Early Warning Systems:

Adaptation, Early Warning, and

Public Health

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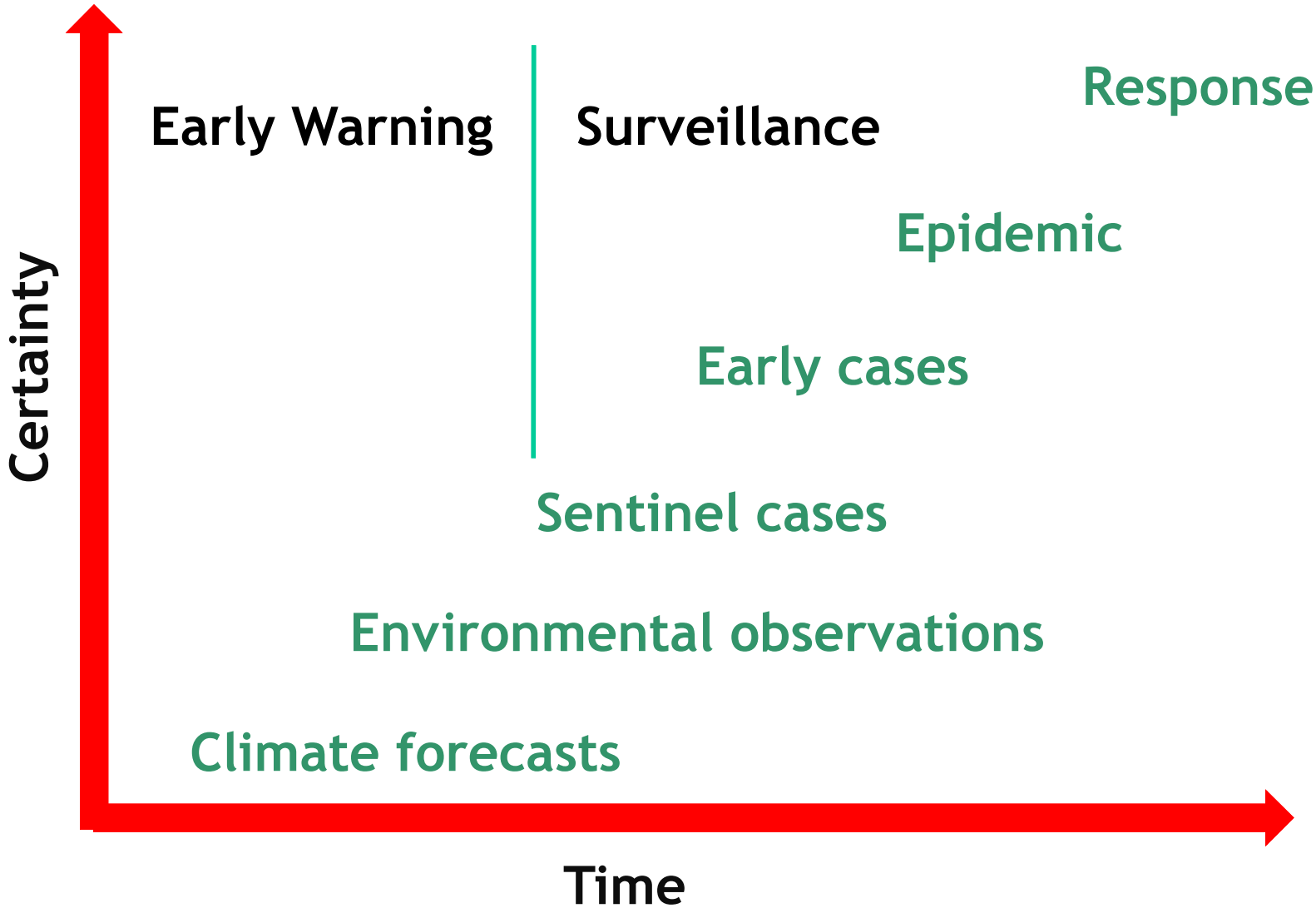
Background

- Improved weather forecasting offers the opportunity to develop **early warning systems** for **weather-based** events
- Use of early warning systems can save lives (e.g., hurricanes, floods, drought, famine)
- Many forecasting models for infectious and chronic conditions are now based on temperature and precipitation

Surveillance vs. Early Warning

- **Surveillance systems** are intended to detect disease outbreaks and measure and summarize data on such outbreaks as they occur
- **Early warning systems** are designed to alert the population and relevant authorities in advance about possible adverse conditions that could lead to a disease outbreak and to implement effective measures to reduce adverse health outcomes

Surveillance vs. Early Warning



WHO 2009

Lessons Learned from Famine Early Warning Systems

- **Climate is only one of many determinants that could be included in an early warning system**

- **Early warning of a crisis is no guarantee of prevention**

Lessons Learned from Famine Early Warning Systems

- **Interest in preventing a crisis is part of a wider political, economic, and social agenda. Governments may not be directly accountable to vulnerable populations**

- **In most cases, the purpose of early warning is undermined as relief arrives too late due to poor organization at the donor and/or national level**

Early Warning Systems

- **The system should be developed with all relevant stakeholders to ensure that the issues of greatest concern are identified and addressed**

- **A basic requirement is that the community or region has sufficient public health and social infrastructure to undertake its design and implementation**

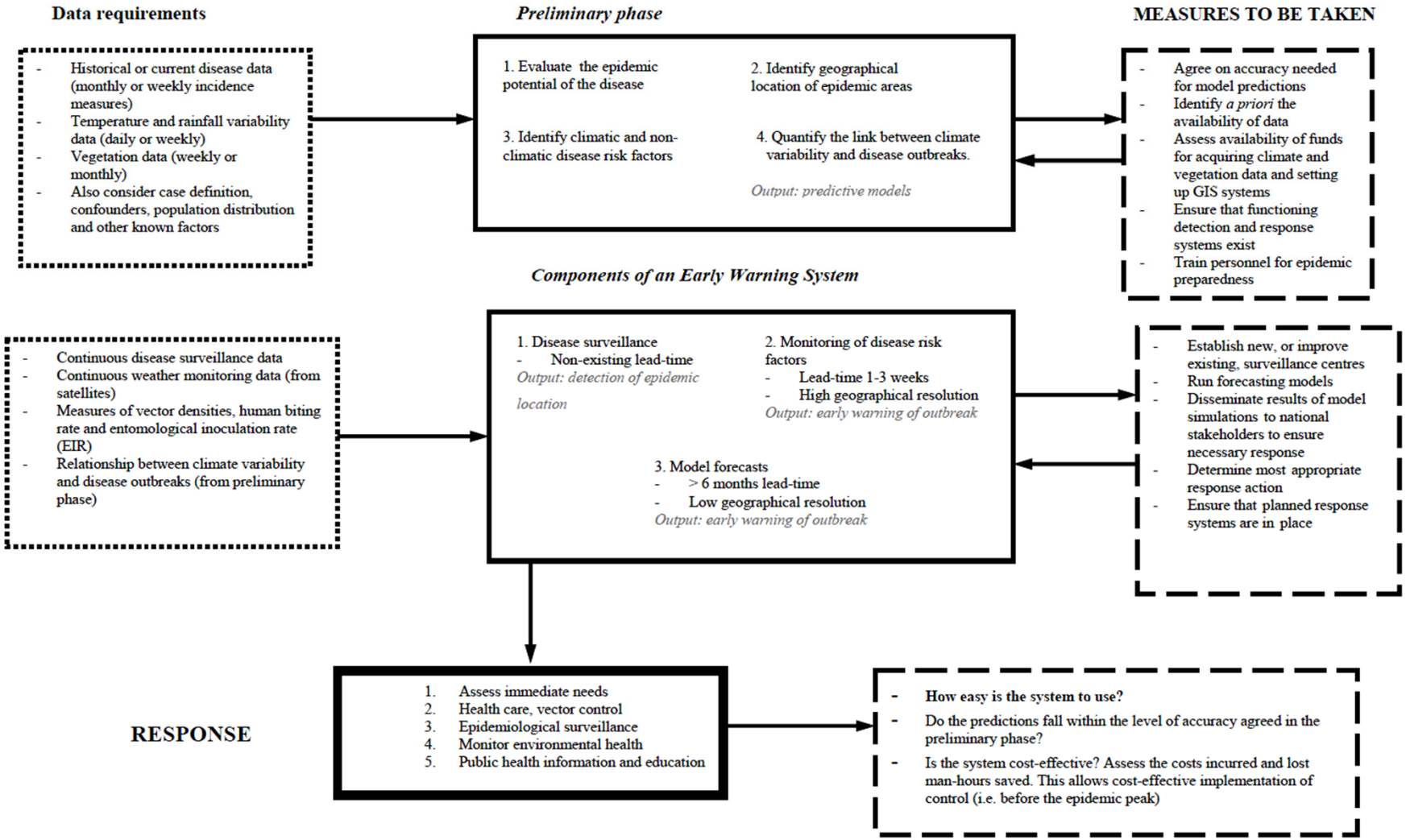
Early Warning Systems

- **The principal components of an early warning system include**
  - **Identification and forecasting of weather conditions**
  - **Prediction of possible health outcomes**
  - **An effective and timely response plan**
  - **Ongoing evaluation of the system and its components**
  - **Sentinel sites, i.e. monitor seroconversion in pigs to forecast possible Japanese encephalitis outbreak in human population**

Effective Early Warning Systems

- Provide warning in sufficient time for action
- Are affordable
  - Require minimal skill and training to operate and maintain
- Give minimal false positive or negative responses
- Are robust, reproducible, and verifiable
- Can be easily modified to address a changing climate

Components of an Early Warning System for Infectious Diseases



WHO 2004

Identification and Forecasting

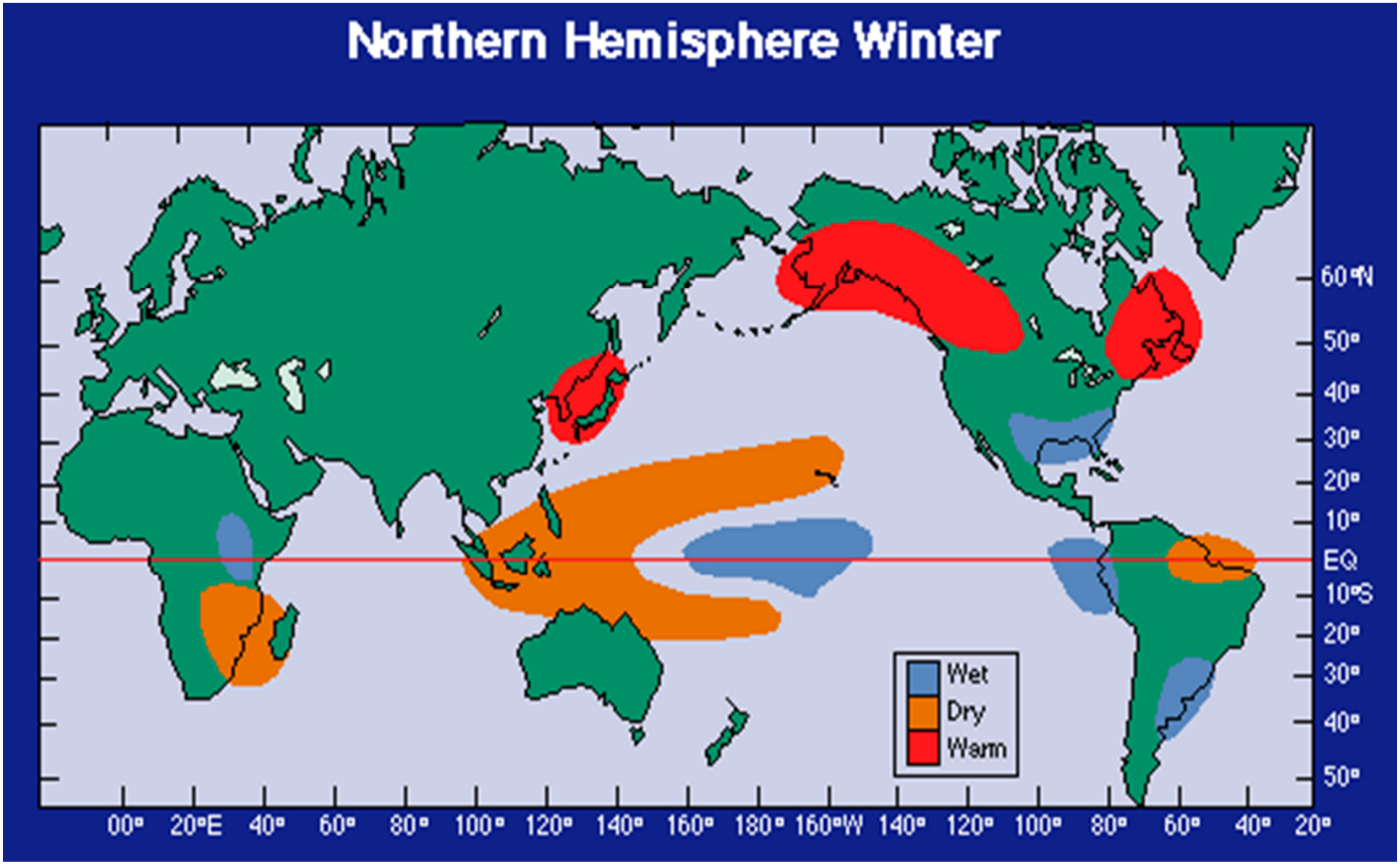
- **Multiple disciplines are required to develop accurate, effective, and efficient population- and location-specific early warning systems**

- **Biometeorology contributes to the development of models that incorporate associations between weather and health outcomes to predict possible health burdens associated with changing weather patterns**

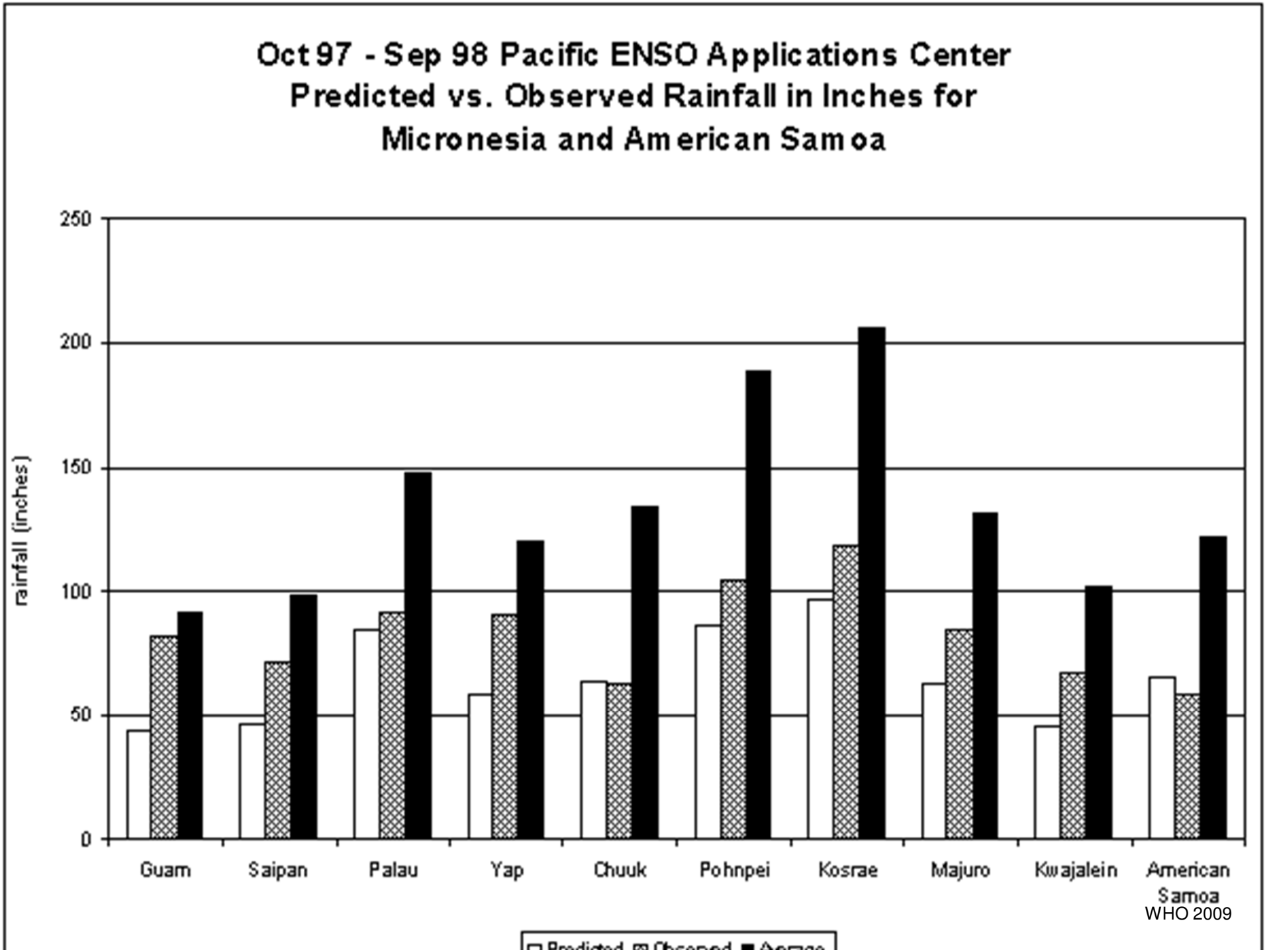
Development and Utilization of Climate Information

- **Data**
  - Spatial and temporal coverage of critical weather variables
- **Methods**
  - Simple correlation; trend analysis; etc.
- **Acceptability / credibility**
  - Timely; relevant; compatible with existing decision-making protocols; accessible
- **Context**
  - Early warning systems are not contingent on climate information alone

El Niño



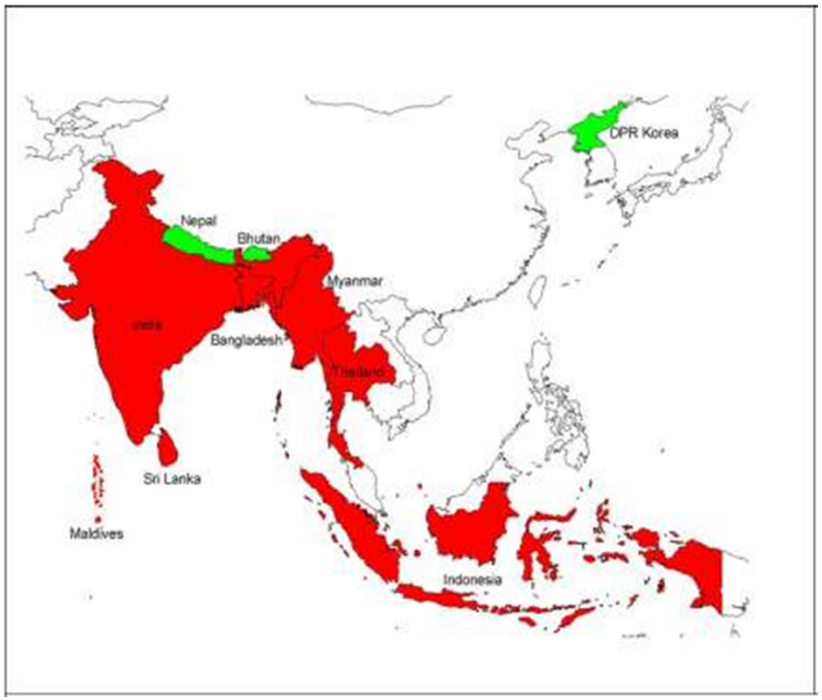
WHO 2009

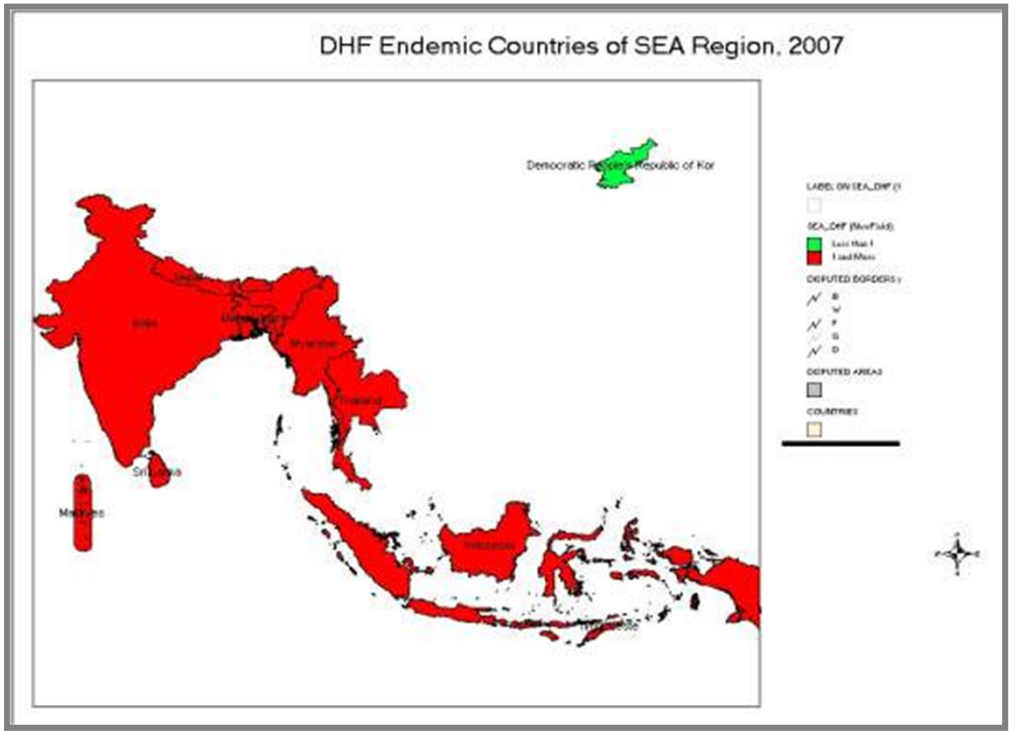

Oct 97 - Sep 98 Pacific ENSO Applications Center
Predicted vs. Observed Rainfall in Inches for
Micronesia and American Samoa
rainfall (inches)
250
200
150
100
50
0
Guam
Saipan
Palau
Yap
Chuuk
Pohnpei
Kosrae
Majuro
Kwajalein
American Samoa

WHO 2009

Geographical Spread of Dengue Fever in SEA Region

Countries in SEA Region reporting Dengue in 2003 and in 2007





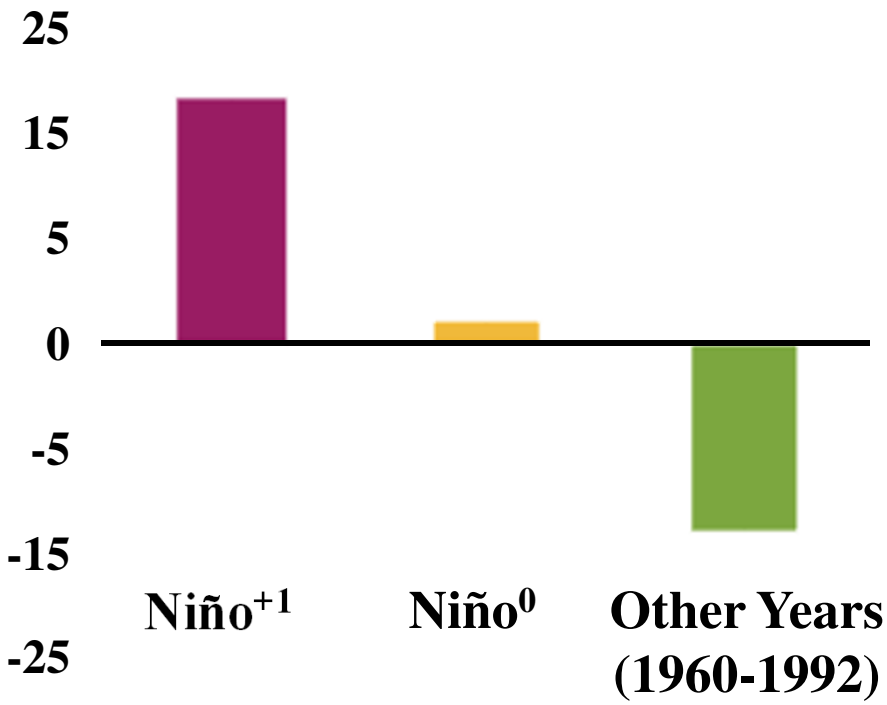
WHO 2009

Prediction of Possible Health Outcomes

- Evaluate potential for epidemic transmission
- Identify epidemic-prone areas and populations at risk to allow rapid
  - Prediction and detection
  - Targeting of response
  - Planning of logistics for response
- Quantify climatic and non-climatic disease risk factors
- Quantify the link between climate variability and disease outbreaks
  - Construct predictive models

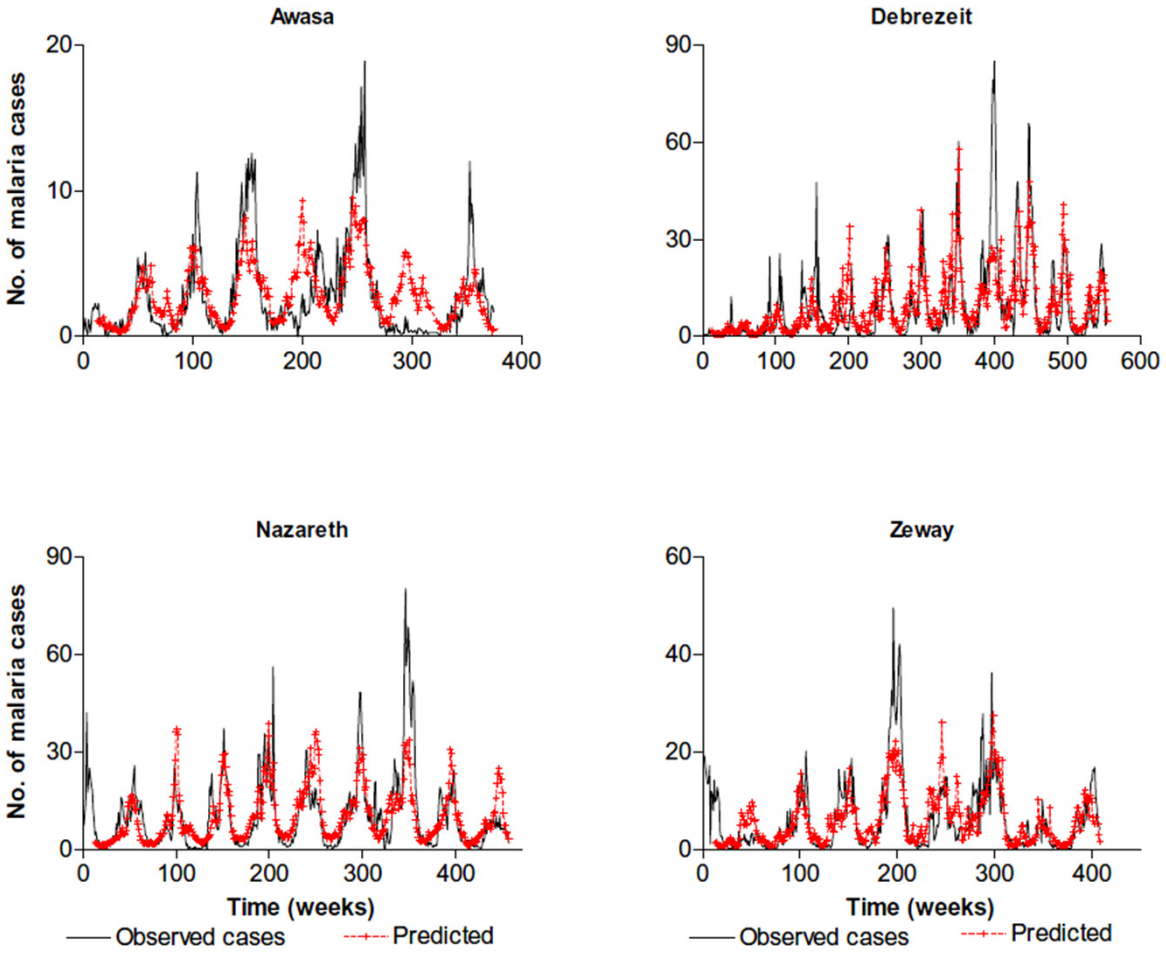
Average Percentage Deviation in Malaria Cases, Colombia

Deviation From Trend in Malaria Cases (%)



Bouma et al., 1997

Using Local Weather Data to Predict Epidemics



Incidence of malaria in highland sites in Ethiopia (black line). Incidence predicted from a model using local meteorological data (red line).

Teklehaimanot et al., 2004

Using Local Weather Data to Predict Epidemics

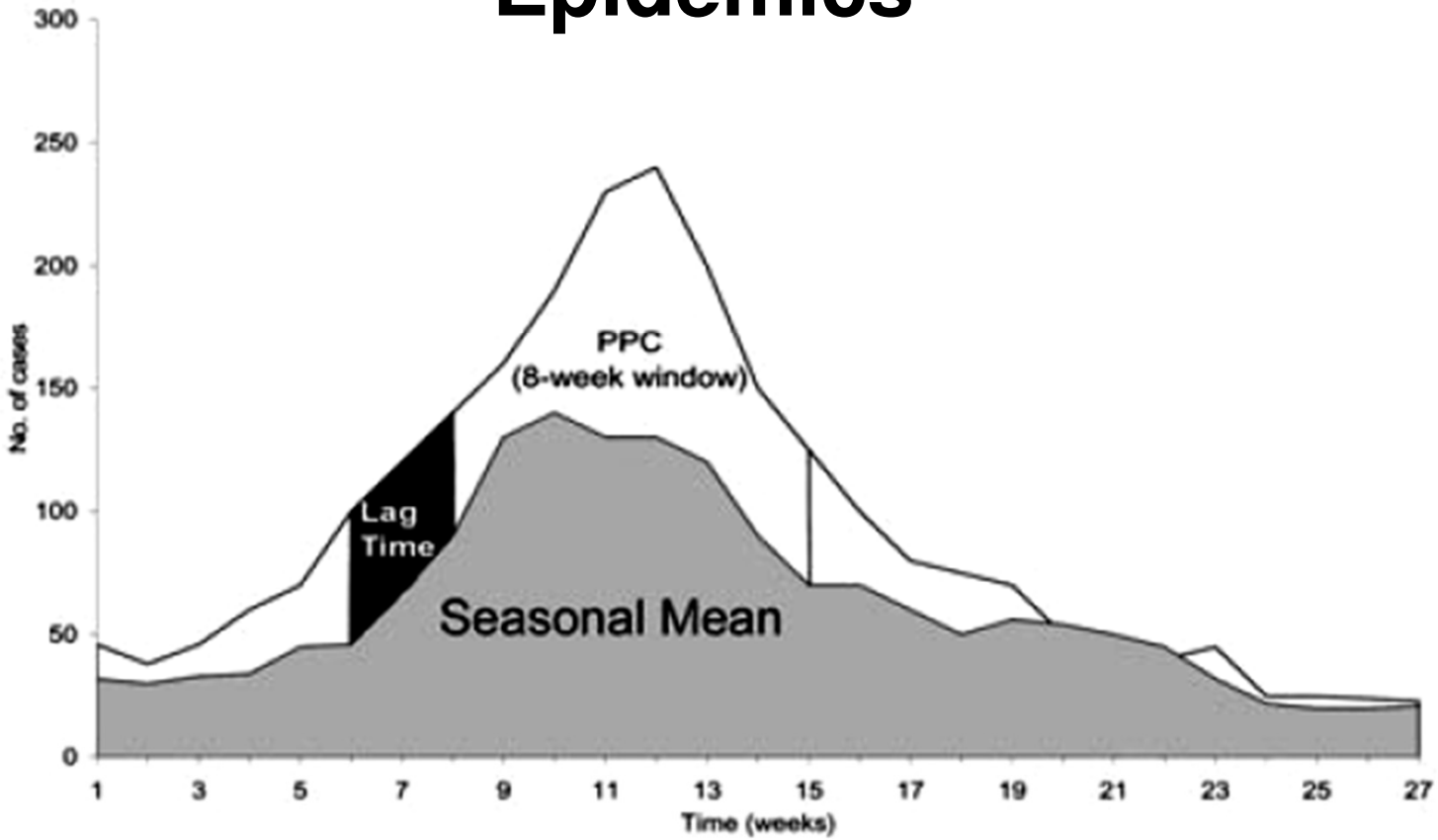
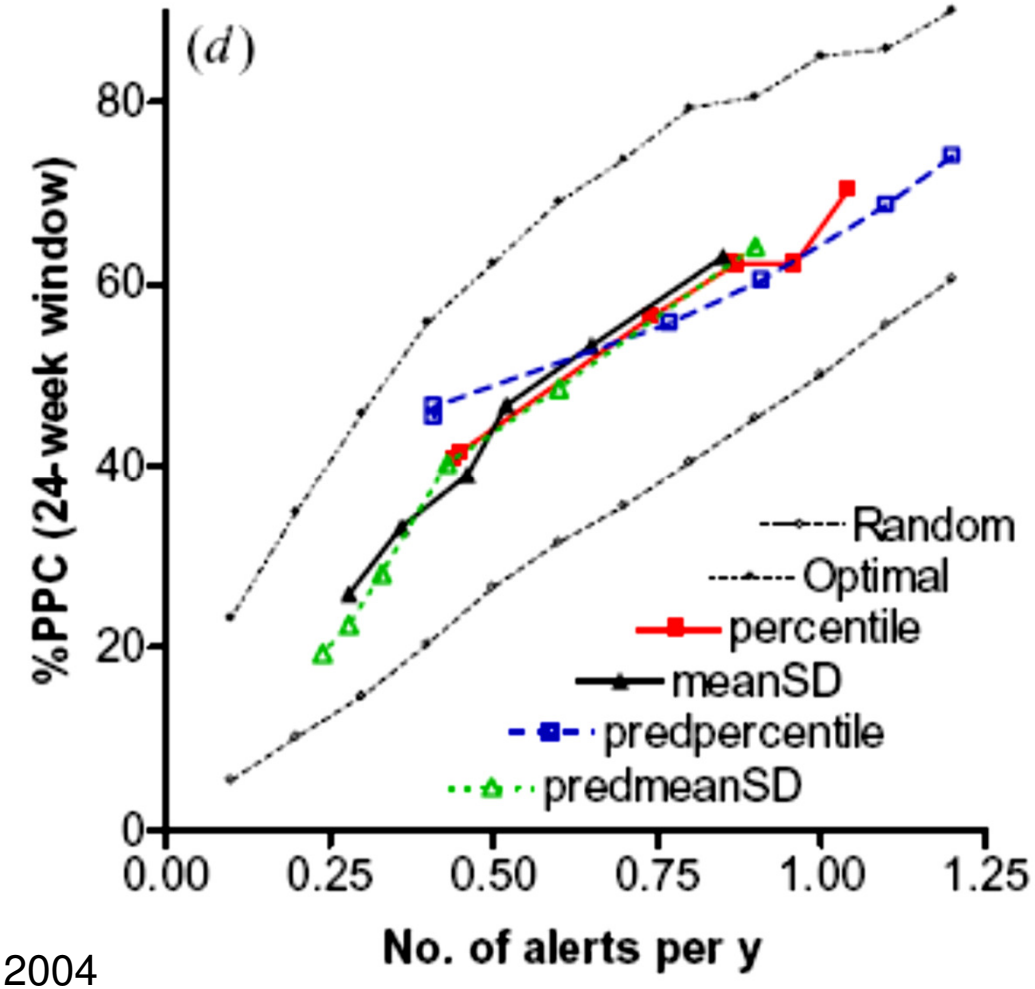


Figure 1. Method for calculating potentially preventable cases (PPC) by using weekly mean. PPC is obtained from cases in excess of the weekly mean with an 8-week window.

Teklehaimanot et al., 2004

Weather-Based Prediction of *Plasmodium falciparum* Malaria in Ethiopia: Comparison with Early Detection



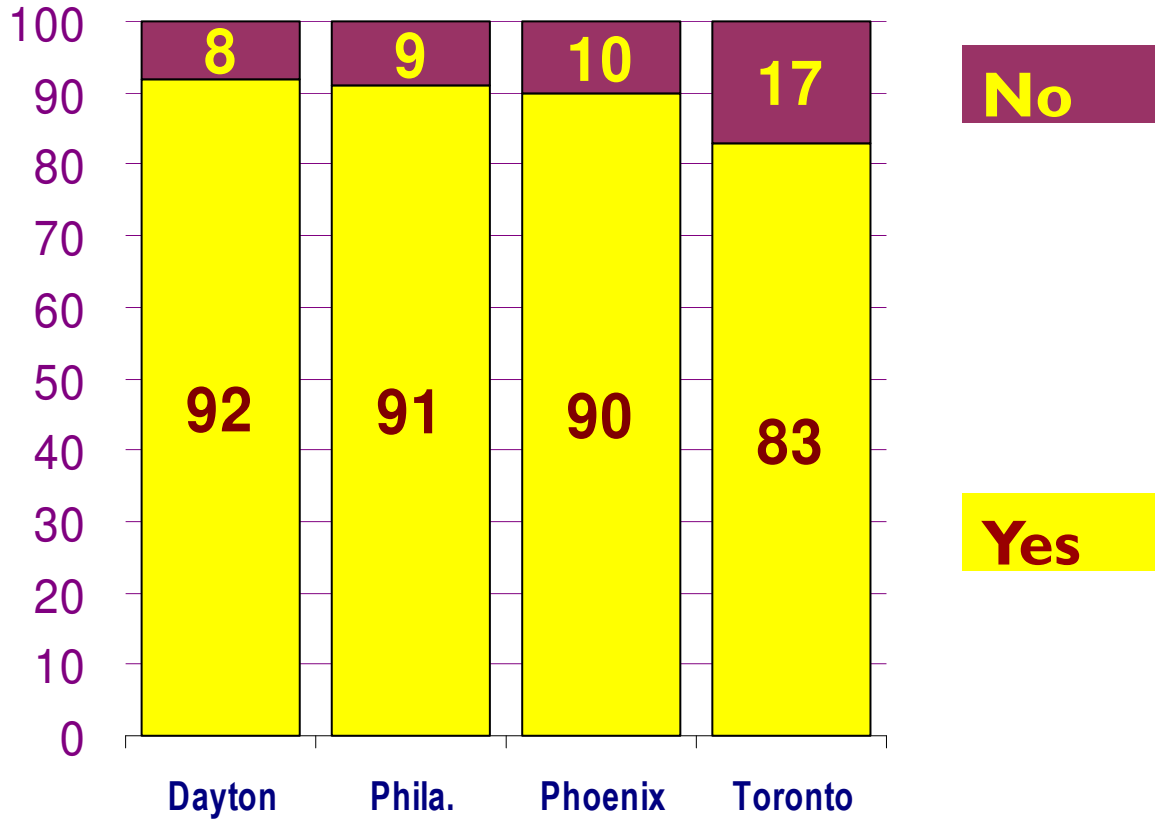
Teklehaimanot et al., 2004

Components of a Response Plan

- Where the response plan will be implemented
- When interventions will be implemented, including thresholds for action
- What interventions will be implemented
- How the response plan will be implemented
- To whom the interventions will be communicated

Ebi and Schmier, 2005

Survey Results on Whether Older Adults Knew that a Heatwave Early Warning Had Been Called



Sheridan, 2007

Surveys were conducted in Dayton, Philadelphia, and Phoenix, in the US and in Toronto, Canada

Heatwave Survey Conclusions

90%	Knew a heatwave early warning had been called.
75%	Knew of at least one action to take to reduce their vulnerability to the heat
45%	Actually took one or more actions

Sheridan, 2007

Monitoring and Evaluation

- **Need to establish programs to answer these questions (at a minimum)**
  - **What are the chances that the system will fail to predict an epidemic, and how many lives could be lost?**
  - **What are the chances of sounding a false alarm, thereby wasting resources and undermining public trust?**
  - **Is the system as responsive as needed? How many lives could have been saved if the system response was faster?**
  - **Is the system cost-effective?**

Candidate Diseases for Epidemic Early Warning Systems

- Cholera
- Malaria
- Dengue fever
- Japanese encephalitis
- Influenza
- Leptospirosis
- Rift valley fever (Major zoonosis)
- Borreliosis (Tick-borne)
- Others

What Have We Learned from Other Systems?

- Early warning systems can save lives (e.g., hurricanes, famine)
- Climate is only one of many determinants that can help in early warning systems
- Early warning of a crisis is no guarantee of prevention
- Capacity and willingness to respond is essential

Discussion

Questions?

Thoughts?

Concerns?

Suggestions?

http://thefuturebuzz.com/2008/10/13/stunning-images-flickr-creative-commons/

Acknowledgements

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