Space, Coastal Zones and Territorial Monitoring: Vector-borne diseases emergence

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Community services

- Shared Global Health mission
- Research Institute and Center of excellence
- Unique infra-structures

- Unique Community Services

TRAVEL HEALTH 2018

- 11,262 Travel Advice Appointments
- 369 Tropical Medicine Appointments
- 21,658 Vaccinations

SAÚDE NOS TRÓPICOS
As coleções da IHMT

Dia Internacional dos Museus. 18 de maio 15 horas. Entra Lola Livr e
**Infrastructure**

✓ Shared Global Health mission
✓ Research Institute and Center of excellence

✓ Unique infra-structures

**Security insectary**

Mosquito colonies and VB pathogens life cycle

Experimental infections

**Biosafety level 3 lab**

**Biobank**

**Bioinformatics Hub**

**Cohort – migrants**

- 600 Children 4 and 5 years of age
- Amadora (Lisbon)

**Projects office**

GAP

**ACCREDITED animal house**

Accredited animal house (license id approval: 023351 and 023355)

Colonies in regular production

A. gambiæ, A. stefhensi and A. atroparvus

Membrane Feeding Assays

Plasmodium berghei, Plasmodium vivax (Manaus Brasil)
UNESCO Center for research and advanced training.

✓ Global Health Teaching
✓ Recognition

“Knowledge for Development Initiative - IkfD”
Based in IHMT NOVA, aims to train 80 new doctors per year from Portuguese-speaking African countries.
The Research Center structure

<table>
<thead>
<tr>
<th>PPS</th>
<th>IHC</th>
<th>THOP</th>
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<tbody>
<tr>
<td>Population Health, Policies and Services</td>
<td>Individual Health Care</td>
<td>Tuberculosis, HIV and Opportunistic Diseases</td>
<td>Vector Borne Diseases</td>
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<tr>
<td>Diagnostics: nanotechnology, point of care</td>
<td>Drug/insecticide discovery &amp; resistance</td>
<td>Public health information</td>
<td></td>
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<tr>
<td>Global pathogen dispersion &amp; mobility of populations</td>
<td>Fair partnerships</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Vulnerable populations
- Universal Health Care
- Health Systems,
- Human Resources for Health
- Travelers health
- Febrile illnesses in the tropics
- Molecular epidemiology
- Phylogeography
- Respiratory diseases
- All genome analysis
- Malaria, Leishmania, Arbovirus
- Entomology.
- Molecular epidemiology and evolution,
- Population genetics
- Host-parasite interactions
Risk Assessment For the Emergence of Vector-Borne Diseases

- Vector habitat suitability in current and future climatic scenarios
- Predictive models for vector abundance
- Connectivity models
- Compartmental/statistical models for disease emergence
Risk Assessment For the Emergence of Vector-Borne Diseases

2004/2006 - "Rarimosq - survey and risk analysis of mosquito borne diseases, particularly arbovirosis, using remote detection".


2008/2010 - "MALVEO - Vulnerability Mapping to Malaria Vector from Earth Observation Data - Anopheles atroparvus density mapping under climate scenarios for Southern Portugal”.


2018/... - “WARDEN - An operational early WARning system for DENgue and other arboviral diseases in Madeira Island”

2018/.... - “TRIAD - HealTh Risk and Social Vulnerability to Arboviral Diseases in Mainland Portugal”
The vector:

**Anopheles atroparvus** Van Thiel, 1927

- One of the 3 *An. maculipennis* sibling species recorded in Portugal.

- **An. atroparvus**
- **An. maculipennis s.s.**
- **An. melanoon**

- The most abundant Anopheline.
- Country-wide distribution.
Risk Assessment For the Emergence of Vector-Borne Diseases

Importância médica

Agente de incomodidade

Vector:
- Dengue
- Febre amarela
- Chikungunya

Antropofílico

Alimentam-se em humanos

Urbano e doméstico

Águas paradas e limpas

Criadouros feitos pelo Homem

Hábitos de picada diurnos

Sinantrópico

Endofílico

Endo/exofágico

Controlo vetorial

Eliminação física de criadouros

Aplicação de larvicidas

Aplicação de adulticidas (em surto)
Present habitat suitability for *Anopheles atroparvus* (Diptera, Culicidae) and its coincidence with former malaria areas in mainland Portugal

César Capinha¹, Eduardo Gomes², Eusébio Reis¹, Jorge Rocha¹, Carla A. Sousa³, V. E. do Rosário², A. Paulo Almeida³
Risk Assessment For the Emergence of Vector-Borne Diseases

- Indoors resting collections

- 770 Collections sites

- 417 Localities

76 records of presence and 16 of absence
Anopheles atroparvus density modeling using MODIS NDVI in a former malarious area in Portugal

Pedro M. Lourenço¹, Carla A. Sousa², Júlia Seixas¹, Pedro Lopes¹, Maria T. Novo², and A. Paulo G. Almeida²(✉)
Satellite-derived estimation of environmental suitability for malaria vector development in Portugal

Risk Assessment For the Emergence of Vector-Borne Diseases

Mapping Risk of Malaria Transmission in Mainland Portugal Using a Mathematical Modelling Approach

Eduardo Gomes¹*, César Capinha²,³, Jorge Rocha¹, Carla Sousa⁴
Risk Assessment For the Emergence of Vector-Borne Diseases

Macroclimate Determines the Global Range Limit of *Aedes aegypti*

César Capinha, Jorge Rocha, and Carla A. Sousa

![Map of global range limit of Aedes aegypti](image)
## Risk Assessment For the Emergence of Vector-Borne Diseases

### Dengue importation into Europe: a network connectivity-based approach

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<th>Meaning</th>
<th>Connectivity ($S_{ij}$)</th>
<th>Source strength</th>
<th>Transport and importation</th>
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<td>1</td>
<td>Dengue activity</td>
<td>$\sum \theta_{i,f} A_i$</td>
<td>$\theta_{i,f}$</td>
<td>$l$</td>
</tr>
<tr>
<td>2</td>
<td>Dengue seasonality</td>
<td>$\sum \theta_{i,f} S_i$</td>
<td>$\theta_{i,f}$</td>
<td>$l$</td>
</tr>
<tr>
<td>3</td>
<td>Incidence estimates of source country</td>
<td>$\sum \theta_{i,f} I_{i,j}$</td>
<td>$\theta_{i,f}$</td>
<td>$l$</td>
</tr>
<tr>
<td>4</td>
<td>Geographical distance</td>
<td>$\sum \theta_{i,f} / \text{Ind}_{i,j}$</td>
<td>$\theta_{i,f}$</td>
<td>$1/\text{Ind}_{i,j}$</td>
</tr>
<tr>
<td>5</td>
<td>Epidemic vulnerability</td>
<td>$\sum \theta_{i,f} / V_i$</td>
<td>$\theta_{i,f}$</td>
<td>$1/V_i$</td>
</tr>
<tr>
<td>6</td>
<td>Source country’s wealth (GDP)</td>
<td>$\sum \theta_{i,f} / \text{lng}_{i}$</td>
<td>$\theta_{i,f}$</td>
<td>$1/\text{lng}_{i}$</td>
</tr>
<tr>
<td>7</td>
<td>Total air passengers from a source country</td>
<td>$\sum P_{i\rightarrow j}$</td>
<td>$l$</td>
<td>$P_{i\rightarrow j}$</td>
</tr>
</tbody>
</table>
An operational early WARning system for DENgue and other arboviral diseases in Madeira Island

- Spatialized real-time climate data
- Travellers flow data
- Ongoing epidemics

- Disease importation risk
- Human population density
- Mosquito vector densities
- Virus extrinsic incubation period

Real-time computational integration of the 2 components
Daily forecasts of risk of an arboviral outbreak up to 16 days

Data assimilation module + Spatial-temporal predictive models

PI: Carla A. Sousa

Funding: PTDC/SAU-PUB/30089/2017
healTH RIsk and social vulnerability to Arboviral Diseases in mainland Portugal

PI: Carla A. Sousa

FCT

Funding: PTDC/EGE-ECO/32511/2017
Obrigada pela atenção