Predictive assessment of transmission conditions of cholera in the environment and human population using earth observations

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DfID, UK-Africa operations
UK Met Office
OCHA
UNICEF
Goal of Research Project

We thematically envision “Cholera Ready Nations” where satellite based prediction (of risk of trigger and likelihood of transmission of cholera in the human population) will provide sustainable and resilient readiness to prevent outbreak of disease, saving human lives and improving quality of life.

Objectives

• Systematically validate the epidemic and endemic cholera hypothesis for trigger component of cholera in Africa
• Develop, calibrate, and validate predictive model for transmission component of cholera.
Relevant earth observations

**EPIDEMIC CHOLERA**
- MODIS/VIIRS [LST, Land cover]
- TRMM/GPM [Precipitation]
- SRTM [DEM]

**ENDEMIC CHOLERA**
- MODIS/VIIRS [Chlorophyll, SST, Organic matter, Land Cover]
- AVHRR [SST]
- TRMM/GPM [Precipitation]
- SRTM [DEM]
- TOPEX/JASON [SSH]
- Aquarius [Salinity]

*SST: Sea Surface Temperature; SSH: Sea Surface Height; LST: Land Surface Temperature; MODIS: Moderate Resolution Imaging Spectroradiometer; TRMM: Tropical Rainfall Measuring Mission; GPM: Global Precipitation Mission; AVHRR: Advanced Very High Resolution Radiometer; DEM: Digital Elevation Model; SRTM: Shuttle Radar Topography Mission*

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**Use of earth observations to advance science of cholera (Section 2.1)**

**Validation of trigger hypothesis for Epidemic mode of cholera (Task 1)**

**Validation of trigger hypothesis for Endemic mode of cholera (Task 2)**

**Cholera Transmission Model (CTM) (Task 3)**

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**Anticipated Results (Section 3)**

**Risk maps showing probabilities of occurrence of inland cholera infection**

**Risk maps showing probabilities of occurrence of cholera infection along coasts**

**Ensemble scenarios on how cholera infection may spread in human population**

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**Capacity building initiatives (Section 2.2)**

- Communication plan with African partners identified by GEO Secretariat to identify core working group for cholera (Task 4)
- Determine feasibility of encourage use of earth observations and testing algorithms by partner foundations (Task 5)
- Workshop on African Cholera Initiative, social media and dissemination kit to advance Agenda 2030 plan (Task 6)
Epidemic algorithm: Hydrology + Microbiology + Sociology
Regional Cholera Prediction System (CAS-version 5)

Air temperature anomalies

Precipitation anomalies

Population density

Disaster and population movement

Drinking water accessibility

Sanitation infrastructure

\[ W_{ij} \]

i = variable of interest
j = risk level

Cholera Risk Map

Hydrology + Microbiology + Sociology
Validation of cholera model for trigger and transmission in Yemen

- Additional countries covered: India, Ethiopia, Mozambique, Sudan and Algeria.
A decision-making initiative for protecting human health and enhancing the resilience of coastal communities under current and changing environments
Cholera Prediction App Development

- Partnerships developed: University of Rhode Island, University of Maryland and University of Florida to develop prototypes for one of the first apps to use earth observations for prediction of water-borne infectious diseases.
- Currently, web hub at UF is being prepared for data ingestion for apps.
Regional Cholera Prediction System (RCPS)

On demand country level cholera prediction has been tested and a product manual has been developed. (snapshot below)

This product is not yet out for public consumption.

Regional Cholera Prediction System – Contact the University of Florida to obtain help, using any of the details shown below:

- By phone: 352-294-6898
- By email: choleraprediction_users@lists.ufl.edu

Please specify your issue, or in the case of Regional Cholera Prediction System Inaccuracies, specify which elements of the forecast that you believe to be inaccurate, in the email subject line

UF listserv will send you an email to confirm your email.
Continuing tasks

• Societal equity and equality at regional scales.
• Earth observations based anticipatory actions decision making framework.
• Ensemble model infrastructure for transmission of cholera on regional scales.
ARL information

Starting ARL: 3

Current ARL: 8 (~8.5)

Target ARL: 9
## Overall timeline for research objective and activities at end user organization

<table>
<thead>
<tr>
<th>Activity</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
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</thead>
<tbody>
<tr>
<td>Kick off meeting (Skype)</td>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
</tr>
<tr>
<td>Task 1: Epidemic cholera</td>
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<tr>
<td>Task 2: Endemic cholera</td>
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<td>Task 3: CTM</td>
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<td>Task 4: Core group formation</td>
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<tr>
<td>Task 5: Training/ dissemination plan with foundations</td>
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<tr>
<td>Task 6: Workshop</td>
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<td>PI meeting</td>
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<tr>
<td>Meetings with stakeholders (OCHA, DfID)</td>
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UF; Q1, Q2, Q3, Q4 represent quarter in a given year.

x¹ : planning; *: status unknown due to COVID19
Thank you