MESA FORUM | VIRTUAL

RESPONDING TO THE THREAT OF ANOPHELES STEPHENSI INVASION IN AFRICA

21 February, 2023
2-3:30 PM CET
Overview, relevance, and the current status of *An. stephensi*’s geographical spread: WHO Threats Map

**Seth Irish**, Technical Officer, Vector Control & Insecticide Resistance Unit, Global Malaria Programme, World Health Organization
Anopheles stephensi

- Major malaria vector from south Asia
- First reported finding in Africa in 2012
- Flexibility in larval site choice, especially able to use urban larval sites
- Host preference for cattle/goats
- Good biological vector for *P. falciparum* and *P. vivax*
- Resistant to many insecticides used for public health
WHO initiative

- Information exchange
- Increasing collaboration
- Strengthening surveillance
- Prioritizing research
- Developing guidance
Tracking the spread

- Malaria Threats Map
  - Native occurrences
  - Invasive occurrences
  - Negative findings
Value of negative findings
Implications for elimination

• In Brazil, *An. arabiensis* spread to an area of approximately 54,000km$^2$, just smaller than the area of the country of Togo.
• What area has *An. stephensi* spread to in Africa?
If you have detected invasive Anophelines vector species please report to us through the reporting form.
WHO form to report detection of invasive Anopheles vector species

Each detection of an invasive species should be reported on a separate row. When the species has been detected through different surveys, please report each detection separately.

A detection is considered to be the collection of one or more specimens of an invasive species on a defined day or month in a specific location. Please submit the form to vectorsurveillance@who.int indicating in the subject the name of the country and the vector species detected.

If you have any questions, please send an e-mail to vectorsurveillance@who.int.

WHO/ICD/GMP/19.11

<table>
<thead>
<tr>
<th>Country</th>
<th>Province/Region/State (1st admin level)</th>
<th>District (2nd admin level)</th>
<th>City/Village/Commune (3rd admin level)</th>
<th>Site name (if the site does not have a specific name, please enter the name of the closest City/Village where it is located)</th>
<th>Latitude X (in decimal/UTM degrees)</th>
<th>Longitude Y (in decimal/UTM degrees)</th>
<th>Name of the Anopheles species detected</th>
<th>Type detected</th>
<th>Other Anopheles species detected (i.e. species not listed in the drop-down of the previous column)</th>
<th>Year of mosquito collection start</th>
<th>Month of mosquito collection start</th>
<th>Year of mosquito collection end</th>
<th>Month of mosquito collection end</th>
</tr>
</thead>
</table>
Malaria threats map

• A start, not an end to itself

• Key questions remain:
  • Where is *An. stephensi*?
  • How is it spreading?
  • What is its role in malaria transmission?
  • How to control it?
RESPONDING TO THE THREAT OF ANOPHELES STEPHENSI INVASION IN AFRICA

Ethiopia’s Action Plan on *An. stephensi* and recent updates

Gudissa Assefa (NMEP Manager)

21 February 2022
Contents

• Introduction

• Planning process

• Actionable Plan (2022-2026): Summary

• Implementation arrangement

• What is next?
Malaria: Burden & Epidemiology

- Malaria burden and epidemiology exhibit a marked variations in the country.

- 3/4th of the area is suitable for malaria transmission;

- Population at risk of malaria infection 52%

- **Determinants**: Altitude & climate (rainfall & temperature)

- Mainly occurs up to 2,000 masl; rare case up to 2,500 masl

- **Transmission**: seasonal & unstable

- **Parasites**: P. f (80.1%) & P. vivax (19.9%) DHIS2 (2020/21)

- **Vector**: *An. Arabiensis* & *An. Stephensi*
### Trend for total malaria and confirmed cases, 2009-2014 EFY

**DHIS-2 Disease report**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Case (Confirmed + Clinical)</th>
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<tbody>
<tr>
<td>2009</td>
<td>1,747,251</td>
</tr>
<tr>
<td>2010</td>
<td>1,206,891</td>
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<tr>
<td>2011</td>
<td>993,999</td>
</tr>
<tr>
<td>2012</td>
<td>1,509,182</td>
</tr>
<tr>
<td>2013*</td>
<td>1,220,027</td>
</tr>
<tr>
<td>2014*</td>
<td>1,612,218</td>
</tr>
</tbody>
</table>

*Total Case (Confirmed + Clinical)*
Malaria Mortality Rate (2017-2022 DHIS 2)

Death/100000 population at risk

- **2017**: 310
- **2018**: 356
- **2019**: 156
- **2020**: 213
- **2021**: 132
- **2022**: 180

Death:
- **2017**: 0.92
- **2018**: 0.63
- **2019**: 0.27
- **2020**: 0.32
- **2021**: 0.25
- **2022**: 0.32
Introduction: An. stephensi

- Detected in Ethiopia in 2016
- In Ethiopia 45 sites found positive for \textit{An. Stephensi}
- Entomological surveillance monitoring is ongoing (CEASE project)
Since WHO epi week 1 to 13/2022, there was outbreak in the city administration. Majority of cases were from Sabian location and Gore health center; and Dire Dawa University (DDU). The reason behind the outbreak are: there is larva positive water treatment in DDU compound and Butuji river which cross the city more than 9 kilometer is larva positive.
1. Evidence generation (Recent DD continued)
Actionable Plan (2022-2026): Summary

**Planning Process**

1. **Evidence Generation for Planning**
   - Evidences collected and reviewed – desk review

2. **Endorsing the evidences and Organization of Partners**
   - Sources for relevant evidences (PMI vector link, AHRI, EPHI, Universities and regions,....)
   - Formed TWG to develop actionable plan
   - Enriching the plan further and finalized
   - The final plan was formally launched in the presence of all stakeholders
   - Implementation is ongoing as per the plan
Action plan for the Integrated Surveillance and Control of Anopheles Stephensii and Aedes Aegypti,

With a targeted elimination of An. Stephensii in Ethiopia, 2022-2026

Main Objective:
- To eliminate *An. Stephensii* from Ethiopia by 2026 and thereby control *Ae. aegypti*
Specific Objectives

1. To **delineate the distribution** of *An. stephensi* within Ethiopia by outlining and implementing strategies for enhanced surveillance including the evaluation and implementation of integrated surveillance with *Ae. aegypti*

2. **To control** *An. stephensi* and thereby *Ae. aegypti* in the already invaded areas by implementing proven vector control measures, monitoring their impact, and evaluating potential new methods and tools

3. Continue control of *An. stephensi* and thereby *Ae. aegypti* in areas at risk including the use of new methods

4. To establish an **Early Warning, Alert and Response System (EWARS)** to prevent *An. stephensi* and thereby *Ae. aegypti* from invading any new geographical areas through the combined surveillance and control response outlined

5. To establish a functioning **inter-sectoral control response** by assigning clear roles and responsibilities to key partners involved in the response against *An. stephensi* and thereby *Ae. Aegypti*

6. To provide **monitoring and evaluation approaches** to surveillance and intervention
Major Interventions

1. Surveillance

   a) Surveillance in areas where presence of An. stephensi is not yet confirmed

   b) Surveillance to monitor An. stephensi and *Ae. aegypti* abundance in areas where presence is confirmed

   c) Determining insecticide susceptibility of An. stephensi and *Ae. aegypti*

   (*already started and ongoing by some partners*)
Major Interventions

2. Control of An. stephensi
   i. **Interventions ready in the short-term**
      a) Environmental and Larval Source Management
      b) Insecticide treated nets and indoor residual spraying (resistance, out door biting/resting behavior) may compromise this part of the intervention
   ii. **Potential new interventions**
      a) Interventions available to be tested
      b) Interventions being developed
   iii. **Enact or introduce by-laws to regulate water storage, construction and solid waste management practices and set up system for enforcement**
LSM Launching Ceremony @ Dire Dawa
Larva Source Management @ Batu town
Major interventions

3. Cross cutting (Stakeholders, governance, coordination, and leadership of implementation)

- Multi-sectoral engagement
- Community Engagement
- Human resource development (training)
- Advocacy/Communication/SBCC
- Monitoring and evaluation
Cross Cutting (Partnership)
Budget Required for Actionable plan

Detailed Activities Budget has been set for 5 years (2022-2026)

• For surveillance = 4,965,437USD
• For Control/Intervention = 42,173,167USD
• Grand total **47,138,604 USD**
• Budget revision may be necessary in the course of time
What is Next?

• Resource Mobilization

• Implementation based on the endorsed plan of action with no time to waste.

• Existing potentials (Adama new training center lead by AHRI, PMI (vector link, ACIPH, PATH, S4ME, Universities...) being great potentials for the way forward

• Strong collaboration with all stakeholders
Thank you for your Attention!
Case Study:
Recent range expansion of Anopheles stephensi to Sri Lanka and staying malaria free

S.N. Surendran
Department of Zoology
University of Jaffna
Malaria in Sri Lanka

• Sri Lanka has been endemic for rural malaria for centuries
Malaria in Sri Lanka…….

• Due to a well-coordinated efforts of the AMC through
  • Early diagnosis  
  • Treatment and
  • Vector control
  No indigenous cases reported since 2013

• Sri Lanka was declared free of any indigenous malaria in 2016

• However, imported malaria cases have been reported in the country even after 2016

![Year vs Imported Cases](http://www.malariacampaign.gov.lk/en/)

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Imported cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>95</td>
</tr>
<tr>
<td>2014</td>
<td>49</td>
</tr>
<tr>
<td>2015</td>
<td>36</td>
</tr>
<tr>
<td>2016</td>
<td>41</td>
</tr>
<tr>
<td>2017</td>
<td>56</td>
</tr>
<tr>
<td>2018</td>
<td>47</td>
</tr>
<tr>
<td>2019</td>
<td>53</td>
</tr>
<tr>
<td>2021</td>
<td>26</td>
</tr>
<tr>
<td>2023 (up to February)</td>
<td>05</td>
</tr>
</tbody>
</table>
Malaria Vectors in Sri Lanka

• Malaria has been endemic in the dry and intermediate climatic zones of Sri Lanka
• Out of 24 anophelines mosquitoes, *Anopheles culicifacies* is the major local vector
• *An. subpictus* is the secondary vector
• There are other anopheline species which are able to transmit malaria parasites

Invasive *An. stephensi*....

- A southward range expansion of *An. stephensi* was observed in India and attributed to urbanization and associated water storage practices.
- *An. stephensi* reached Goa in the 1970s.
- Kanyakumari at the southernmost location of India in the 1980s, and subsequently.
- It was predicted in 2001 that *An. stephensi* may further expand southwards to invade Sri Lanka and the Maldives.

Invasion to Sri Lanka

• *Anopheles stephensi* was detected for the first time in Sri Lanka in **2016** in the island of Mannar subsequently in Jaffna in **2017**.

• The adaptation of *An. stephensi* to undergo preimaginal development in domestic wells and cement water storage tanks has been considered to facilitate range expansion into new territories.

Invasion to Sri Lanka...

• Arrival:
  • movement of people across the 64 to 137 km-wide Palk strait that separates south India and Sri Lanka.
  • Wind-borne migration due to SW monsoon

• Establishment:
  • the readily availability of urban domestic wells and cement water storage tanks as habitats to which it was already adapted

• Spread:
  • it is therefore likely that An. stephensi can utilize similar anthropogenic fresh and brackish water habitats to further extend its range within the Jaffna peninsula and other coastal areas of Sri Lanka.

* Surendran et al, 2020: 30;13(1):156
Bionomics of *An. stephensi* in Sri Lanka

• Undergo preimaginal development in wells and cement water storage tanks

• Can lay eggs and undergo preimaginal development in brackish water of up to 3.5 g/L salt proving that *An. stephensi* has euryhaline characteristics.

• Highly resistant to 4% DDT, 5% malathion and 0.05% Deltamethrin

• It is therefore likely that they can utilize similar habitats to further extend its range within the Jaffna peninsula and other coastal areas of Sri Lanka.

Bionomics of *An. stephensi* in Sri Lanka

- Based mode of the number of egg ridges on egg-floats type/intermediate/mysorensis forms are present in Jaffna.
- **Spiracular index revealed presence of type and mysorensis**
- **AsteObp1** intron-1 region that identified all three biotypes in Iran and Afghanistan failed to differentiate the biotypes in Sri Lanka as in the case of Indian samples.

Bionomics of *An. stephensi* in Sri Lanka

- The results suggested that **numbers of egg ridges**, **spiracular indices** and **AsteObp1 intron 1** sequences were not useful for differentiating *An. stephensi* biotypes in Jaffna.

- It is proposed that the observed differences between *An. stephensi* mosquitoes in Jaffna now results from normal population variance in the context of rapidly changing bionomics in India and northern Sri Lanka.

Vector surveillance strategies of Antimalaria Campaign (AMC)

• Two categories of entomological investigations:
  • spot surveys: Spot surveys were carried out as reactive spots when a malaria patient was reported and as proactive spots when vulnerability of a certain area is increased.
  • Sentinel surveys: Sentinel monitoring has been carried out in foci where vulnerability and/or receptivity was moderate to high, on quarterly basis.
• Special entomological surveys are carried out in areas where the Anopheles stephensi is found.
• Special larval surveys have been conducted as pre and post intervention larval surveys in areas where invasive Anopheles stephensi has been found.
Control efforts

• The AMC continues **Reactive Spot Vector Surveys in all areas** with reported cases.

• Soon after the detection of *An. stephensi* extensive vector surveys were carried out mainly in the northern Sri Lanka to identify areas invaded by the mosquito.

• All identified preimaginal develop sites and potential sites were treated either with temephos or larvivorous fish or both and covered with mosquito proving nets wherever possible.
Control efforts

• Because of the well-coordinated vector survey and control activities, further expansion of *An. stephensi* to mainland of Sri Lanka has been prevented.

• Its presence is now mainly confined to three coastal areas
Challengers in controlling *An. stephensi*

- Adaptation to undergo preimaginal development in urban environment – transmission of urban malaria

- Ability to undergo preimaginal development in brackish waters – transmission of malaria in coastal areas

- Resistant to common insecticides – difficulties in control during malaria transmission
Implications and staying malaria free

• Posing a challenge to prevent re-emergence rural and urban malaria in Sri Lanka due to
  • Imported malaria cases and
  • Presence of local vectors along with invasive urban malaria vector An. stephensi

• The recent spread of An. stephensi to new territories are also likely to have been caused by anthropogenic and urbanization-associated factors similar to those discussed for Sri Lanka.

• Broad appreciation of the effects of anthropogenic drivers of mosquito vector-adaptation by global health decision-makers, and the development of appropriate mitigating strategies is clearly important.
Thank you
Anopheles stephensi Liston

India case study: Lessons learnt from decades fighting the vector

Ashwani Kumar
Director ICMR-Vector Control Research Centre, Puducherry, India
Malaria: Human Plasmodial Infections

**ANOPHELES STEPHENSI TRANSMITTED MALARIA INCIDENCE IN PANAJI, GOA, INDIA FROM 1985-1988**

<table>
<thead>
<tr>
<th>Year</th>
<th>BSE</th>
<th>Total Pos.</th>
<th><em>P. vivax</em></th>
<th><em>P. falciparum</em></th>
<th>Pf%</th>
<th>API</th>
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</thead>
<tbody>
<tr>
<td>1985</td>
<td>2497</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>20</td>
<td>0.12</td>
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<td>352</td>
<td>351</td>
<td>1</td>
<td>0.3</td>
<td>8.3</td>
</tr>
<tr>
<td>1987</td>
<td>21710</td>
<td>4416</td>
<td>4409</td>
<td>7</td>
<td>0.2</td>
<td>103.6</td>
</tr>
<tr>
<td>1988</td>
<td>29853</td>
<td>5677</td>
<td>5435</td>
<td>242</td>
<td>4.3</td>
<td>132.6</td>
</tr>
</tbody>
</table>
Malaria Problem Delineation

Types and number Breeding sites surveyed and their vector status

Relative contribution of various breeding habitats to An. stephensi breeding in 1990

Seasonal build up: Percentage of habitat positive for all mosquitoes and An. stephensi

A comparison of malaria incidence among construction workers and Local residents in Panaji, Goa in 1990.
**Anopheles stephensi** Control Interventions

**Breeding Habitat**

<table>
<thead>
<tr>
<th>Breeding Habitat</th>
<th>Treatment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyres</td>
<td>Safe storage / disposal</td>
</tr>
<tr>
<td>Intradomestic Containers</td>
<td>Inversion / disposal</td>
</tr>
<tr>
<td>Barrels and Tins</td>
<td>Inversion / disposal</td>
</tr>
<tr>
<td>Curing Waters</td>
<td>Drying with sand</td>
</tr>
<tr>
<td>Ornamental Fountains</td>
<td>Drying</td>
</tr>
<tr>
<td>Underground tanks</td>
<td>Periodical drying by pumping out water</td>
</tr>
<tr>
<td>Masonry Tanks</td>
<td>Hole drilling</td>
</tr>
<tr>
<td>OHT</td>
<td>Netting / Mosquito-proofing / Inversion</td>
</tr>
</tbody>
</table>

**Breeding Habitats with Numbers**

<table>
<thead>
<tr>
<th>Breeding Habitats</th>
<th>Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tyres</td>
<td>0</td>
</tr>
<tr>
<td>Intradomestic Containers</td>
<td>1250</td>
</tr>
<tr>
<td>Barrels and Tins</td>
<td>2500</td>
</tr>
<tr>
<td>Curing Waters</td>
<td>3750</td>
</tr>
<tr>
<td>Ornamental Fountains</td>
<td>5000</td>
</tr>
<tr>
<td>Underground tanks</td>
<td>0</td>
</tr>
<tr>
<td>Masonry Tanks</td>
<td>1250</td>
</tr>
<tr>
<td>OHT</td>
<td>0</td>
</tr>
</tbody>
</table>

**Bio-environmental intervention against An. stephensi:**
Breeding Source Reduction / Elimination

**Drains**

- Bacillus sphaericus

**Rain Pools on terraces and concrete slabs**

- Bacillus thuringiensis israelensis

**Masonry Tanks**

**Ground water tanks**

**Curing Waters**

**Biological control utilizing larvivorous fishes in Panaji, Goa, India (1990-92)**

- Aplocheilus blocki (93.5%)
- Rasbora daniconius (0.28%)
- Poecelia reticulata (4.47%)
- Gambusia affinis (1.48%)
- Other species (0.18%)

**Biological Control of An. stephensi with biolarvicides in Panaji from 1990-92**

- 98 Drains
- 32 Ponds
- 184 Rain pools/ditches
- 437 Overhead tanks (abandoned)
- 317 Ornamental Fountains
- 2786 Wells
- 2688 Masonry Tanks
Mosquito-Proofing
Goa Port: *Anopheles stephensi* Breeding Habitats and Interventions

- Construction sites
- Unlined surface drains
Impact of intervention on vector and malaria incidence from 1990 to 1992

Fig. Impact of Bio-environmental control intervention on SPR and SfR in Panaji, Goa from 1990-1992.

Impact Assessment: Child and Infant Parasite Rates

Fig. Malaria incidence in Panaji, Goa, India from 1985-1999 and impact of Bio-environmental control of malaria from 1989-1992.
Challenge with Adult *Anopheles stephensi* Resting
Collection by Hand Catch: Sumodan et al, 2004 JAMCA

Collected 38 mosquitoes resting on 15 different surfaces
CDC Light Trap Deployment, Mosquito collections and Identification: More Effective for Collections/Vector Surveillance
Thank you!
Anopheles stephensi: a catalyst for multi-sectoral action
OUTLINE

- Unique vector
- What is PMI doing?
- Multi-sectoral opportunities
- Indian Ocean example
- Global engagement and advances in public health entomology
An. stephensi IS STILL SPREADING IN AFRICA

- Djibouti (2012)
- Ethiopia (2016)
- Sudan (2016)
- Somalia (2019)
- Nigeria (2020)
- Kenya (2022)

WHO threats map
A UNIQUE VECTOR CREATES CHALLENGES OPPORTUNITIES

- Urban and rural adapted
- Thrives in artificial habitats
  - Shared with dengue mosquito, *Aedes aegypti*
  - Water storage for personal use, agriculture, construction, etc.
- Persists through dry periods
- Often collected in proximity to livestock
- Transmits-*Plasmodium falciparum* and *P. vivax* (Tadesse et al. 2021)
WHAT IS PMI DOING?

- Alignment with WHO initiative
- PMI *An. stephensi* interagency Task Force formed
- USG coordination across 7 agencies
- PMI LSM policy revised for rapid response
- Action plan developed, shared w/ 27 countries, will be online
- Leverage PMI partnerships-12 PMI countries began activities
- Supported modeling study on potential impact in Ethiopia
- Surveillance/control needs have identified new partners to engage with surveillance and response capacity
PMI & CDC GLOBAL COORDINATION

- WHO urban malaria technical advisory group
- WHO An. stephensi initiative
- WHO EMRO/AFRO
- Roll Back Malaria-Vector Control Working Group
- Global Fund
- Indian Ocean Commission
- Academic partnerships
- West African Aedes Surveillance Network
- Pan African Mosquito Control Association
WHAT IS CDC DOING?

- WAASuN trained *Aedes* programs in 18 countries
- PAMCA trainings and response in Djibouti
- Provide support to non-PMI partner countries
- Genomics-identified source populations and reintroductions (Carter et al. 2021)
- Collaboration within CDC- One Health, border health, FETP, geospatial training support opportunities
- CDC BAA call for *An. stephensi* population genomics and control innovation
PMI Action Plan 2.0

Approach
- Mitigation of impacts of An. stephensi utilizing enhanced vector and disease surveillance, coordinated intervention implementation, and improved monitoring

Geography
- **Scenario 1** An. stephensi is established
- **Scenario 2** At risk of invasion

Activities that can be conducted immediately
- Investigate anomalous Anopheles spp. from routine collections and IRM
- Align with Aedes surveillance
- Strengthen urban and port vector surveillance activities
- Habitat suitability maps provided to guide efforts

Guidance and activities proposed
- Surveillance, monitoring and evaluation
- Vector control
- **Social and behavior change (SBC) guidance developed**
- Multisectoral coordination-One Health, WASH, trade/commerce, population mobility
- Regulatory needs
- Community engagement

U.S PRESIDENT’S MALARIA INITIATIVE
Invasive *An. stephensi* entomological surveillance and monitoring
  ○ Insecticide resistance trends
  ○ 48 detection sites
  ○ Sporozoite and bloodmeal analysis

Training support for: Kenya, Benin, Nigeria, Yemen, Sudan, Somalia, Djibouti

Control launched in eight towns beginning Aug 2022

Support to investigation of 2022 malaria Dire Dawa outbreak led by AHRI, NMEP

Support to NMEP and national action plan for *An. stephensi* elimination
OPPORTUNITIES

- Leveraging enhanced surveillance and control monitoring
- Cross-border coordination and collaboration to accelerate response and learning opportunities
- Coordination with non-malaria programs to fill gaps
- Accelerate GVCR and preparedness and response for mosquito borne diseases
- Urban mosquito borne disease surveillance and control
- Enhance public health entomology workforce
SURVEILLANCE

- Improved scientific quality of routine entomological data by reporting and investigating anomalies
- Leverage sequencing capacity
- Negative detections are beneficial for tracking spread
- Understanding urban vector dynamics when not *An. stephensi*
- GVCR accelerated by leveraging *Aedes*/arboviral and *Anopheles*/malaria programs
  - *Aedes* data in Africa enhanced
- WHO urban malaria framework alignment
INVASIVE SPECIES

- Opportunities to leverage invasive species efforts and consortia
- US National Invasive Species Council (NISC)
- Biosurveillance, trade, economics, regulations, containment, elimination thresholds
- Invasive mosquitoes often thrive in containers and approaches can be integrated
- Cross-border training to identify species outside of typical keys
- Species distribution models to predict likelihood of introduction/establishment
TRADE/COMMERCE

- 2011 maritime trade data identified **Djibouti** and **Sudan** as countries at greatest risk of introduction (*Ahn et al. 2023*)
- 2020 marine trade (introduction) data combined with habitat suitability:
  1. Egypt
  2. Kenya
  3. Tanzania
  4. Morocco
  5. Libya
  6. Madagascar
  7. Mozambique
  8. Angola
  9. Senegal
  10. DRC

U.S PRESIDENT’S MALARIA INITIATIVE
POPULATION MOBILITY

- Identify points of entry/points for control
- Leverage existing data on pinch points from communicable disease (Medley et al. 2021)
- PopCAB Toolkit in PMI Action Plan
INeian OceAn EXAMPLE: Anopheles and Aedes

- Mauritius connects Asia and Africa through maritime trade
- Strong Aedes surveillance program leveraged (Diana Iyaloo)
  - *An. stephensi* surveillance reveals Anopheles diversity
- Indian Ocean Commission
- In 1 yr **five island nations** are coordinating vector programs
- Port surveillance in coordination with Port Authorities
WHAT HAVE WE LEARNED?

- Strengths in global partnerships, evidence-informed decision making, and localization initiatives when combined with efforts outside of malaria can accelerate the rate of action
- Cross-cutting engagement can allow for progress in parallel
- Multisectoral engagement can advance initiatives and activities outside of organizational scope
- Gaps and competing resources limit existing surveillance, research, and response capacity
- It is critical to drive more action and address questions around a future with *An. stephensi*
THANK YOU!
Pre-Forum Questions

1. What is the threat of *An. stephensi* in other regions of Africa, what is the basic step for proximal countries to take and why are most countries more interested with detecting it rather than starting to put strategies to prevent its introduction?

2. Is there any finding that indicates the current malaria transmission by *An. stephensi* and what molecular tools are being used for detection in developed urban areas?

3. Is there any change in the vector control interventions since the detection of *An. stephensi*?

4. There are parallels with *Aedes aegypti* control and behaviour. What have we learnt from that species?

5. What options are there for action by individuals and organisations in response to the *An. stephensi* rising danger to global eradication?