, sitting and bathing areas are absolutely possible by using treated netting around them.
Examples from Five Transmission Foci in Western Cambodia

Figure legend. Incoming migrant worker who left his net at home for his family (where this is no transmission.) He saw the sign and is wondering how to get a treated net. There were no plans in place to screen incoming migrants for malaria or to provide treated nets.

Figure legend. Many migrants like to use this type of untreated tent in which nets cannot be used. A = treated tent is now newly available for purchase by malaria elimination programs.
Examples from Five Transmission Foci in Western Cambodia (continued)

Figure legend. This family purchased their own untreated net; they wanted one big enough for the entire family to use. By visual inspection, >50% of people in this area were using self-purchased, untreated nets. Additional sites in Northern and Northeastern Cambodia reviled very low use of treated nets by forest-goers through interviews with village health workers and commune health staff.

Figure legend. This family was not home; but may have chose this net because of appearance. Indian merchants on motorcycles sell untreated nets in this area. Treatment of self-purchased products in actual transmission foci should become standard practice in areas eliminating malaria. Using products with binder will allow for less frequent retreatment.
How Can “ConsortiumHA” Best Contribute?

- Partner with strong organizations (National Malaria Control Programs)

Figure legend. We have been partnering with the National Institute of Malariology, Parasitology and Entomology (NIMPE) for three years. We developed the methodology together and they executed the work in partnership with Provincial Preventive Health. This image represents current and retired NIMPE staff reviewing the work of a young NIMPE physician who captured GPS coordinates, images and information at the actual transmission locations. He is pointing at a typical sleeping structure in a paper plantation.
How Can “ConsortiumHA” Best Contribute?

Figure legend. NIMPE staff demonstrating nets people want to use can either have WHOPES-approved LLIN sewn in (cost for “thin” type ~ $10 and for thick type ~$15) or that existing nets can be treated.

Figure legend. NIMPE staff demonstrating a safer sleeping and sitting area; almost no forest sleeping structures have walls allowing spraying; nearly all have a tarp or thatch cover and wooding support frame allowing for treated net to be placed around them.
How Can “ConsortiumHA” Best Contribute?

• Facilitate targeting of malaria foci
  “Red to green, keep it green”
• Facilitate cross-border/intersector collaboration
• Execute operations/operational research
• Support pay-for-performance implementation
• Provide on-going quality monitoring
• Provide flexible mechanisms to address critical gaps

Figure legend. Our goal is as much “green” in terms of prevention and treatment packages as possible in actual transmission locations. Sixty-70% green will lead to rapid elimination of malaria from this site. Province health staff at this location can absolutely do this!
Questions/Thoughts??

Figure legend. Dr. Ohrt, the Founding Director of ConsortiumHA, as a young field researcher visiting transmission hot spots in West Papua, Indonesia on a project dirt bike.