

13 November 2012

Knowledge Integration in Climate and Health

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IAI-NCAR Colloquium C2012

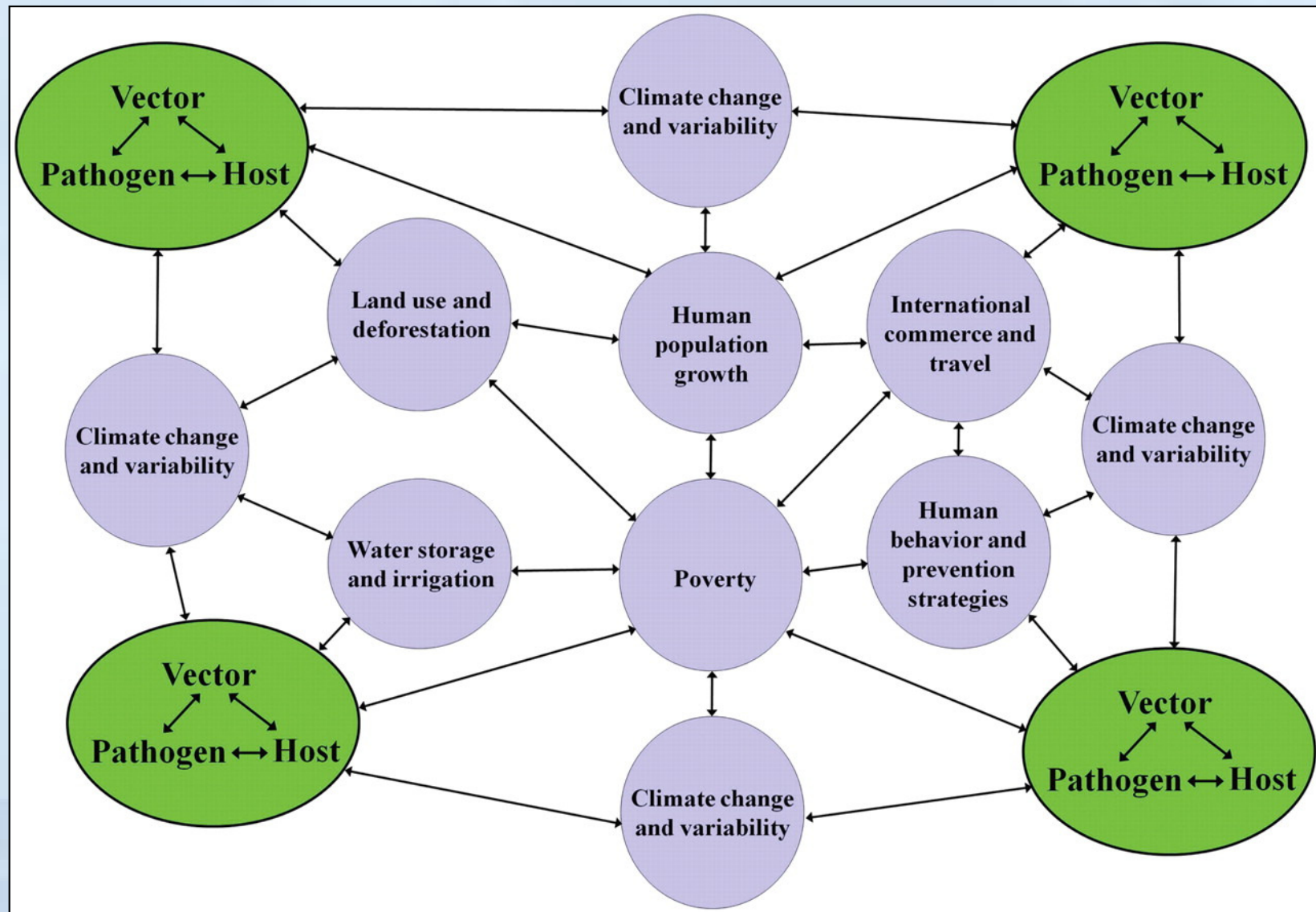
Knowledge Integration at the Science-Policy Interface

13 November, 2012

NCAR



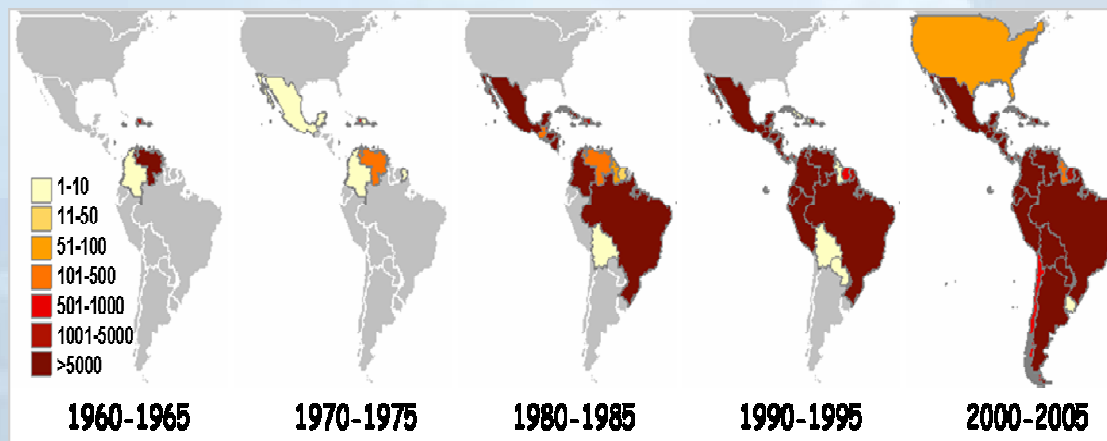
Vector-borne Disease Systems



VBDs are extremely complex!

Dengue Fever

- Dengue Fever and Dengue Hemorrhagic Fever are caused by dengue viruses transmitted by *Aedes* mosquitoes
- Annually, 100 million people contract dengue worldwide
 - 500,000 people develop severe dengue hemorrhagic fever every year
 - No approved vaccine available
 - Increasing number and severity of cases in the Americas...



Source: WHO DengueNet

Estimated Distribution of Dengue in Mexico, Present Day



Regions of ongoing dengue transmission in Mexico and surrounding countries (shaded). Red markers indicate reports of local and regional dengue transmission during the first 3 months of 2011. (Source: DengueMap – a CDC-HealthMap collaboration)

Aedes aegypti and Temperature

Immature Development

- Thermally constrained (as well as by water/organic load); the higher the temperature, the quicker the immatures develop into adults

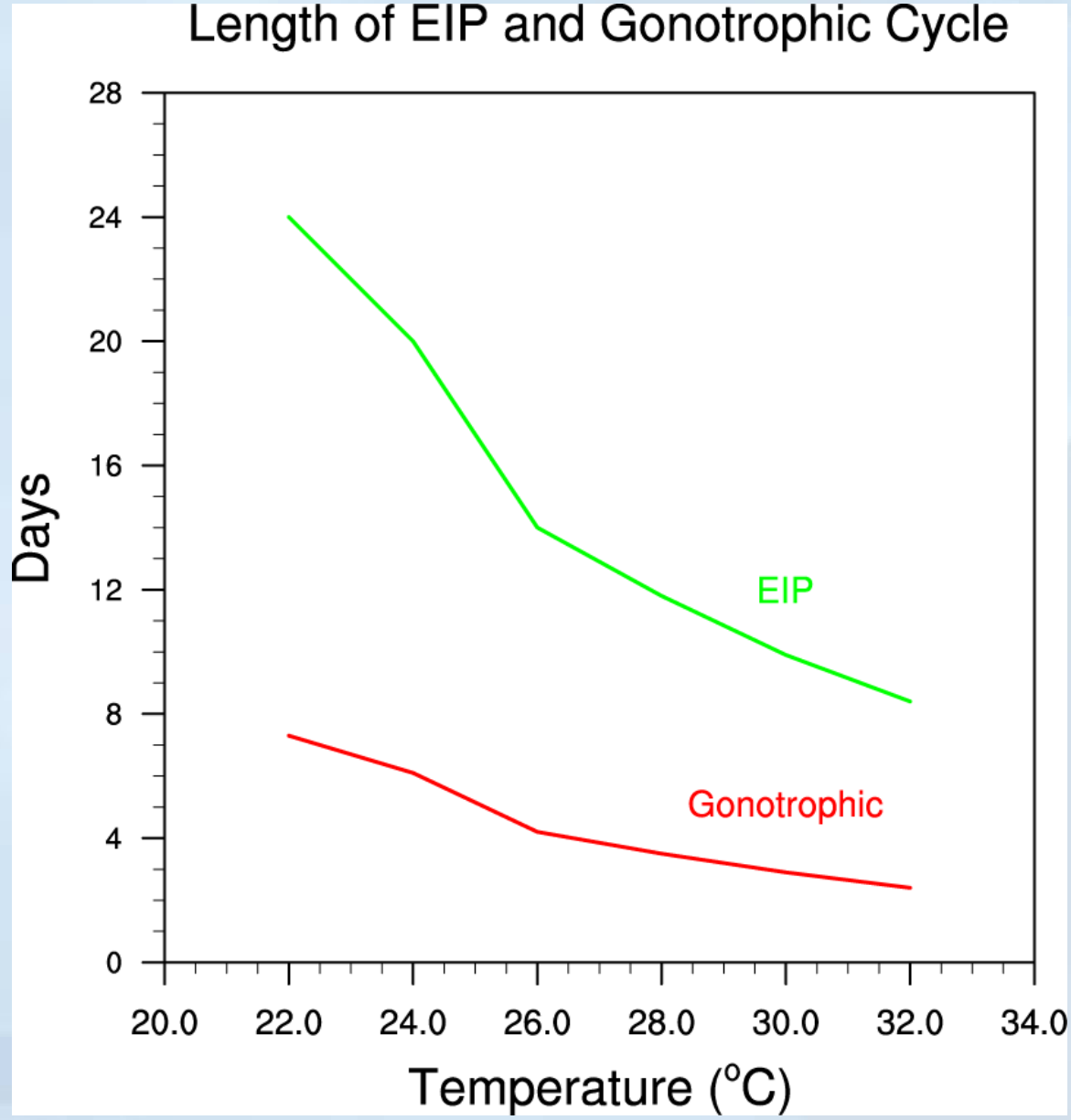
Extrinsic Incubation Period

- Time needed for a newly infected female mosquito to become infectious
- Temperature dependent
- However, probability of transmitting virus also varies with how often the female bites – a function of length of gonotrophic cycle

Gonotrophic Cycle

- Time between ingesting a blood meal and oviposition; temperature dependent

Length of EIP and Gonotrophic Cycle vs. Temperature

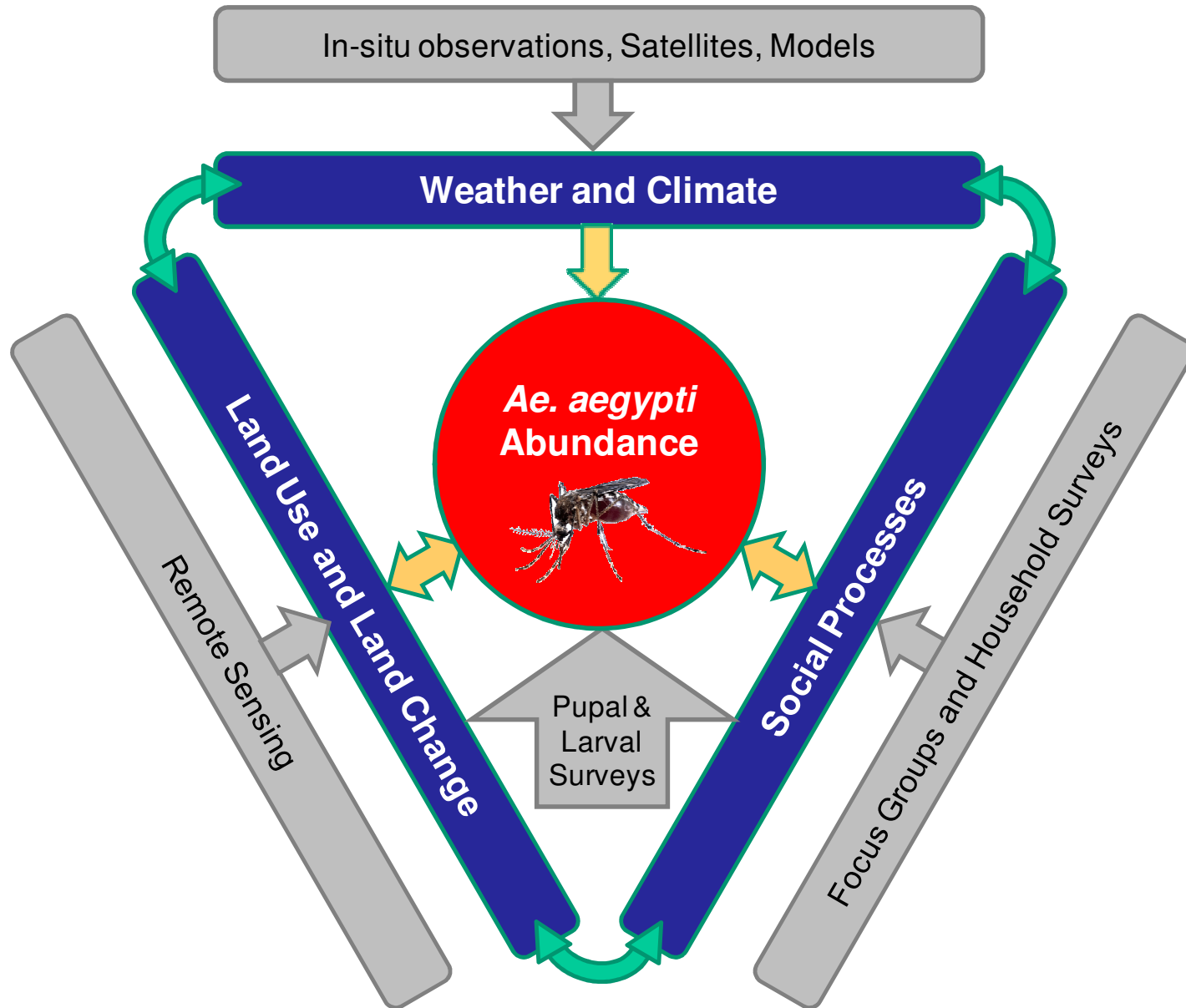


Aedes aegypti and Precipitation

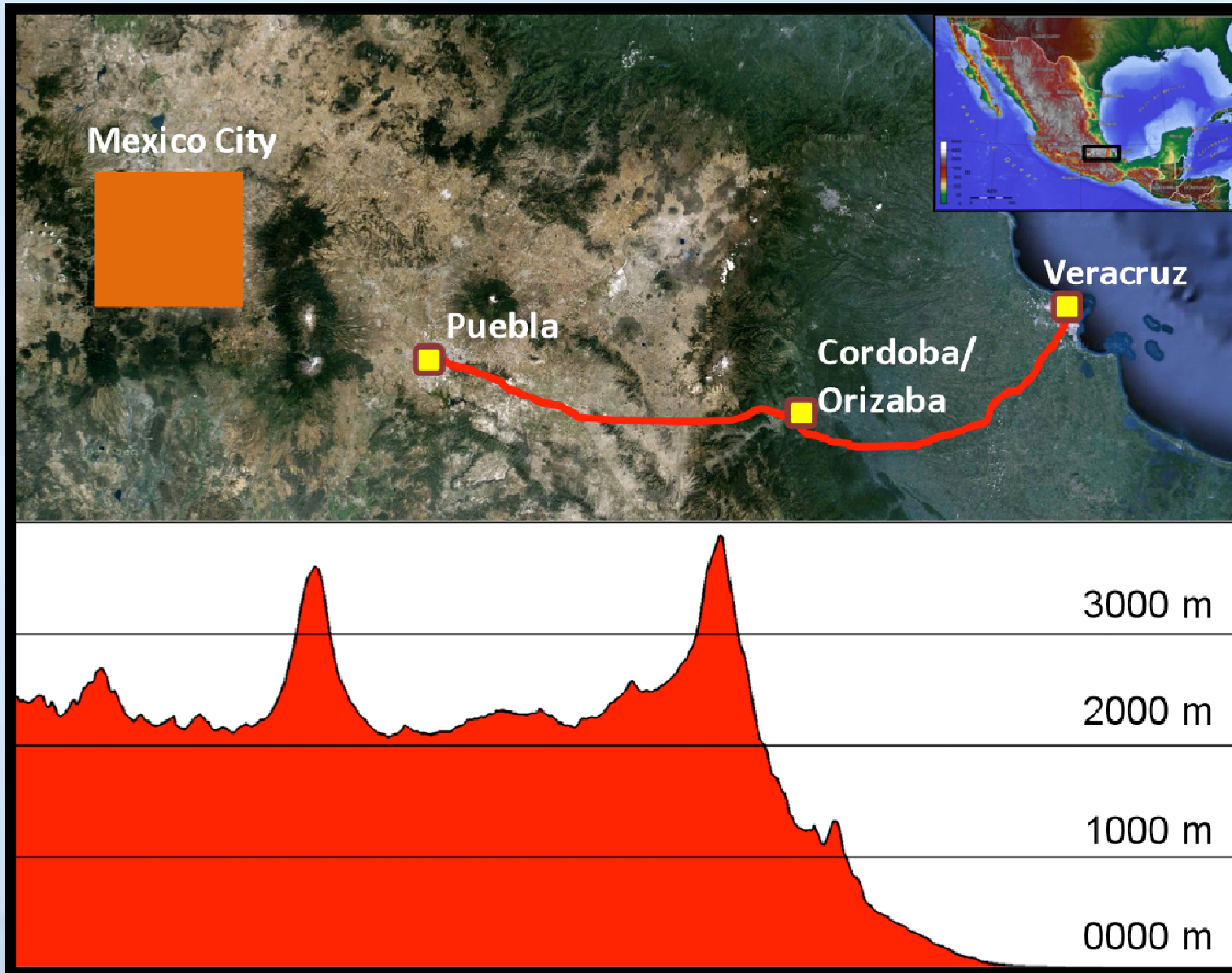
- Oviposits in artificial containers
- Containers can be rain-filled (tires; discarded items) or filled manually (potted plant bases; buckets; 55 gallon drums)
- Manually filled containers provide oviposition sites even in times of drought
- Even with 'reliable' piped water, people store water



Framework for *Aedes aegypti* Study



Main Transect in Study Region

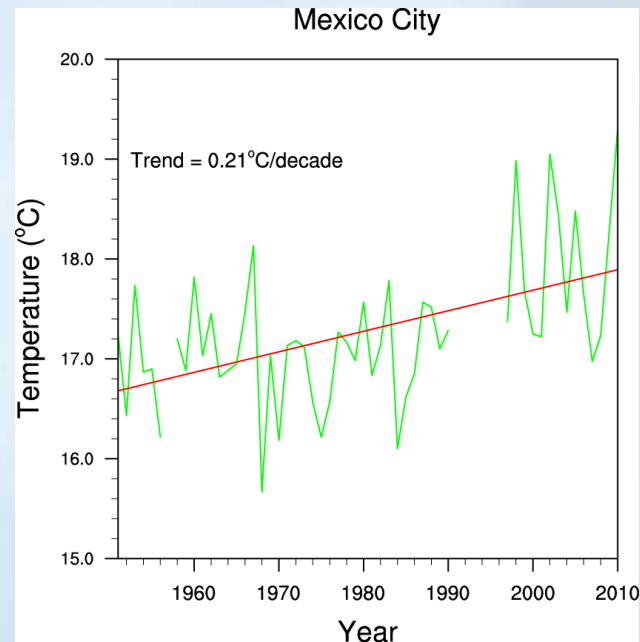
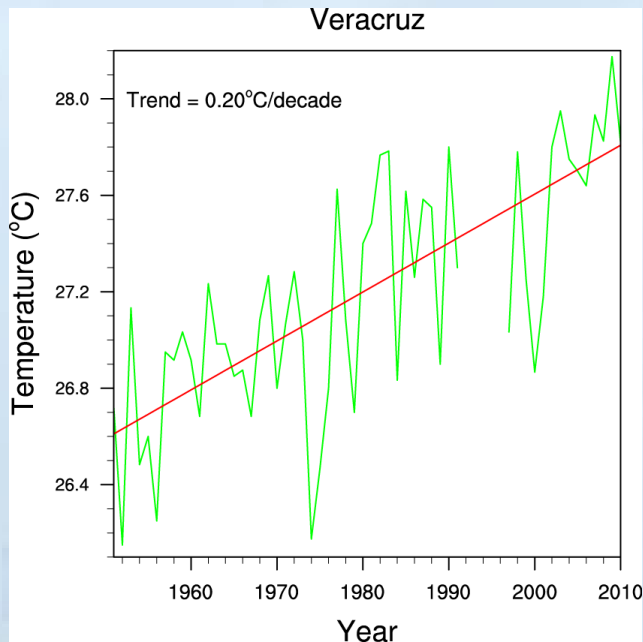
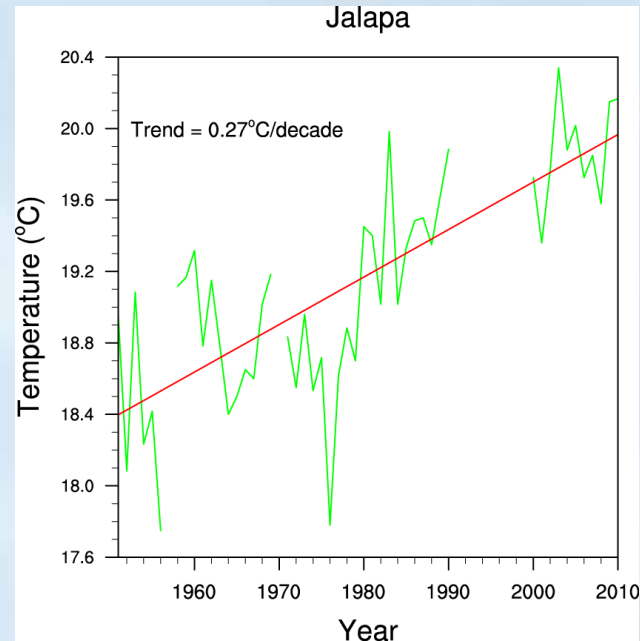
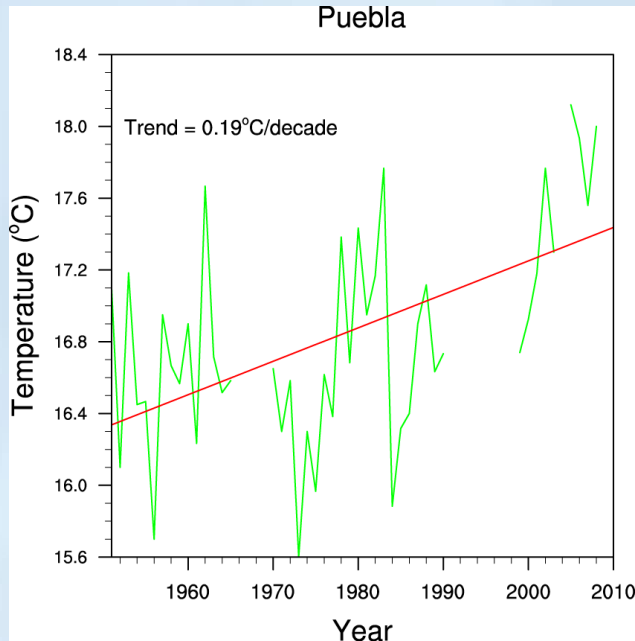


Research Activities – Summer 2011, 2012

- Collect weather and climate data (*in situ* observations; satellites)
- Collect data on mosquito presence/abundance (larval and pupal surveys; oviposition traps along gradient – 2011)
- Collect pupae and adults in areas at the margins of transmission - 2012
- Conduct focus groups and household surveys



Temperature Trends from 1951 - 2000



Wet season (May-October) temperature (°C) trend over 1951-2010 period.
Source: NASA GISS

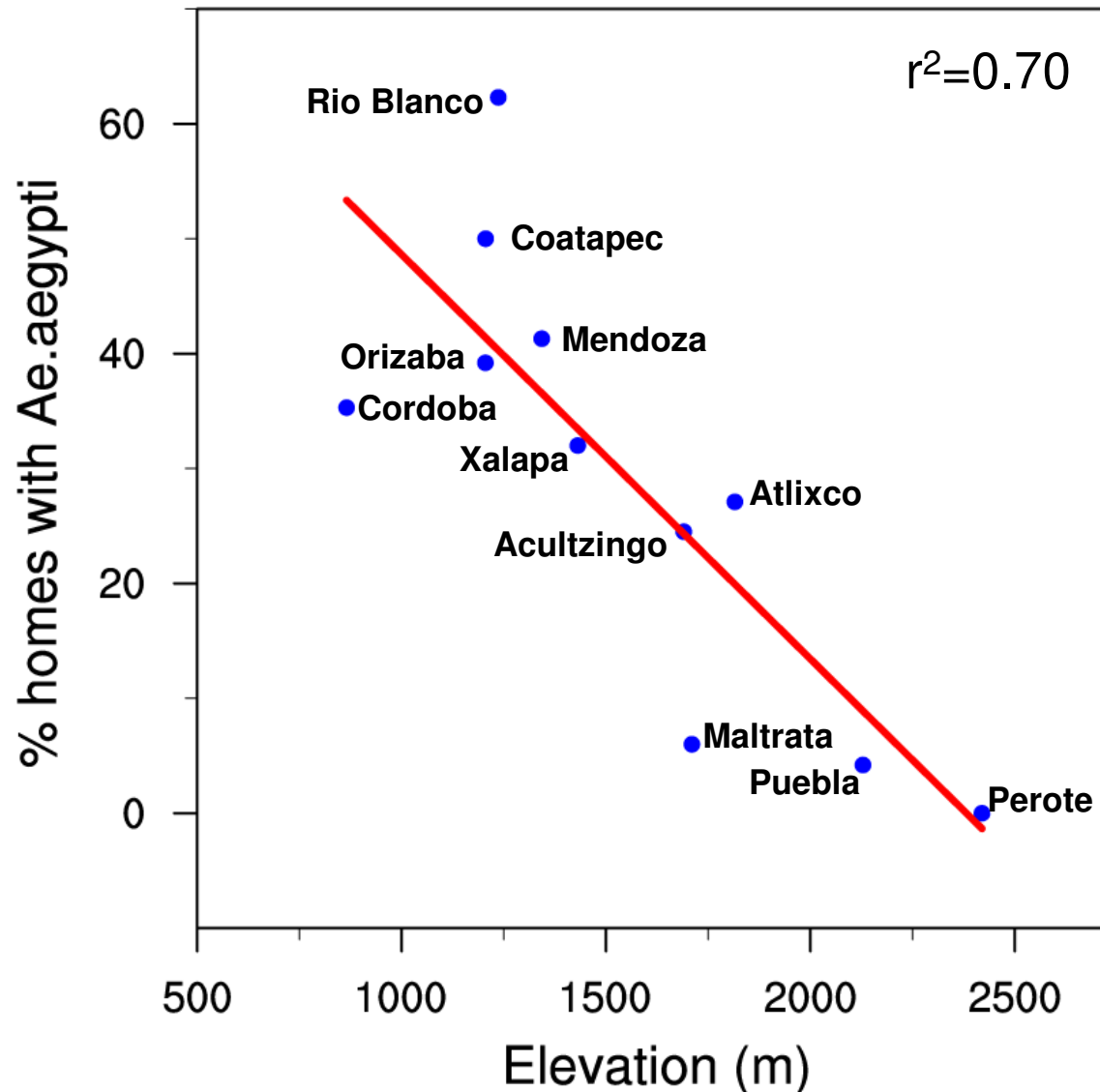
Climate Data Collection

- Install 1-2 HOBO™ temperature/humidity sensors in each community.
- Collect satellite-based rainfall data (CMORPH, TRMM)
- Supplement data with long-term records from available Mexican weather stations



Results from 2011

Estimated % of homes with *Ae.aegypti* vs. Median elevation



**Based on sample of ~50 homes per community*

Focus Groups – Summer 2011

Household Surveys – 2011, 2012

- Sixteen FGs conducted in 4 communities along the transect
- Household surveys in 600 households each year
- Information from FGDs used in development of household survey
 - Water storage practices
 - Human-mosquito interactions/barriers such as screens
 - Cultural practices
 - Perception of dengue risk in community



Plague in Northwest Uganda

Plague in Northwest Uganda

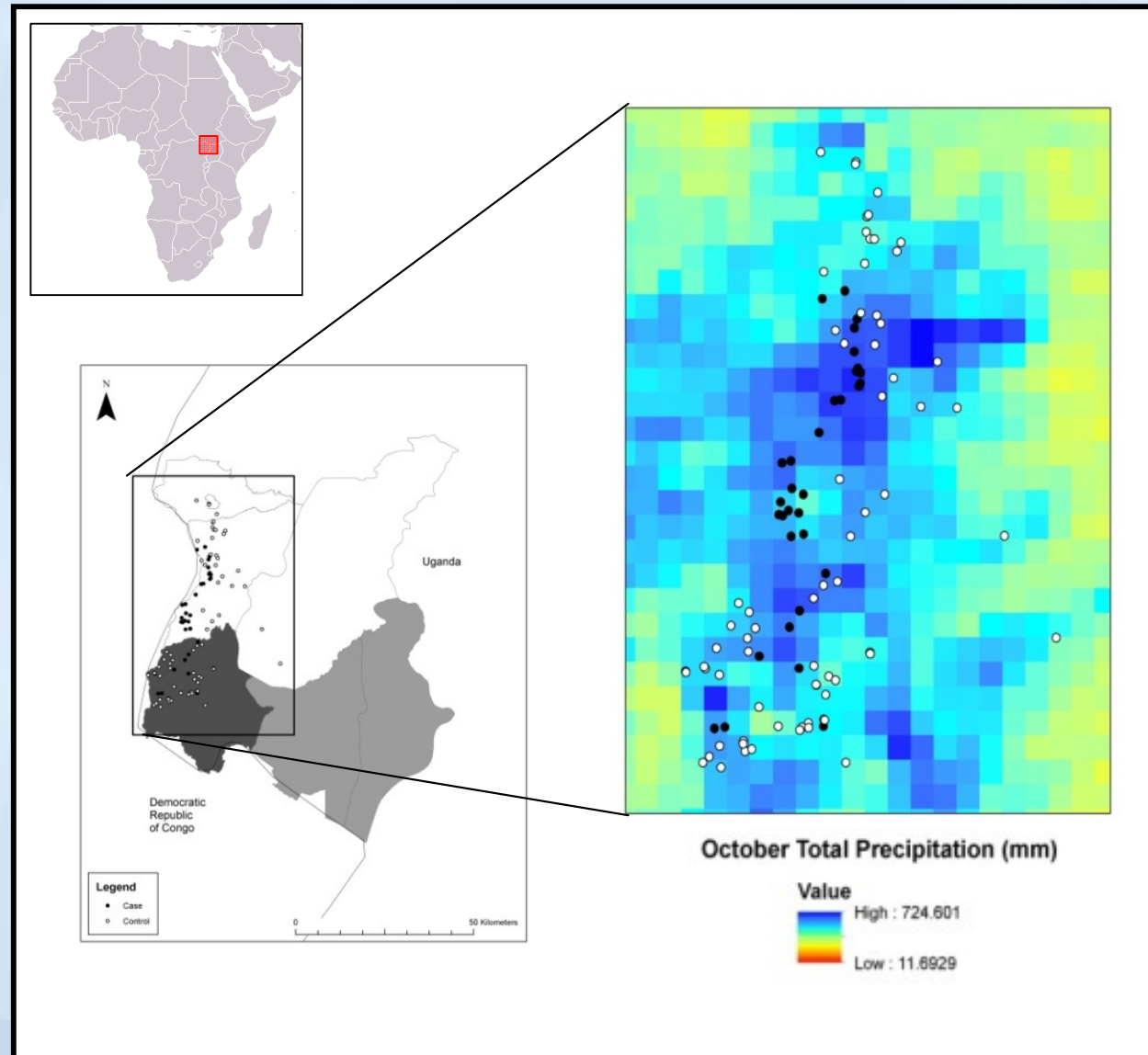
West Nile
region



- Plague is a highly virulent and flea-borne disease caused by *Yersinia pestis*.
- Infected fleas travel on rats that intermittently come into contact with humans
- Local rat and flea populations fluctuate in response to weather and climate variability



Observed Plague Cases in Uganda



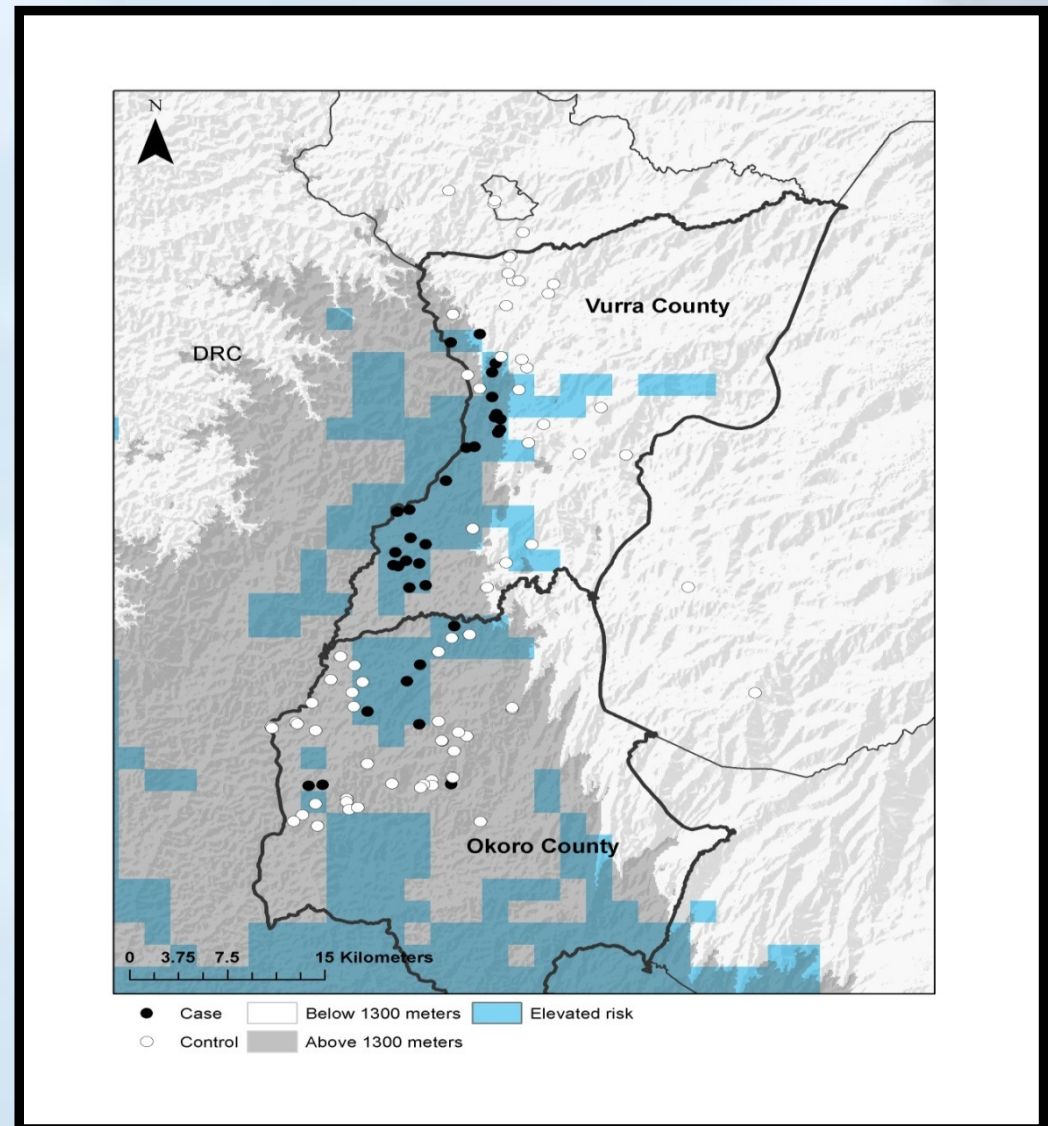
Cases are associated with wetter, cooler regions

Modeled Spatial Plague Risk, Uganda

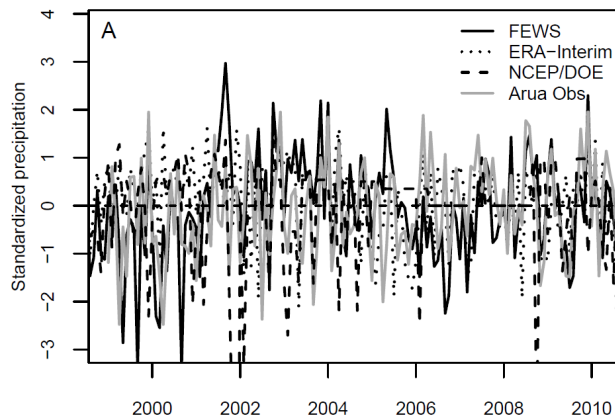
Case and control locations were discriminated based on the following climatic variables (10 yr averages).

- Total precipitation at tails of rainy season (+)
- Total precipitation during annual dry spell (-)
- Above 1300 m (+)

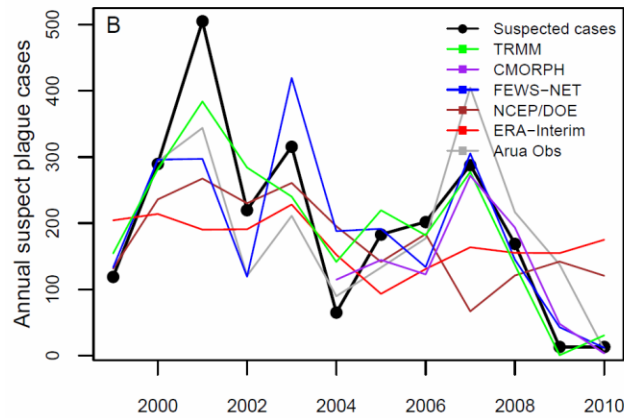
Model Accuracy = 94%



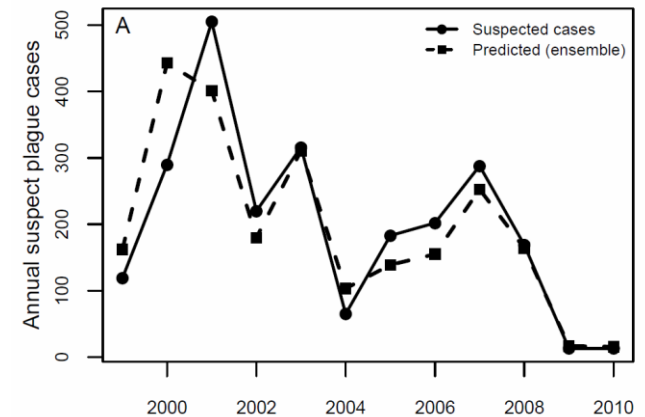
Modeled Temporal Plague Risk, Uganda



Monthly Rainfall



Modeled Annual Risk (per rainfall dataset)



Modeled Annual Risk (ensemble)

Meteorological data are highly uncertain in many regions of greatest risk.

Ensemble modeling techniques may help.

Training Traditional Healers



Plague is a deadly disease!

Sick with plague?

Hurry to the health centre!

Early treatment saves lives!

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention

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Motivation

- **Why interest in traditional medicine and plague?**
- **Estimated that 40-60% of Uganda's population uses TM (WHO, 2002)**
- **Public health concerns**
 - Delays in care seeking may contribute to mortality
 - Gap in surveillance—Occupational risk for healers
- **Potential public health benefits**
 - Improved patient outcomes
 - Facilitate collaboration, improve referral and patient outcomes (beyond plague, too)
 - Improve understanding of plague epidemiology



Descriptive and Practice Characteristics

- Eleven healers interviewed
 - 4 in Nebbi district (one woman)
 - 7 in Arua district (all men)
- Age ranged 30s thru 70+
- Interviews conducted in local languages, with translation assistance



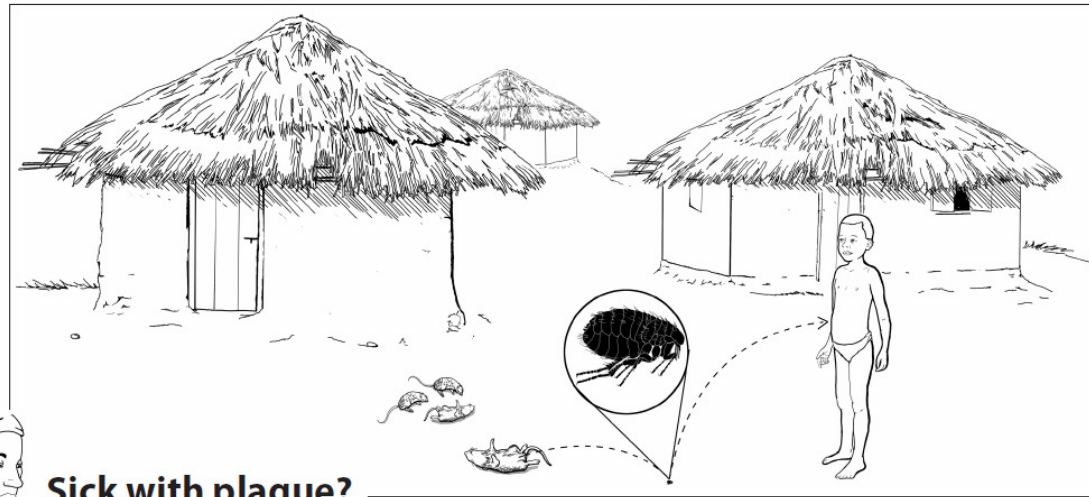
Type of Practice

- **Marked variation in practice**
 - Use of local herbs prominent in Arua sample
 - Spiritual description of practice (e.g. from ancestors) more prominent in more remote areas
- **Specialties**
 - Chronic vs. acute conditions
 - Bone setting, snake bites, poisoning, gonorrhoea, malaria



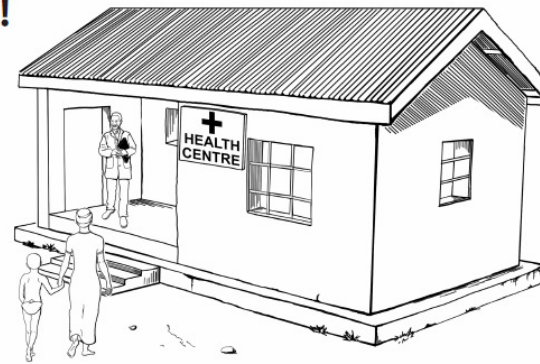
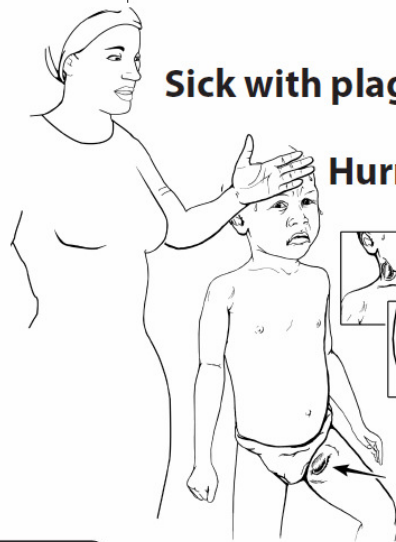
Low literacy educational materials (developed with A. Eckert, CDC Communication Services), distributed in local languages

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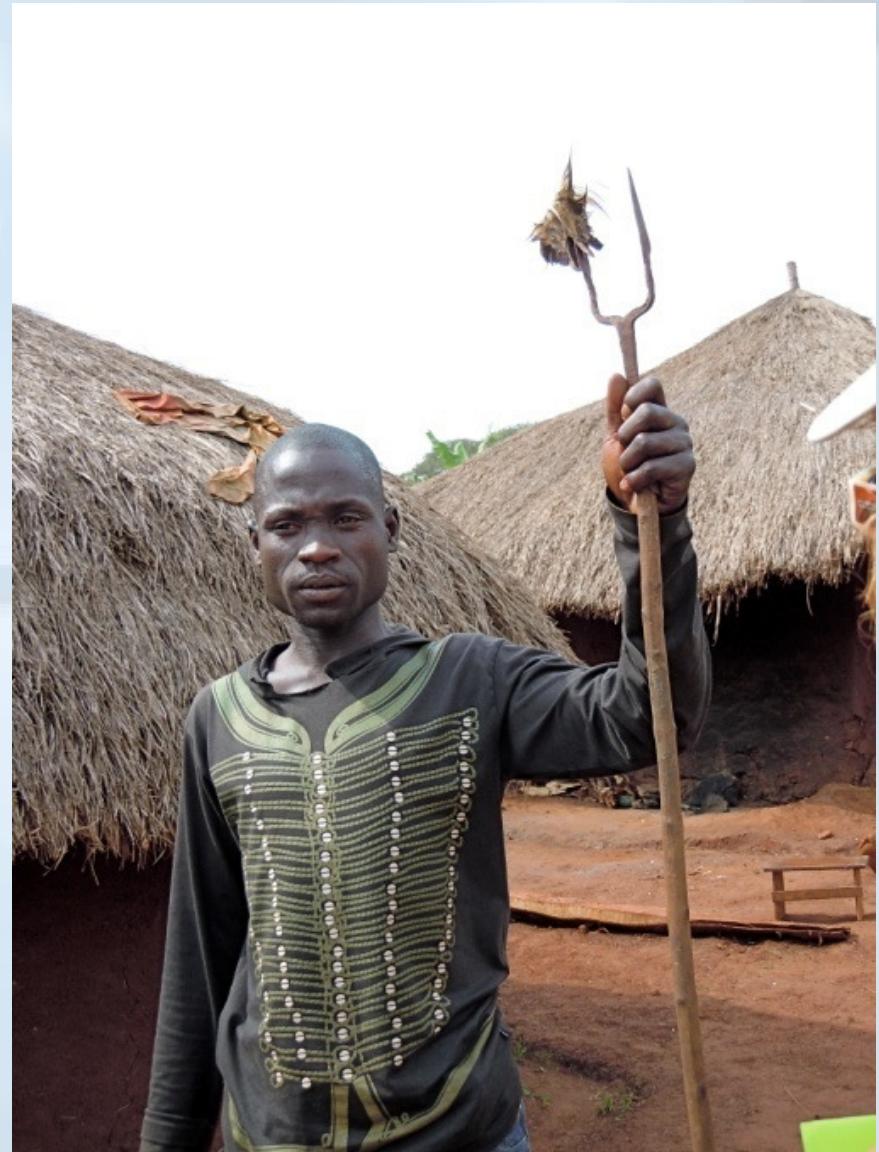
Early treatment saves lives!



U.S. Department of
Health and Human Services
Centers for Disease
Control and Prevention

Development of Traditional Healer Referral Network: September 2010

- **Pilot implemented with 10 healers near Logiri and Zeu sub-counties**
- **Training conducted through individual visits**
 - Discussed plague symptoms and risk
 - Introduced healers to local clinic and project staff
- **Provided:**
 - referral cards
 - bicycle
 - cell phone programmed with minutes and clinic contacts (chargers are available in villages)
 - certificate of training



Expansion of Pilot

- **In early March 2012, Traditional Healer Referral Network was expanded to 34 additional healers (44 total)**
 - Each of the pilot healers sent 1-10 contacts from their region
 - New network members received training workshop, referral lanyards and training certificate
 - Will share use of existing phones and bicycles, and work with Village Health Team to implement referrals

Thank you!

