Introduction to Public Health Surveillance

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Objectives

- Discuss the goals and purposes of surveillance
- Review examples of uses for surveillance information

Post Questions in the Chat!

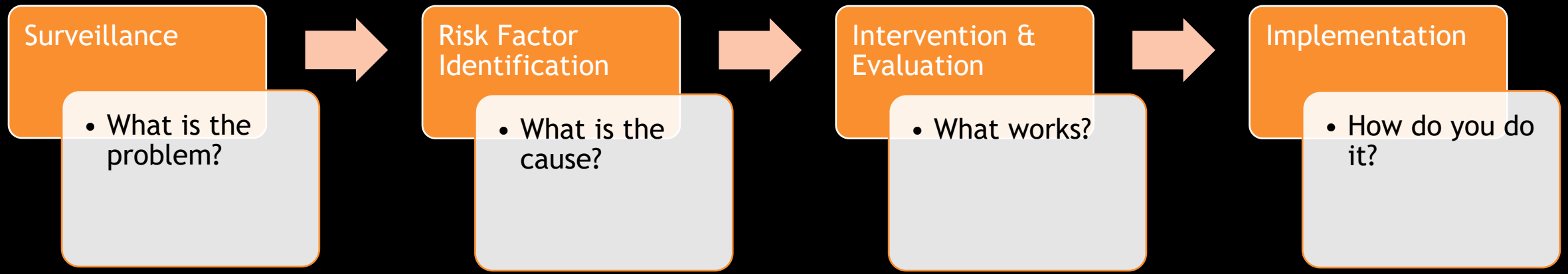
(we will have breaks to answer these during the workshop)

Workshop Schedule

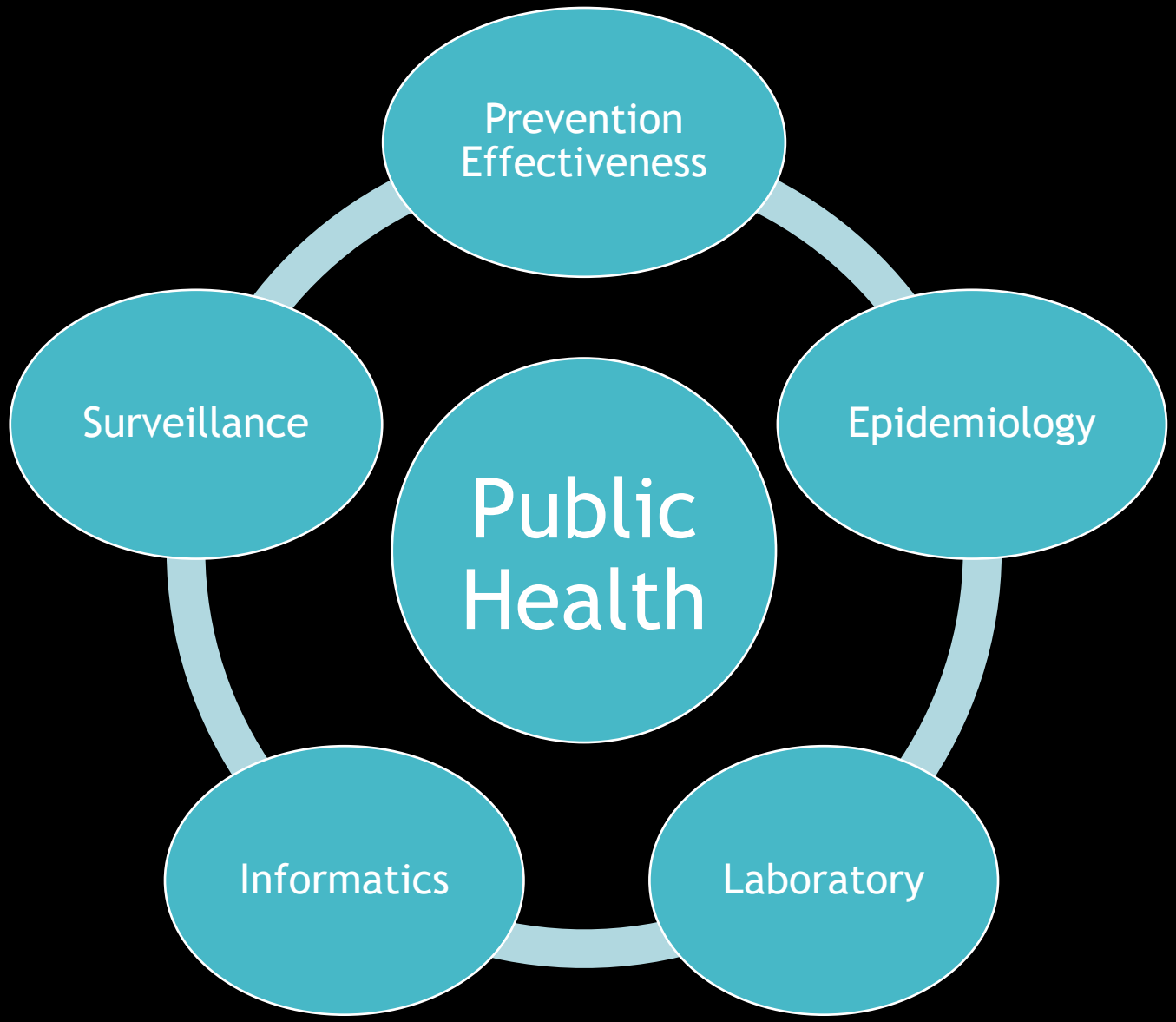
Time	Topics
2:00–2:10 pm	Outline & Public Health Overview
2:10–2:30 pm	Definitions & Uses
2:30–2:50	Uses in Practice
2:50–3:00 pm	Break
3:00–4:00 pm	Introduction to R (continued)

Surveillance as a Part of Public Health

Public Health Approach



Problem → Response



Public Health Core Sciences

What is Public Health Surveillance?

data collection
analysis
public health action

What is Public Health Surveillance?

- Ongoing systematic collection, analysis and interpretation of health-related data
- Essential to planning, implementation, and evaluation of public health practice
- Closely integrated with the timely dissemination of data to those responsible for prevention and control

Adapted from: Thacker SB, Birkhead GS. Surveillance. In: Gregg, MB, ed. Field epidemiology. Oxford, England: Oxford University Press; 2008.

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Goals & Uses for Surveillance

Goal of Public Health Surveillance

- Provide information that can be used for health action by public health personnel, government leaders, and the public to guide public health policy and programs

Smith PF, Hadler JL, Stanbury M, et al. Blueprint version 2.0: updating public health surveillance for the 21st century. J Public Health Manag Pract 2013;19:231–9.

Uses for Public Health Surveillance

- detect outbreak ← emergence
- tracking disease trends
- disease response/control/prevention
- changes/new developments
  - pathogen change
  - human behavior change
  - animal/insect change } — spillover
- changes in health practices
  - health behaviors

"increase in rare E. coli"

Uses for Public Health Surveillance

- Identify patients & their contacts for treatment and intervention
- Detect epidemics, health problems, changes in health behaviours
- Estimate magnitude and scope of health problems
- Measure trends and characterize disease
- Monitor changes in infectious and environmental agents
- Assess effectiveness of programs and control measures
- Develop hypotheses and stimulate research

Public Health Surveillance in Action

Minister: 70% of deaths in Bangladesh caused by noncommunicable diseases

Evidence shows midwifery education in Bangladesh is making real impact by improving women's access to safe childbirth

Increase Seen in Deaths from Pneumonia and Flu

Number of Rare *E. Coli* Cases In U.S. Rose Last Year

Over 90,000 deaths in Bangladesh caused by indoor air pollution in 2019

The New York Times

Number of Rare *E. Coli* Cases In U.S. Rose Last Year

By **WILLIAM NEUMAN**

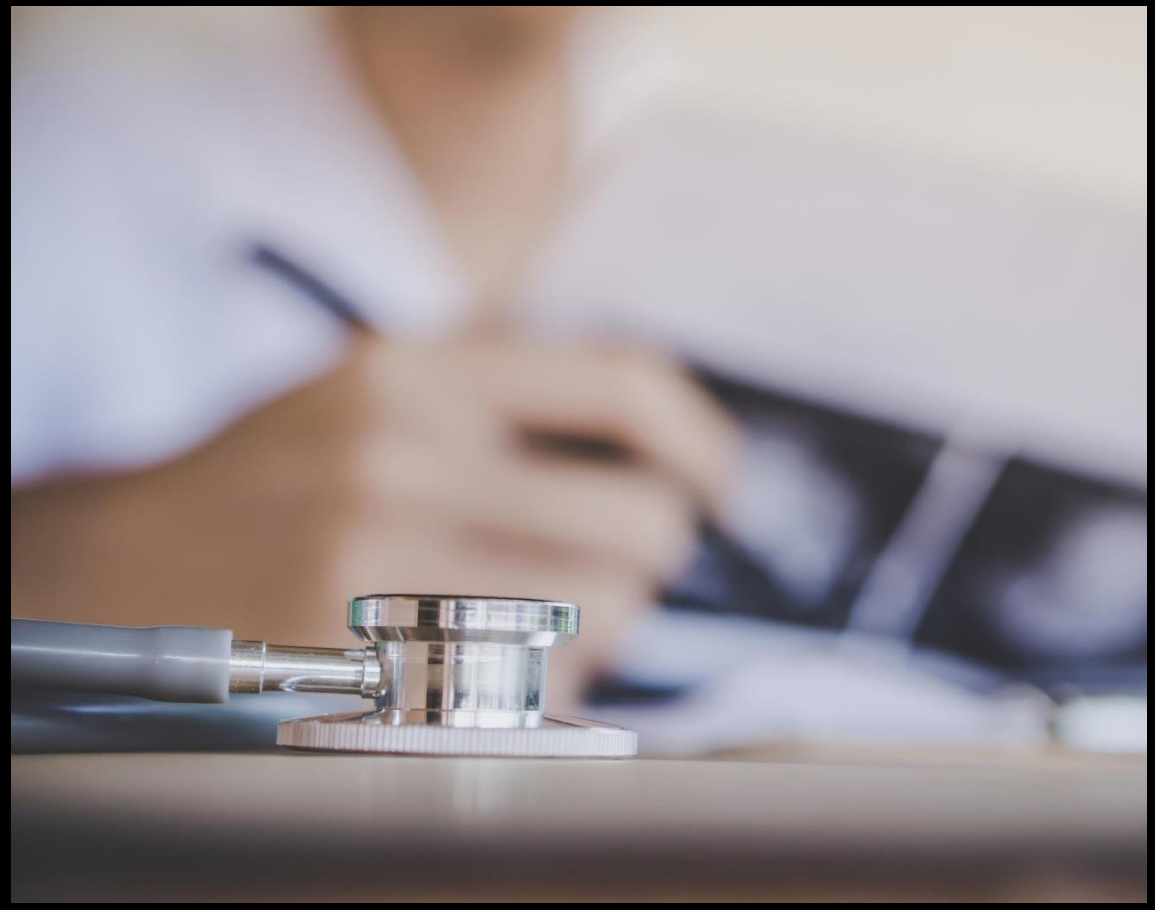
Federal officials said on Tuesday that a national monitoring system for food-borne illness detected an increasing number of sicknesses last year from a group of rare E. coli bacteria related to the little-known and highly toxic strain that has been ravaging Germany.

For the first time, the group of rare E. coli strains was collectively identified as the cause of more illnesses in the United States than the more common form of the pathogen, probably because more laboratories have begun to test for their presence, said officials at the Centers for Disease Control and Prevention, which on Tuesday released 2010 results from its nationwide tracking system for food-borne diseases.

Neuman W. Number of Rare *E. Coli* Cases In U.S. Rose Last Year. *The New York Times*. June 7, 2011. http://www.nytimes.com. Accessed July 8, 2014.

Outbreak Detection

Outbreak Detection



- New York City, 23rd August 1999
- Infectious disease specialist calls Department of Health
  - two cases of encephalitis

- what do we know about the cases?
- what's the cause?
- intervention

Outbreak Detection

- Initial investigation uncovers 6 additional cases
- Case details:
  - 58—87 years of age] older
  - presented with febrile illness and change in mental state
  - most had severe muscle weakness

Outbreak Detection

- Blood chemistry suggests a viral infection

time + place = geography

history

contacts

Outbreak Detection

- Blood chemistry suggests a viral infection
- Patient interviews
  - live within same 16 square mile area
  - no known exposures in common
  - outdoor activities in evening

Outbreak Detection

- Blood chemistry suggests a viral infection
- Patient interviews
  - live within same 16 square mile area
  - no known exposures in common
  - outdoor activities in evening
- Home inspections
  - *Culex* mosquitoes in neighborhoods

arboviruses

arbovirus

Outbreak Detection

- Further testing of patient samples
  - ELISA is IgM positive for St. Louis encephalitis virus
- Laboratory, clinical, and epidemiologic data all consistent with an SLE outbreak
- Mosquito eradication campaign initiated

Outbreak Detection

- Further testing of patient samples
  - ELISA is IgM positive for St. Louis encephalitis virus
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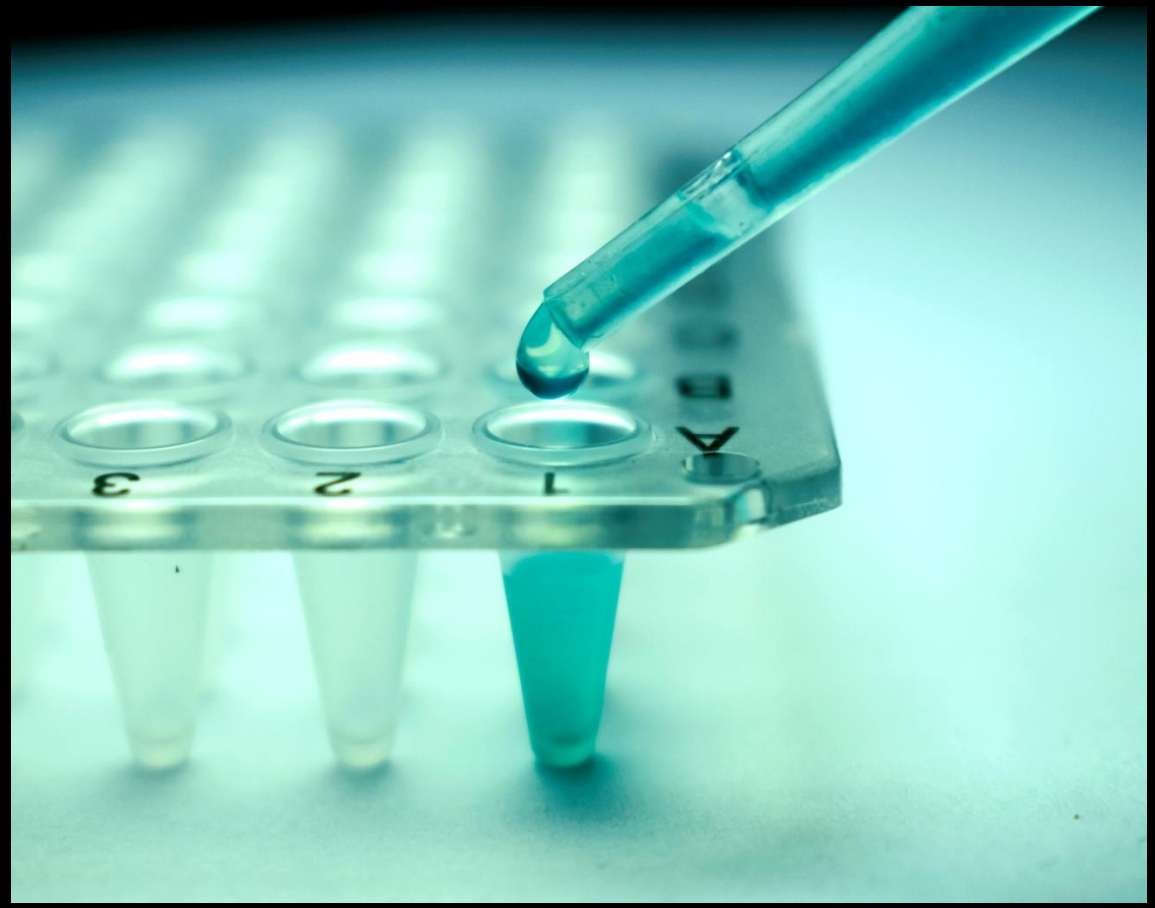
End of the story?

Outbreak Detection

- Epizootic disease is causing death of substantial numbers of birds in NYC area
- Necropsy shows multiple organ failure in the birds, including encephalitis
- Samples are negative for common bird pathogens
- SLE does infect birds but does not typically kill the avian reservoir

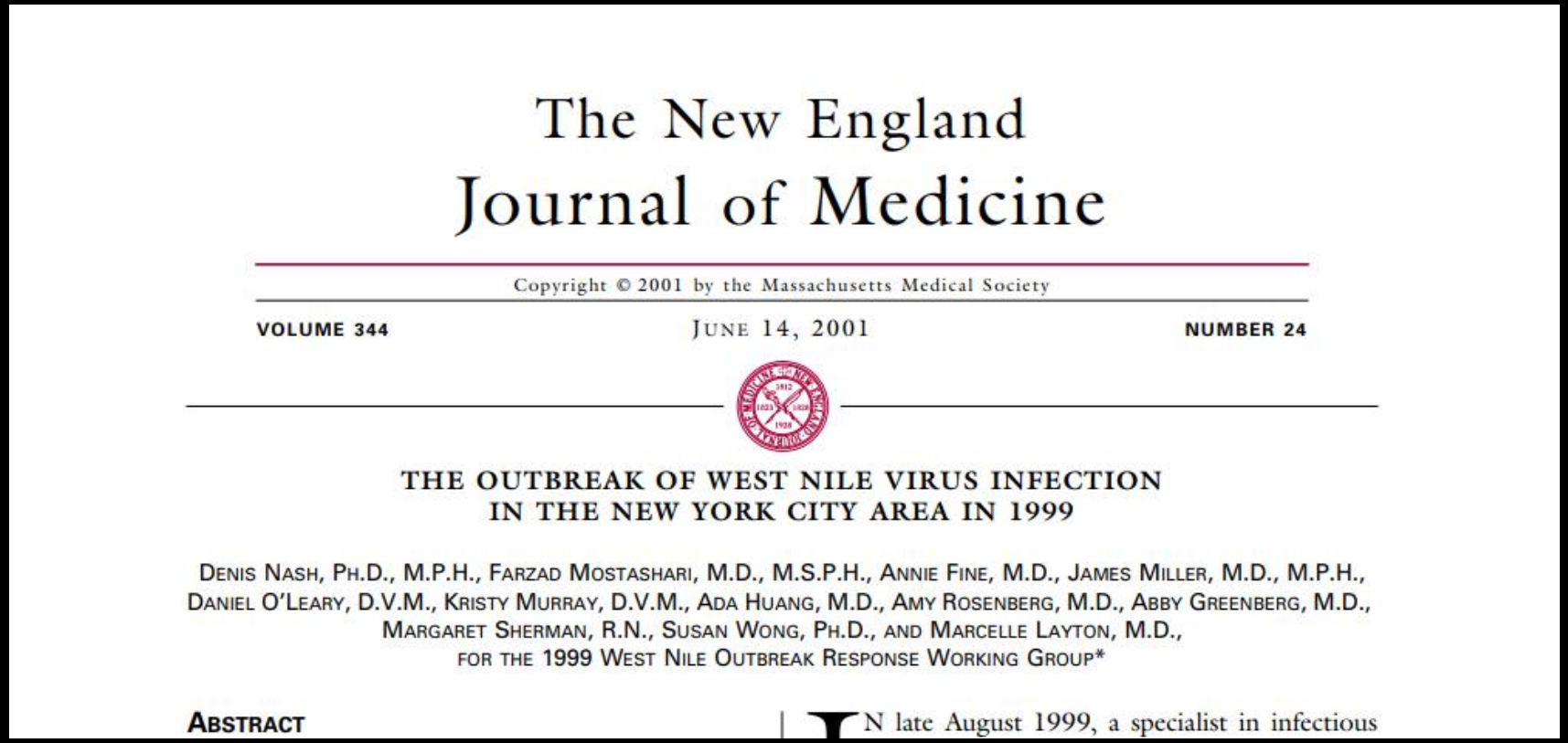
Outbreak Detection
Disease Emergence/Re-emergence



- Virus isolated from bird samples
  - similar sequence to West Nile virus
- Identical sequence found in sample from human case
- Virus detected in *Culex* and *Aedes* samples
- Emergence of West Nile virus in the Western Hemisphere

WNV

Outbreak Detection
Disease Emergence/Re-emergence



The New England
Journal of Medicine

VOLUME 344 JUNE 14, 2001 NUMBER 24

THE OUTBREAK OF WEST NILE VIRUS INFECTION IN THE NEW YORK CITY AREA IN 1999

DENIS NASH, PH.D., M.P.H., FARZAD MOSTASHARI, M.D., M.S.P.H., ANNIE FINE, M.D., JAMES MILLER, M.D., M.P.H., DANIEL O'LEARY, D.V.M., KRISTY MURRAY, D.V.M., ADA HUANG, M.D., AMY ROSENBERG, M.D., ABBY GREENBERG, M.D., MARGARET SHERMAN, R.N., SUSAN WONG, PH.D., AND MARCELLE LAYTON, M.D., FOR THE 1999 WEST NILE OUTBREAK RESPONSE WORKING GROUP*

ABSTRACT

IN late August 1999, a specialist in infectious

Outbreak Detection
Disease Emergence/Re-emergence

- 59 positive patients, 7 deaths
- Eventual spread of WNV across USA

Early Warning Systems

- After disease trends are well-understood it may be possible to establish an early warning system
  - early detection gives the opportunity for early intervention and prevention of further disease
  - increased effectiveness of disease control
- Useful for:
  - epidemic-prone diseases
  - emergency situations
- May be designed for temporary or routine/long-term use

Early Warning Systems - Forecasting

- Climate-informed EWS
  - combine weather and surveillance data
  - forecast disease outbreaks
- Need
  - efficient monitoring of weather and environmental conditions
  - timely surveillance data
  - well-established predictive relationship between weather and disease

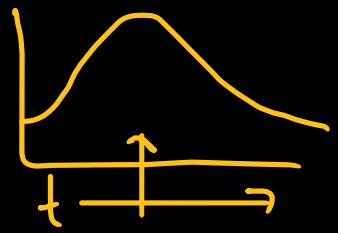
Early Warning Systems - Approaches

- Short-range forecast
  - establish predictive relationship between current weather conditions and future disease
  - use predictive relationship and current weather data to forecast disease
- Long-range forecast
  - establish predictive relationship between weather and disease using historical data
  - use of historical climate data to obtain future climate prediction (seasonal or annual forecasts)
  - use predictive relationship and weather forecasts to forecast disease

today's data → future disease

today's data + today's disease

Early Warning Systems - Forecasting



Articles

Climate services for health: predicting the evolution of the 2016 dengue season in Machala, Ecuador

Rachel Lowe, Anna M Stewart-Ibarra, Desislava Petrova, Markel García-Díez, Mercy J Borbor-Cordova, Raúl Mejía, Mary Regato, Xavier Rodó

Summary

Background El Niño and its effect on local meteorological conditions potentially influences interannual variability in dengue transmission in southern coastal Ecuador. El Oro province is a key dengue surveillance site, due to the high burden of dengue, seasonal transmission, co-circulation of all four dengue serotypes, and the recent introduction of chikungunya and Zika. In this study, we used climate forecasts to predict the evolution of the 2016 dengue season in the city of Machala, following one of the strongest El Niño events on record.

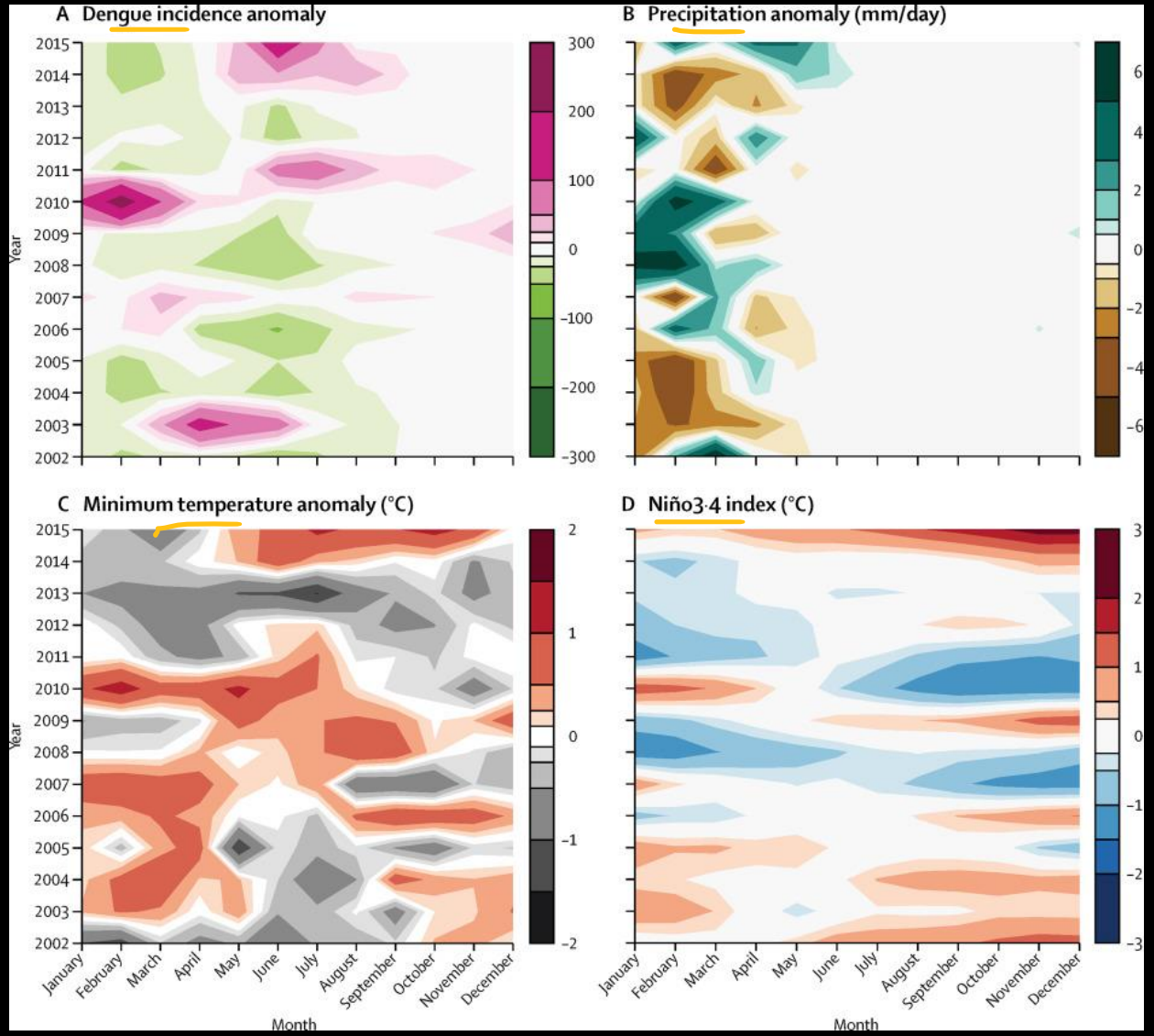
Lancet Planet Health 2017; 1: e142–51

See Comment page e126

Centre for the Mathematical Modelling of Infectious Diseases and Department of

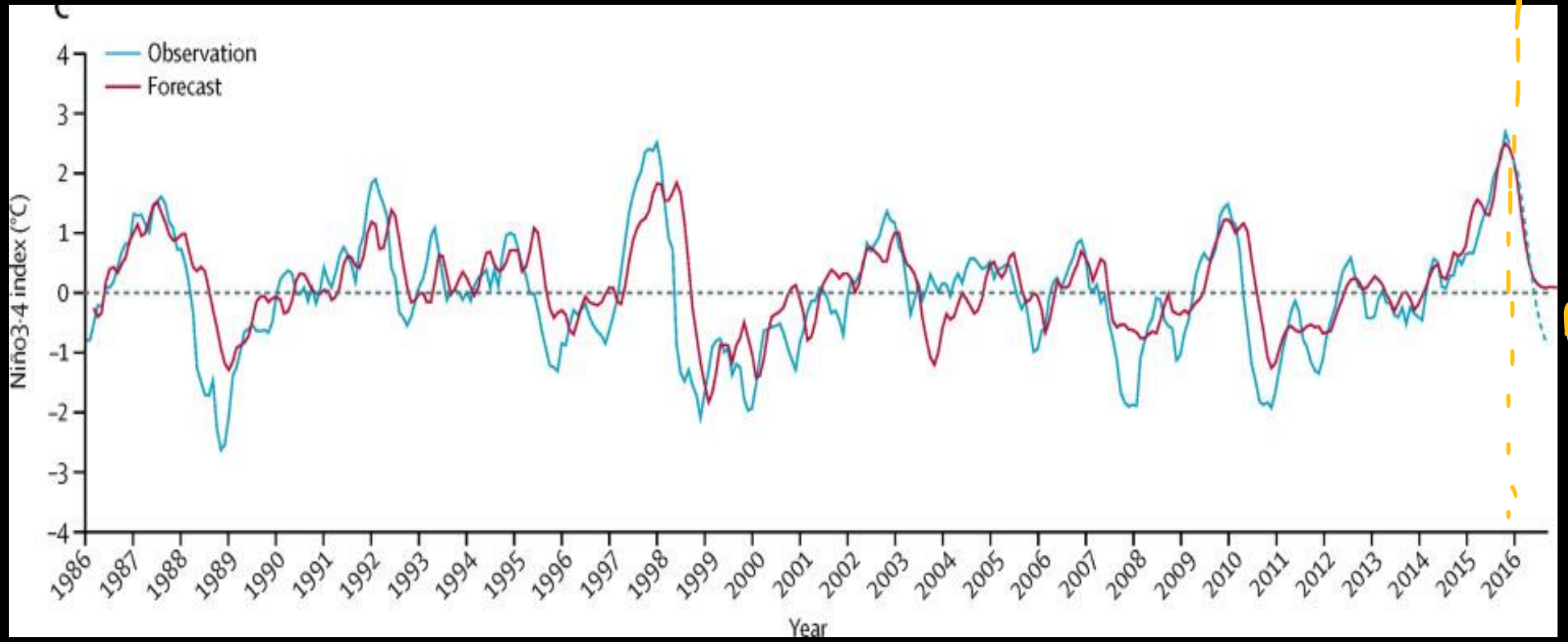
Early Warning Systems - Forecasting

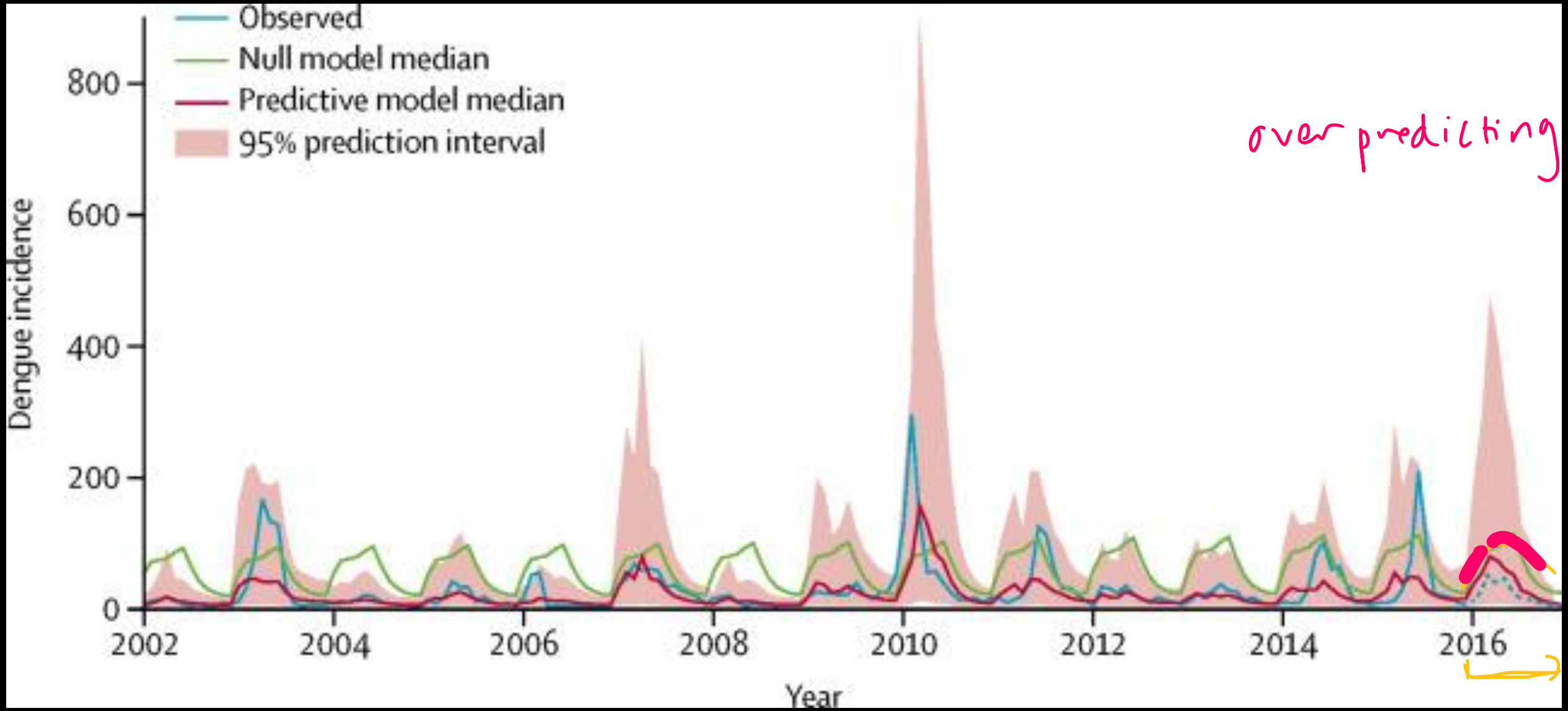
- Long-range forecasting
  - Model of dengue incidence developed with historic dengue surveillance data and climate data
  - Model to predict weather conditions for 2016
- Inputs
  - precipitation, minimum temperature, El Niño Index
- Output
  - predicted monthly dengue incidence for January—November 2016



Early Warning Systems - Forecasting

Early Warning Systems - Forecasting




Observed
Null model median
Predictive model median
95% prediction interval
Dengue incidence
800
600
400
200
0
2002
2004
2006
2008
2010
2012
2014
2016
Year
over predicting

Surveillance

- Surveillance is a critical component of a public health system
- Surveillance provides timely health data and information to guide health actions and policies
- Useful for trend monitoring, outbreak detection, disease forecasting, and many other uses

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