Climate Change & Health Risks

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MSc+PhD

Program:
– India’s first integrated MSc + PhD program in Health Informatics
– Problem solving approach
– Innovative concepts have been designed and developed
– Successfully raised national and international grants
What we do!

- Medicine
- Engineering
- Design
Climate Change and Health Risks

- A. What it is
- B. What to know
- C. What we are doing
- D. What to do
- E. Collaborate
Earth's average surface temperature.
Climate Change and Health Effects

Human exposures
- Regional weather changes
  - Heatwaves
  - Extreme weather
  - Temperature
  - Precipitation

Contamination pathways
- Transmission dynamics
- Changes in agro-ecosystems, hydrology

Socioeconomic and demographic disruption

Health effects
- Temperature-related illness and death
- Extreme weather-related health effects
- Air pollution-related health effects
- Water and food-borne diseases
- Vector-borne and rodent-borne diseases
- Effects of food and water shortages
- Mental, nutritional, infectious and other health effects

Modulating influences
Climate Change affects Transmission C

**Anthroponoses**

**Direct transmission**
- HUMANS
- HUMANS

**Indirect transmission**
- HUMANS
- VECTOR/VEHICLE
- VECTOR/VEHICLE

**Zoonoses**

- ANIMALS
- ANIMALS

- ANIMALS
- VECTOR/VEHICLE
- VECTOR/VEHICLE
- HUMANS
- HUMANS
Transmission Cycle

– (i) vector survival and reproduction,
– (ii) the vector’s biting rate, and
– (iii) the pathogen’s incubation rate
– within the vector organism. Vectors, pathogens and hosts each survive and reproduce within a range of optimal climatic conditions: temperature and precipitation are the most important.
## Climate Change and Disease

<table>
<thead>
<tr>
<th>Environmental changes</th>
<th>Example diseases</th>
<th>Pathway of effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dams, canals, irrigation</td>
<td>Schistosomiasis</td>
<td>▲ Snail host habitat, human contact</td>
</tr>
<tr>
<td></td>
<td>Malaria</td>
<td>▲ Breeding sites for mosquitoes</td>
</tr>
<tr>
<td></td>
<td>Helminthiasies</td>
<td>▲ Larval contact due to moist soil</td>
</tr>
<tr>
<td></td>
<td>River blindness</td>
<td>▼ Blackfly breeding, ▼ disease</td>
</tr>
<tr>
<td>Agricultural intensification</td>
<td>Malaria</td>
<td>Crop insecticides and ▲ vector resistance</td>
</tr>
<tr>
<td></td>
<td>Venezuelan haemorrhagic fever</td>
<td>▲ rodent abundance, contact</td>
</tr>
<tr>
<td>Urbanization, urban crowding</td>
<td>Cholera</td>
<td>▼ sanitation, hygiene; ▲ water contamination</td>
</tr>
<tr>
<td></td>
<td>Dengue</td>
<td>Water-collecting trash, ▲ Aedes aegypti mosquito breeding sites</td>
</tr>
<tr>
<td></td>
<td>Cutaneous leishmaniasis</td>
<td>▲ proximity, sandfly vectors</td>
</tr>
<tr>
<td>Deforestation and new habitation</td>
<td>Malaria</td>
<td>▲ Breeding sites and vectors, immigration of susceptible people</td>
</tr>
<tr>
<td></td>
<td>Oropouche</td>
<td>▲ contact, breeding of vectors</td>
</tr>
<tr>
<td></td>
<td>Visceral leishmaniasis</td>
<td>▲ contact with sandfly vectors</td>
</tr>
<tr>
<td></td>
<td>Reforestation</td>
<td>▲ tick hosts, outdoor exposure</td>
</tr>
<tr>
<td></td>
<td>Lyme disease</td>
<td>▲ Toxic algal blooms</td>
</tr>
<tr>
<td></td>
<td>Red tide</td>
<td>▲ Pools for mosquito breeding</td>
</tr>
<tr>
<td>Elevated precipitation</td>
<td>Rift valley fever</td>
<td>▲ Rodent food, habitat, abundance</td>
</tr>
<tr>
<td></td>
<td>Hantavirus pulmonary syndrome</td>
<td>▲ increase, ▼ reduction</td>
</tr>
</tbody>
</table>

▲ increase, ▼ reduction
Climate Change and Health Effects

Public health research

- Baseline relationships
  - Dose-response
- Evidence of early effects, including monitoring
- Scenario modelling
- Adaptation options
- Co-benefits of mitigation

Assessments of
- vulnerability
- adaptation
Questions to address?
Information sufficient?

Other disciplines

Communication to
- Policy-makers
- Stakeholders
- Other researchers

Policy formulation process
To Do
To do - Levels

- Individual
- House Hold
- Street
- Community
- Village/ Town/ City
- District/ City
- State
- Country
Project GRAPH

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Public Health Limitations

– Community Vs Individual
– Preventive Vs Curative
– Sampling Vs Comprehensive

– Project GRAPH also tries to address these limitations
Project GRAPH What is?

GRAPH: GIS & AI enabled Real time Active Personalized location-specific Healthcare
Project GRAPH

Right data: to understand

• Input data - Meta data, close to source, continuous

Right content: to act (i/o)

• Structured, Simple, Language neutral, simple, precise, personalized, localized

Right skills: to act, effectively

• Risk profile input data and connect to precise, personalised and location specific content

• Native and assisted intelligence – person + software
NTD WASH Project

26,800 households in 128 villages, 14,300 women in 1330 SHGs, 20 schools with 3000 children, 500 persons with NTDs requiring health care services, 5 health centres, anganwadis, block/district Govt offices

Village Questionnaire
- SDE, Govt Benefits
- WASH Status, Practice
- Facilities Available +
- Health- Disease- NTD+
- GPS Coordinates, Photos, Feature update on map

School Questionnaire
- WASH Status, Practice
- Absenteeism Cause?
- Catchment area?
- Health- Disease- NTD+
- GPS Coordinates, Photos

Government Benefits Questionnaire
- WASH Status
- Support available
- Availed details
- GPS Coordinates, Photos

House Hold Questionnaire
- SDE, Govt Benefits
- WASH Status, Practice
- Animals
- Health Facility Assess Usage
- Health- Disease- NTD+
- GPS Coordinates, Photos

Health Facility Questionnaire
- Health facility info
- Disease- NTD+ info registers
- GPS Coordinates, Photo registers

SHG Questionnaire
- WASH- Roles and Responsibilities
- Health- Disease- NTD+
- GPS Coordinates, Photos

better WASH, lesser NTD

channel: five point health
# NTD WASH Project - Regular

<table>
<thead>
<tr>
<th>Category</th>
<th>Score</th>
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<tbody>
<tr>
<td>SDE</td>
<td></td>
</tr>
<tr>
<td>WASH Status (IL, HL, VL, SL)</td>
<td></td>
</tr>
<tr>
<td>WASH Practice (IL, HL, VL, SL)</td>
<td></td>
</tr>
<tr>
<td>Health Access, Practice</td>
<td></td>
</tr>
<tr>
<td>Health Management</td>
<td></td>
</tr>
<tr>
<td>Village Facilities</td>
<td></td>
</tr>
<tr>
<td>Govt Benefits, Schemes</td>
<td></td>
</tr>
<tr>
<td>SHG Role</td>
<td></td>
</tr>
</tbody>
</table>

### Disease Outcomes
- (Trends – Causation by strength of Association)

### GPS Coordinates, Photos, Feature update on map
- (Person, Time, Place)

### Beyond Trends
- More precise granular/personalized/customized risk analysis at IL, HL, VL, SL for improving WASH and managing NTDs
NTD WASH Project – Study Area
NTD WASH Project - FGD
NTD WASH Project – Village Viz

- Darpada Village-Water body and OD area in close proximity
NTD WASH Project – VL – Auto Analytics

– Darpada Village-
Calculating Distance, Centroid

Legend
- Drinking Water Source with Distance
- Water Source for other purpose with Distance
- Places of Worship
- Open Defecation Area
- Tubewell
- AWC
- PHC
- Gram Panchayat
- Wells
- Ponds
- Places of Interest
- Households
- Roads
- UGME School
- Darptada
- Best Location for Water Treatment
- Central Position for Water Treatment
NTD WASH Project – IL/HL

– Base Map-Kusapande ri Village
NTD WASH Project IL/ HL

- Kusapande ri Village-House Holds with Self Help Group Members
NTD WASH Project HL – Wealth Status

Kusapanderi Village - Type of Residence

Legend
- Kacha
- Pakka
- Roads
- Schools
- Ponds
- Forest
- Farm

Channel: five point health
OD Practice - Presence?
NTD WASH Project – IL/HL

Presence Toilets Vs OD Practise

<table>
<thead>
<tr>
<th>IIHL ABSENT</th>
<th>OD YES</th>
<th>OD NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIHL ABSENT</td>
<td>34</td>
<td>3</td>
</tr>
<tr>
<td>IIHL PRESENT</td>
<td>6</td>
<td>24</td>
</tr>
</tbody>
</table>

Legend:
- OD - Yes
- OD - No
- IIHL - Absent
- IIHL - Present
- Roads
- Schools
- Ponds
- Forest
- Farm

channel: five point health
NDT WASH Project – IL/HL

House Holds- Water Stagnation Risk Profile

Legend
- Houses
- School
- Forest
- Ponds
- Farms
- Roads
NTD WASH – Village – Digital Twin
NTD WASH – Village – Digital Twin
NTD WASH – Village – Digital Twin
NTD WASH Project – Dashboard
Baseline Map for Kusapanderi, Jiripada, Padiabhanga
NTD WASH – Leprosy - Routing
NTD WASH– Leprosy- centroid
NTD WASH – Leprosy - centroid
NTD WASH Project – Optimization SC
PHC+SC Catchment Analysis – Nalgonda Dt
PHC Nalgonda Dt – Optimization & Routing
Integrated Screening And Intervention
NTD WASH Project – Content - o
Project GRAPH

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More...

Efficient Logistics

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Philosophy

– Effective Service; Efficient Logistics

– Logistics has Seven R’s: Right product, Right quantity, Right condition, Right place, Right time, Right customer, Right cost

– Worked backwards to describe what is Effective Service- Can it be- Right intervention, Right time, Right location, Right person, Right resources

– Digitization as the common denominator!
Aero Health Systems

Drones tested to deliver drugs

In a novel scheme of utilising technology in healthcare, researchers at the Indian Institute of Public Health (IIPH) in Hyderabad are testing drones (unmanned aerial vehicles) to deliver drugs.

On a pilot basis, the researchers have been testing a drone at a Primary Health Centre (PHC) at

Medicines weighed at a Primary Health Center, India
Aero Health Systems

Using Autonomous Drones and Deep Learning in a dengue surveillance system

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Abstract. The aim of this research is to acquire and analyze detailed georeferenced and geospatial information about the environmental factors pertaining to dengue outbreak within a region using various sensors mounted on a drone. The use of drones avoids the limitations of a satellite based surveillances such as frequency of data acquisition, higher operating cost, low spatial resolution of imagery, cloud contamination etc. To detect the existing and potential locations of larval infestation using the acquired aerial images, we propose using deep learning techniques for robust image classification.

Keywords: Dengue Surveillance, Drones, Deep Learning
2 DREAM

2DREAM—Digital Drone based Real time Advanced Medical Modular logistics system
2 DREAM

2DREAM—Digital Drone based Real time Advanced Medical Modular logistics system

– Medicines @ PoN
– Diagnostics Network
– Direct Vaccine @ PoN
– Blood Bank Network
– Organ Transport network

– Universal coverage
– For Universal Primary Health Care
2 DREAM - Optimization

Fig 02: District maps of Odisha, Telangana, Arunachal and Jharkhand and suggested optimized locations for 2 DREAM Logistics Hubs
<table>
<thead>
<tr>
<th>Channel: five point health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Visualizations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compound</th>
<th>Dose (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hexadecanol 1.5mg + Glycerylmonium 50mg</td>
<td>22.5 (22.5μM)</td>
</tr>
<tr>
<td>Methyl 4-17% 100mg</td>
<td>2.5 - 200mg</td>
</tr>
<tr>
<td>Lithium carbonate 300mg (Plain)</td>
<td>0.5 - 600mg</td>
</tr>
<tr>
<td>Lecithin Tablet 2mg</td>
<td>6 - 1000mg</td>
</tr>
<tr>
<td>Magnesium tablets 135 mg IP</td>
<td>300 - 1000mg</td>
</tr>
<tr>
<td>Morphine Sulphate 10mg</td>
<td>0.1 - 0.0013mg</td>
</tr>
<tr>
<td>Naproxen Sodium 250mg</td>
<td>6 - 1000mg</td>
</tr>
<tr>
<td>N. Acetylcysteine injection 500mg</td>
<td>0 - 0.5mg</td>
</tr>
<tr>
<td>Nadolol 5mg, 10mg</td>
<td>0.5 - 4mg</td>
</tr>
<tr>
<td>Ranitidine 200mg Inj.</td>
<td>0 - 40mg</td>
</tr>
<tr>
<td>Bispekter Resectabile Tissue Patching</td>
<td>0 - 100mg</td>
</tr>
<tr>
<td>Breflaxin 10mg 450mg Tablets</td>
<td>0 - 100mg</td>
</tr>
<tr>
<td>Butazolidine 18mg per 75 mg</td>
<td>0.06 - 120mg</td>
</tr>
<tr>
<td>Dexamethasone Injection 1%</td>
<td>0 - 1mg</td>
</tr>
<tr>
<td>Valganciclovir 450mg</td>
<td>0 - 50mg</td>
</tr>
<tr>
<td>Diltiazem</td>
<td>0 - 20mg</td>
</tr>
<tr>
<td>Acetaminophen Oint 1% w/w</td>
<td>0 - 15mg</td>
</tr>
<tr>
<td>Budenoside Respirator solution</td>
<td>0 - 1mg</td>
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<tr>
<td>Bevacizumab Inhale 200mg</td>
<td>0 - 0.5mg</td>
</tr>
<tr>
<td>Calcium (Soluble) 50mg Capsule</td>
<td>0 - 0.5mg</td>
</tr>
<tr>
<td>Lamotrigine 25mg tab.</td>
<td>0 - 25mg</td>
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<tr>
<td>Sirolimus 25mg Tab.</td>
<td>0 - 25mg</td>
</tr>
<tr>
<td>Cilostazol 50mg Tab.</td>
<td>0 - 50mg</td>
</tr>
<tr>
<td>Diethyl Ether Injection</td>
<td>0 - 20mg</td>
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<tr>
<td>Hydroxy Progesterone Caproate</td>
<td>0 - 20mg</td>
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<tr>
<td>Bleomycin and Adenosine Injection 2%</td>
<td>0 - 20mg</td>
</tr>
<tr>
<td>Melatonin Nasal Spray</td>
<td>0 - 10mg</td>
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<tr>
<td>Meprobamate 2.5mg Tab</td>
<td>0 - 10mg</td>
</tr>
<tr>
<td>Zinc Sulphate 20mg IP Dispersible Tablet</td>
<td>0 - 20mg</td>
</tr>
<tr>
<td>Dexamethasone 4mg Tablet</td>
<td>0 - 4mg</td>
</tr>
<tr>
<td>Ceftriaxone for Injection 250mg</td>
<td>0 - 250mg</td>
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<tr>
<td>Chlorothiazide 50mg (Generic)</td>
<td>0 - 50mg</td>
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<tr>
<td>Furosemide tab. 160mg</td>
<td>0 - 160mg</td>
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<tr>
<td>Norepinephrine 2mg cap.</td>
<td>0 - 2mg</td>
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<tr>
<td>Human Placenta Immunoglobulin Injection 2500IU</td>
<td>0 - 2500IU</td>
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<tr>
<td>Meclozine HC1 Tablets 25mg</td>
<td>0 - 250mg</td>
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<tr>
<td>Feclodim 120mg</td>
<td>0 - 120mg</td>
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<tr>
<td>Ivermectin 500mg</td>
<td>0 - 500mg</td>
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<td>Propranolol Injection 325mg</td>
<td>0 - 325mg</td>
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<tr>
<td>Captopril 250mg Tablet</td>
<td>0 - 250mg</td>
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<tr>
<td>Mephenoxol injection 100mg</td>
<td>0 - 100mg</td>
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<td>Glycopyrrolate 0.5 mg, Neostigmine methyl</td>
<td>0 - 50mg</td>
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<td>Nebivolol 5mg Tablets</td>
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<td>Atorvastatin Injection 2mg/ml</td>
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<td>Oxycodone Chloride Tablets 2.5mg</td>
<td>0 - 2.5mg</td>
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<tr>
<td>Thriatrin tab. 20mg</td>
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<td>Sulphur Valporate Oral Solution 20mg/ml</td>
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<tr>
<td>buprenorphine 30mcg/ml IP Injection (diss. in 5mg</td>
<td>0 - 30mcg/ml</td>
</tr>
<tr>
<td>Vincristine</td>
<td>0 - 10mg</td>
</tr>
<tr>
<td>White Petrolatum 250g</td>
<td>0 - 250g</td>
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<tr>
<td>Carbamic acid 400mg (Phenoxy)</td>
<td>0 - 400mg</td>
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<tr>
<td>Nifedipine Tablets 10mg IP</td>
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<tr>
<td>Nifedipine 5mg IP</td>
<td>0 - 5mg</td>
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<tr>
<td>Methylparaben for Injection 50 mg IP</td>
<td>0 - 50mg</td>
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<tr>
<td>Antimicrobial Injection 80mg/ml</td>
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<tr>
<td>Betamethasone Dispersible Inhalation IP (P21)</td>
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<td>Gefitinib 50mg Tablet</td>
<td>0 - 50mg</td>
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<td>Flecainide 500mg Tablet</td>
<td>0 - 500mg</td>
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<tr>
<td>Ethanol solution 10% edematous (hand Rub)</td>
<td>0 - 10%</td>
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<tr>
<td>Dichloromethane Monoterpine 20mg Tablet</td>
<td>0 - 20mg</td>
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<tr>
<td>Methadone 1mg Tab</td>
<td>0 - 1mg</td>
</tr>
<tr>
<td>Thiopropyl Inlay (MRI)</td>
<td>0 - 1mg</td>
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<tr>
<td>System, as Aromatase-inhibiting IUD</td>
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<tr>
<td>5,6-Dichloro-pyridin-3-yl</td>
<td>0 - 5,6-Dichloro-pyridin-3-yl</td>
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</tbody>
</table>
UHC - OP Index
Data Collection
Data Collection
2 DREAM – UHC + Cost

– Effective Service; Efficient Logistics

Fig 14a: Model 3: Proposed 2 DREAM—BBN Hub and Spoke Asset and Service Optimized System

Fig 14b: Model 1: Present Asset and Service Un Organized and Un Optimized System providing grossly insufficient coverage

Fig 14c: Model 2: Scaled Up Service Optimized and Asset Heavy System
2 DREAM – 3D models

2DREAM – Digital Drone based Real time Advanced Medical Modular Logistics System for Blood Banks, Vaccines, Diagnostics, Medicines, Organ Transport. USP – Top Loading VTOL Drone, 50-75 Kg Payload, 200-300 Km Range, Modular Carrier Boxes, Temperature controlled digitally enabled, powered, secured carrier boxes – with several patentable design concepts.
2 DREAM – 3D models
2 DREAM – UHC
2 DREAM – UHC
2 DREAM – UHC
Tracking Climate Change - Skymet
Tracking Climate Change - Ambient
Tracking Climate Change – Clima Cell
Climate Change and Health Risks

- Climate change is accelerating
- Health risks are enormous
- Infrastructure is critical in mitigating and managing risks
- Micro level infra interventions necessary in real time
- Micro level data and analytics necessary in real time
- Collaboration necessary
Thank You