Outbreak investigation

"First, get the cow out of the ditch.
Second, find out how the cow got into the ditch.
Third, make sure you do whatever it takes so the cow
doesn't go into the ditch again."

Anne Mulchay

What is an outbreak?

- *Can be defined as:*
  - *Two or more linked cases*

  - *Situation where observed number of cases exceeds the expected number*

 - *A single case of an serious pathogen*

What is surveillance?

- *Can be defined as:*
    - *"continued watchfulness over distribution/trends of diseases through systematic collection, consolidation & evaluation of data…"*

    - *"Information for action…"*

General principles of outbreak management

- Confirm the existence of an outbreak
- Confirm the diagnosis
- Create a case definition
- Create "line listing"
- Construct epidemic curve
- Develop and test hypotheses
- Implement control measures
- Communication
- Screen personnel and environment
- Write outbreak report

Epidemic curves

Date of symptom onset, June 2006

Continuous Exposure
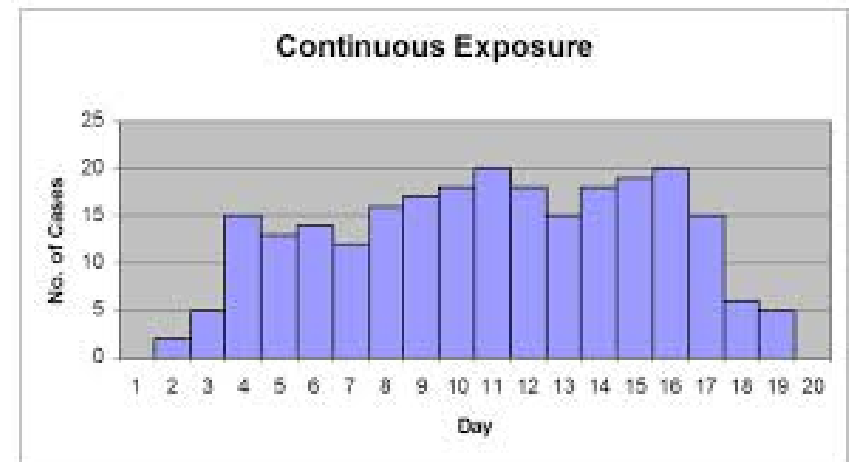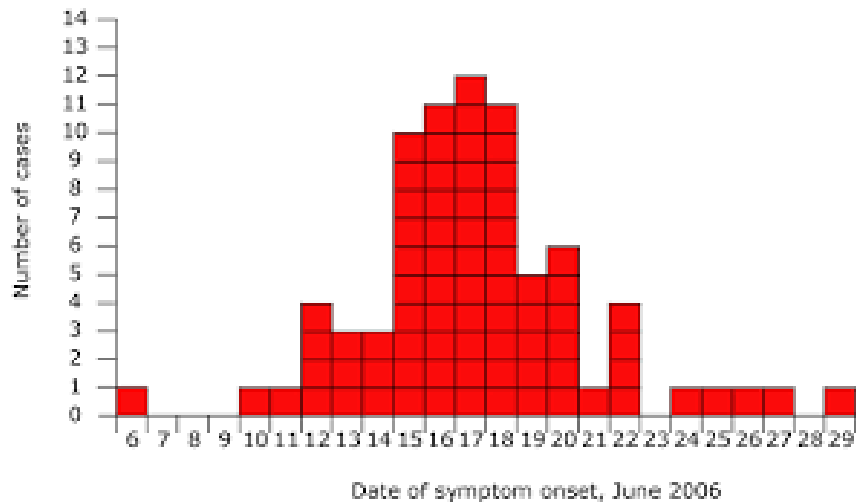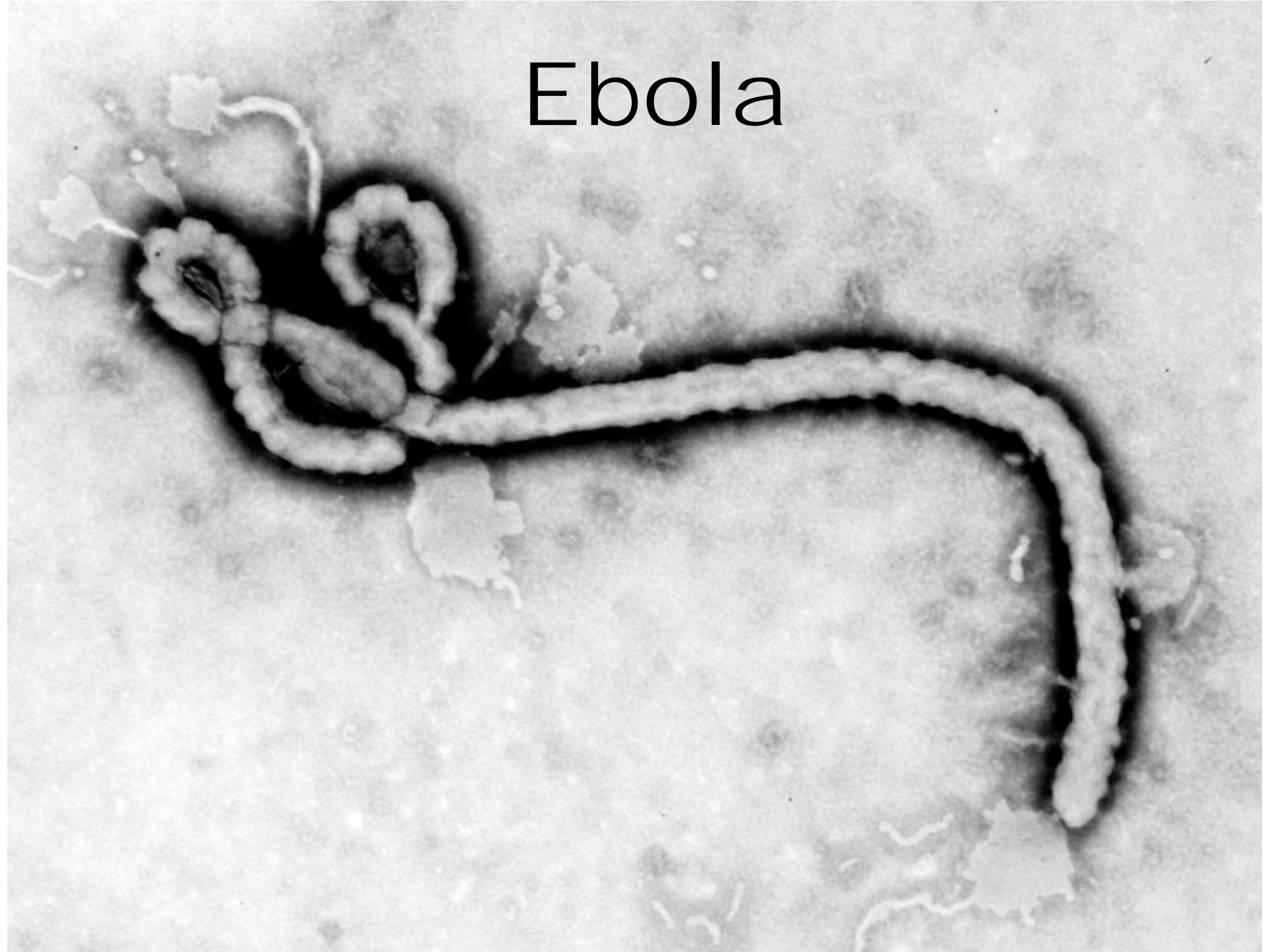
Ebola

Ebolavirus Ecology

Enzootic Cycle

New evidence strongly implicates bats as the reservoir hosts for ebolaviruses, though the means of local enzootic maintainance and transmission of the virus within bat populations remain unknown.
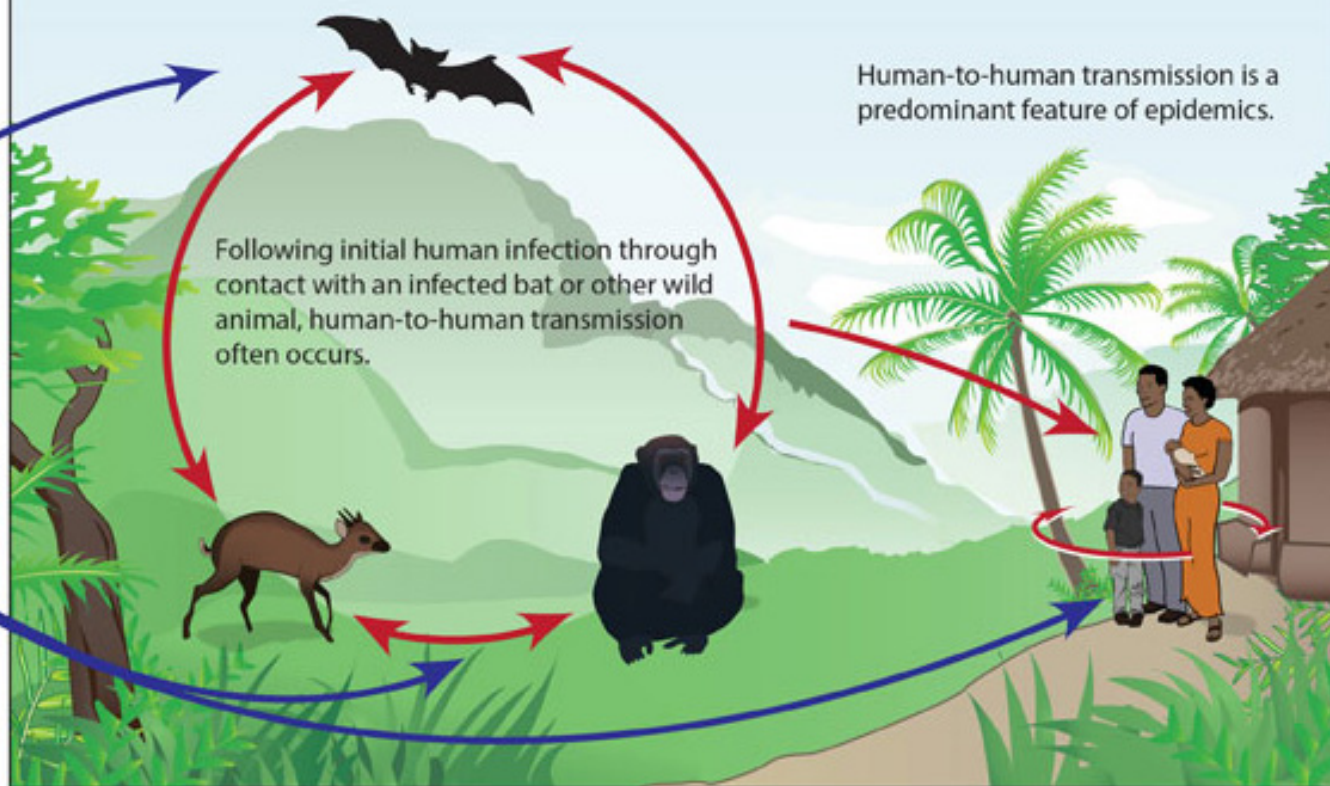
Ebolaviruses:
Ebola virus (formerly Zaire virus)
Sudan virus
Taï Forest virus
Bundibugyo virus
Reston virus (non-human)

Epizootic Cycle

Epizootics caused by ebolaviruses appear sporadically, producing high mortality among non-human primates and duikers and may precede human outbreaks. Epidemics caused by ebolavi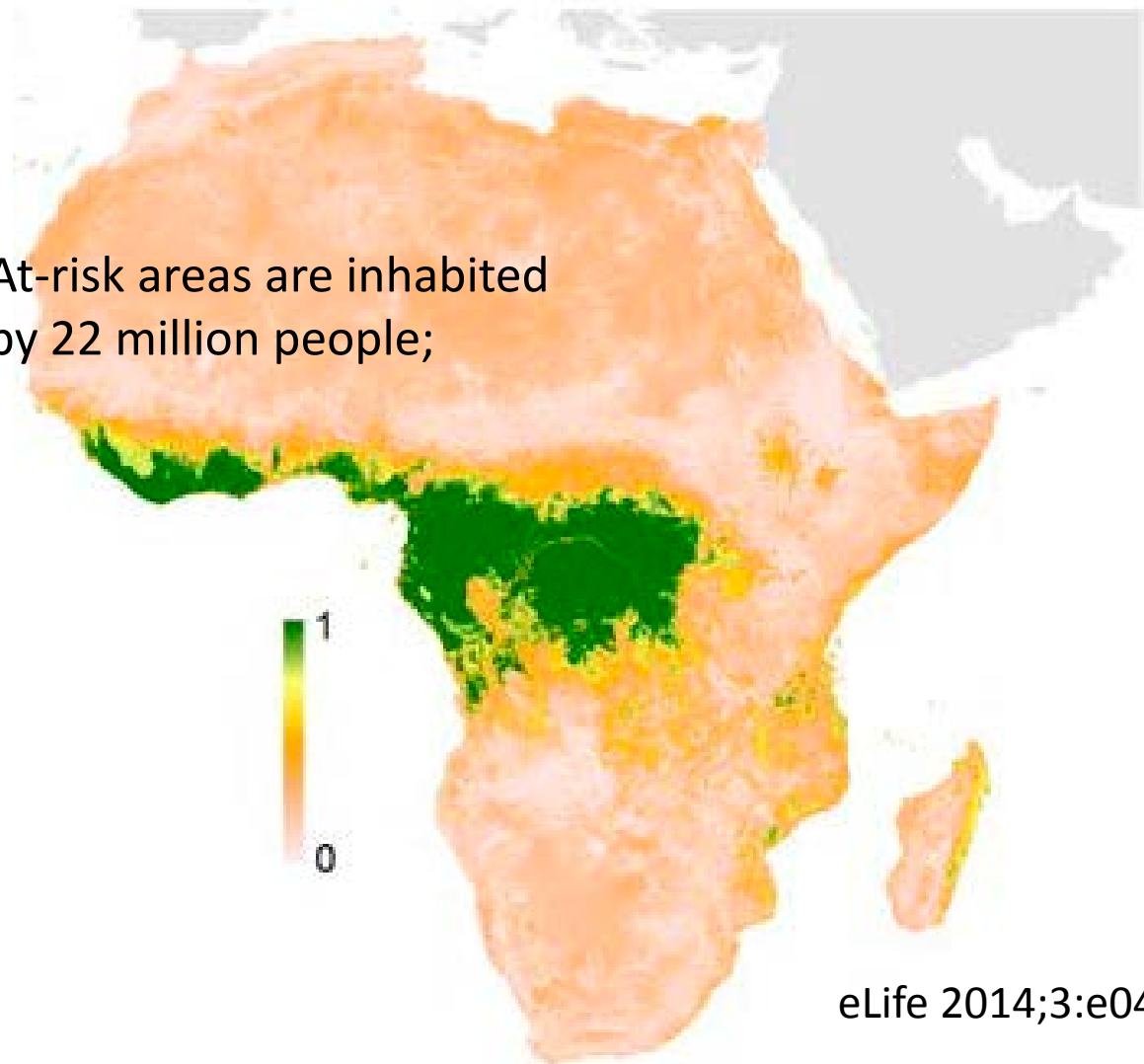ruses produce acute disease among humans, with the exception of Reston virus which does not produce detectable disease in humans. Little is known about how the virus first passes to humans, triggering waves of human-to-human transmission, and an epidemic.
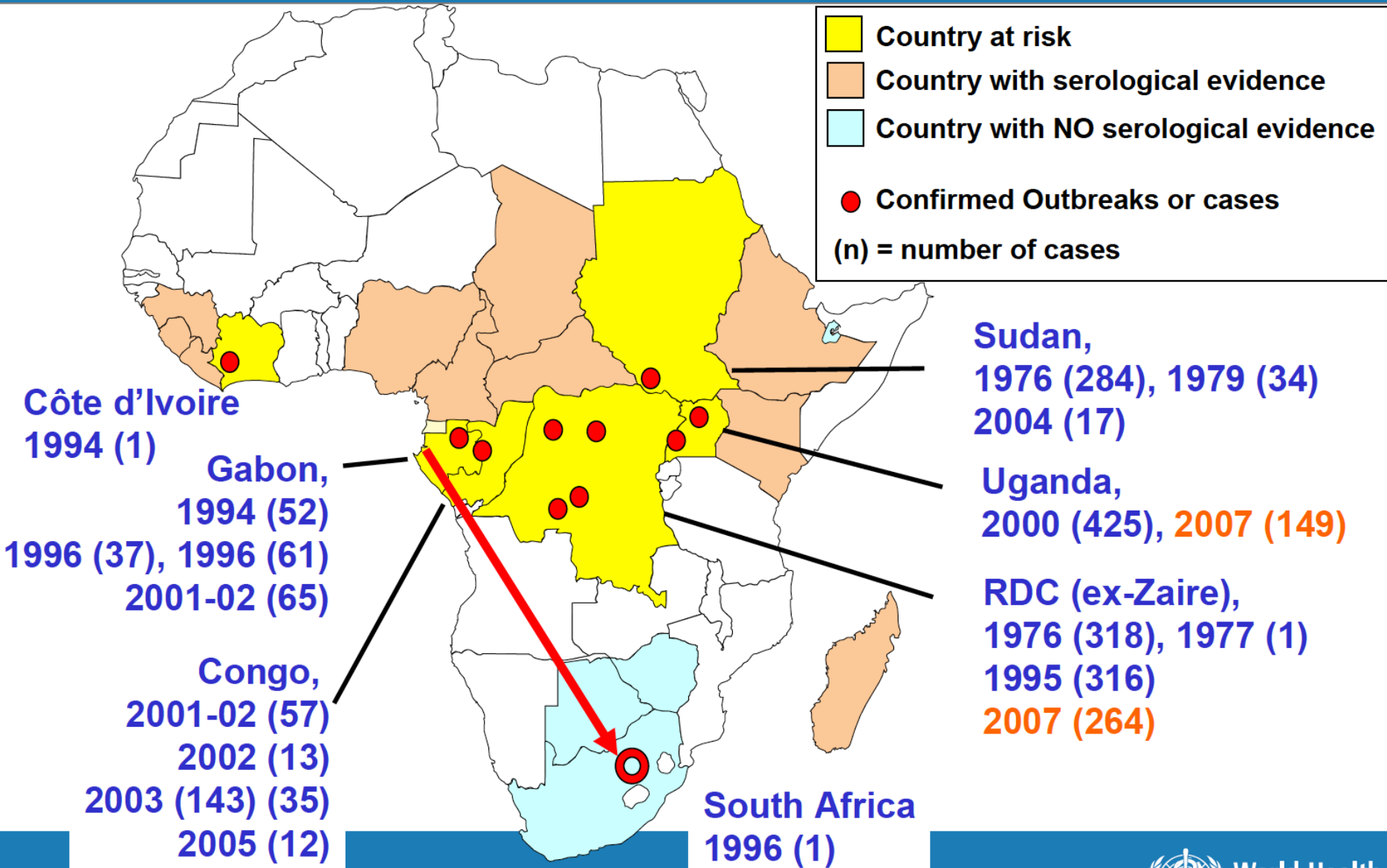
Human-to-human transmission is a predominant feature of epidemics.

Following initial human infection through contact with an infected bat or other wild animal, human-to-human transmission often occurs.

CDC

Combined probability of occurrence map of the three species of fruit bats known to be reservoirs of Ebola virus (*Hypsignathus monstrosus, Myonycteris torquata and Epomops franqueti*)
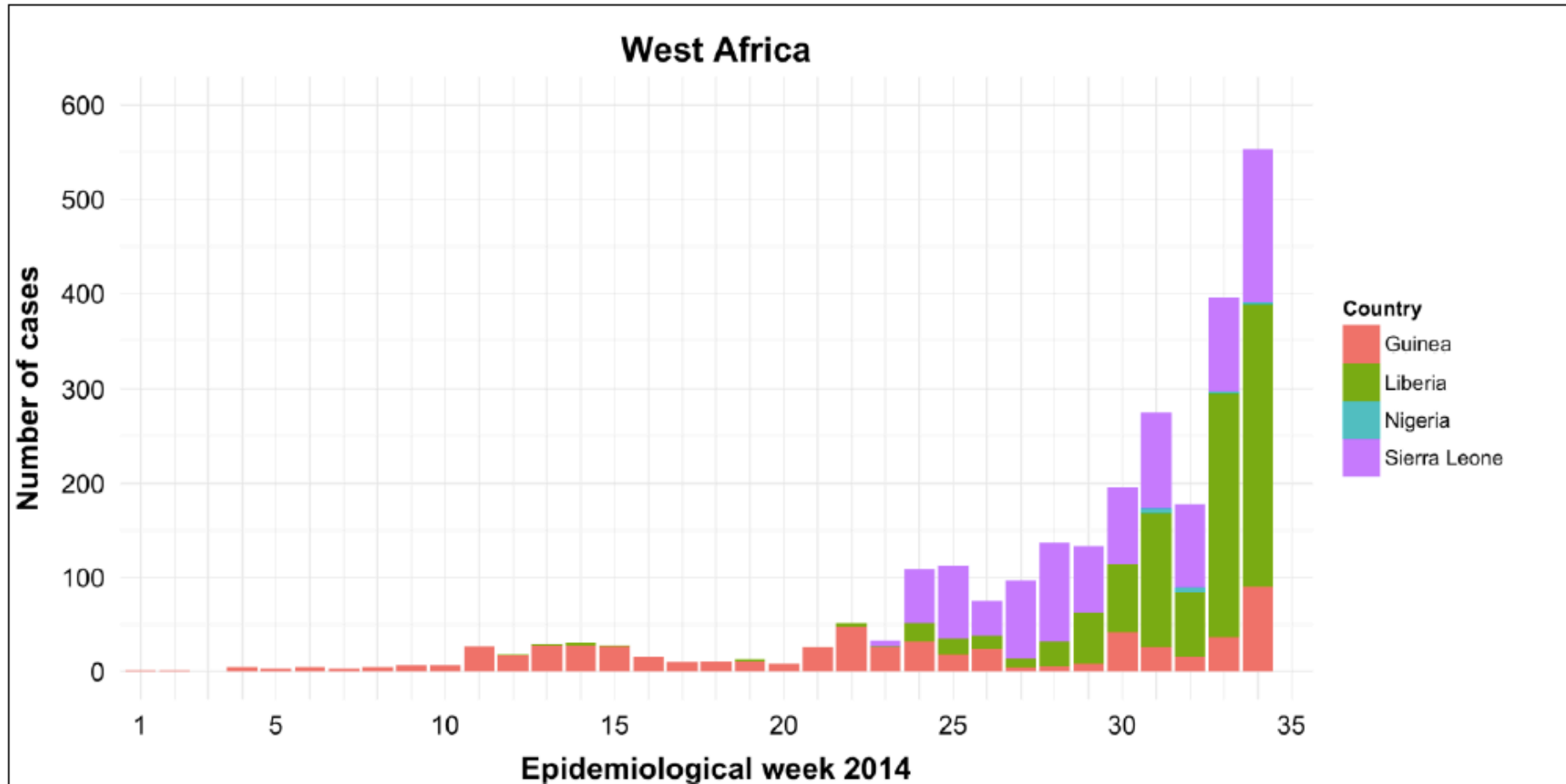

At-risk areas are inhabited by 22 million people;
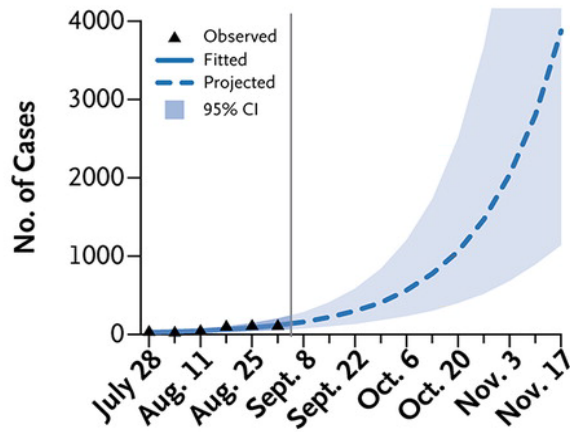
Ebola Haemorrhagic Fever in Africa

Country at risk

Country with serological evidence

Country with NO serological evidence

● Confirmed Outbreaks or cases

(n) = number of cases

Côte d'Ivoire
1994 (1)

Gabon,
1994 (52)
1996 (37), 1996 (61)
2001-02 (65)

Congo,
2001-02 (57)
2002 (13)
2003 (143) (35)
2005 (12)

Sudan,
1976 (284), 1979 (34)
2004 (17)

Uganda,
2000 (425), 2007 (149)

RDC (ex-Zaire),
1976 (318), 1977 (1)
1995 (316)
2007 (264)

South Africa
1996 (1)

Global Alert and Response Department

World Health Organization

Cases accumulate, outbreak spreads

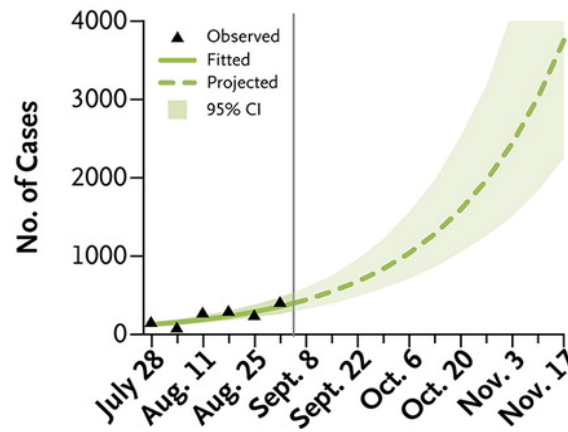# Alarm bells: observed and Projected Case Incidence
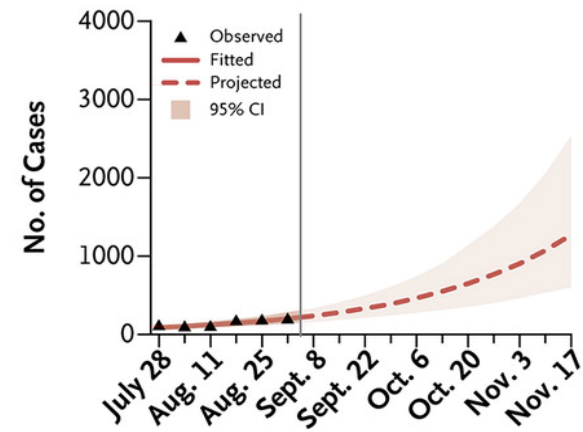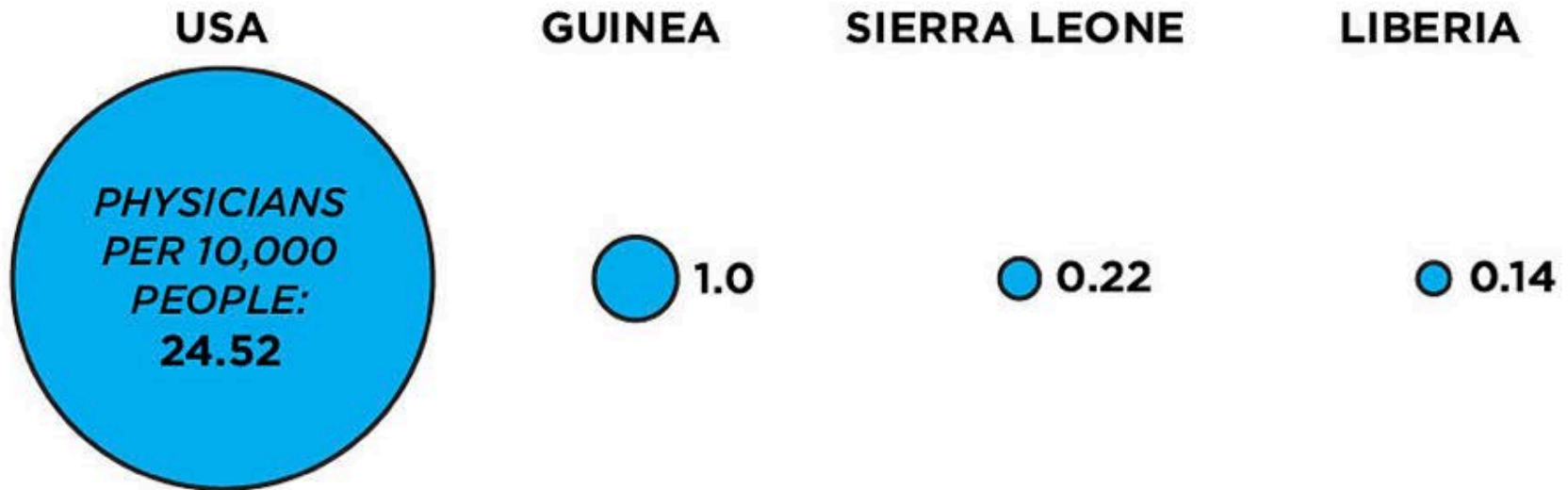
Context for outbreak

- Widespread on multiple fronts
- Affected large cities
- Weak and fragile infrastructure
- Lack of knowledge of the disease
- Distrust of government and foreigners
- Not seeking health care
- Social rituals / burial rituals
- Delayed response; more resources needed

Context

Country	Population 2012 (millions)	Median age 2012 (years)	Literacy levels 2010 or 2012 (percent)	Expenditures on health 2012 (per capita total expenditures at average exchange rate - US)
Guinea	11.5	18.5	25 / 41	$ 32
Liberia	4.2	18.4	61	$ 66
Sierra Leone	6	20	43	$ 96
Canada	34.8	40		$ 5741

Context

Cases accumulate, outbreak spreads

Alarm bells: observed and Projected Case Incidence

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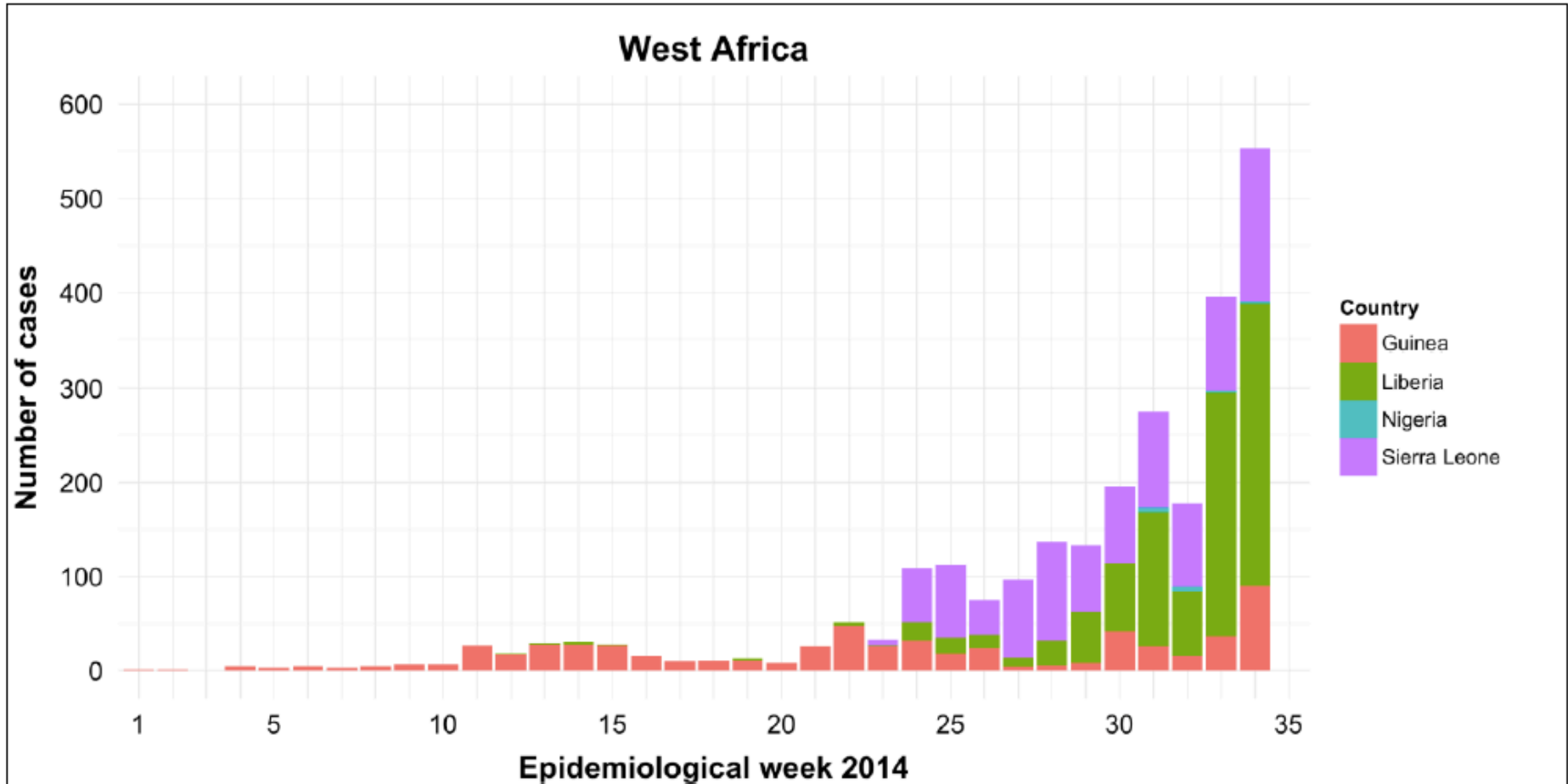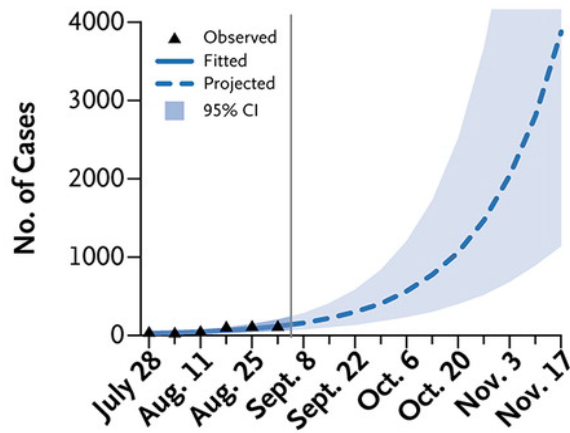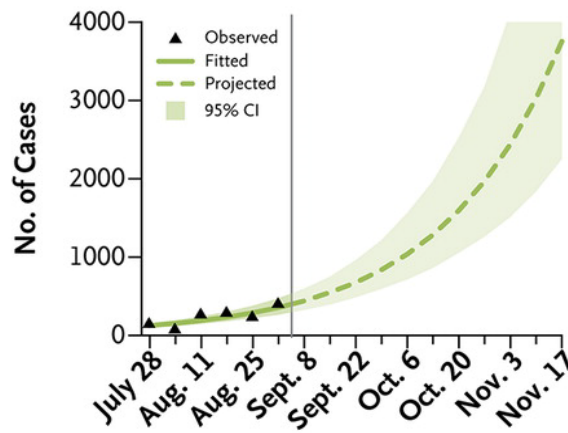- Delayed response; more resources needed

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Context

USA — PHYSICIANS PER 10,000 PEOPLE: **24.52**

GUINEA — 1.0

SIERRA LEONE — 0.22

LIBERIA — 0.14

Early Clinical Presentation

- Acute onset; typically 8–10 days after exposure (range 2–21 days)

- Signs and symptoms

  - Initial: Fever, chills, myalgia, malaise, anorexia
  - After 5 days: GI symptoms, such as nausea, vomiting, watery diarrhea, abdominal pain
  - Other: Headache, conjunctivitis, hiccups, rash, chest pain, shortness of breath, confusion, seizures
  - Hemorrhagic symptoms in 18% of cases

- Other possible infectious causes of symptoms

  - Malaria, typhoid fever, meningococcemia, Lassa fever and other bacterial infections (e.g., pneumonia) – all very common in Africa

Clinical Features

- Nonspecific early symptoms progress to:

  - Hypovolemic shock and multi-organ failure

  - Hemorrhagic disease

  - Death

- Non-fatal cases typically improve 6–11 days after symptoms onset

- Fatal disease associated with more severe early symptoms

  - The fatality rates of 70% have been historically reported in rural Africa

  - Intensive care, especially early intravenous and electrolyte management, may increase the survival rate

Response – WHO Roadmap for control of Ebola

- **Objectives targeted at countries:**
  - With widespread and intense transmission
  - With an initial case(s) or with localized transmission
  - Sharing land borders with an intense transmission area and those with international transportation hubs
- **Elements of the response:**
  - treatment centres
  - referral centres
  - laboratory access
  - surveillance and contact tracing
  - safe burial
  - social mobilization
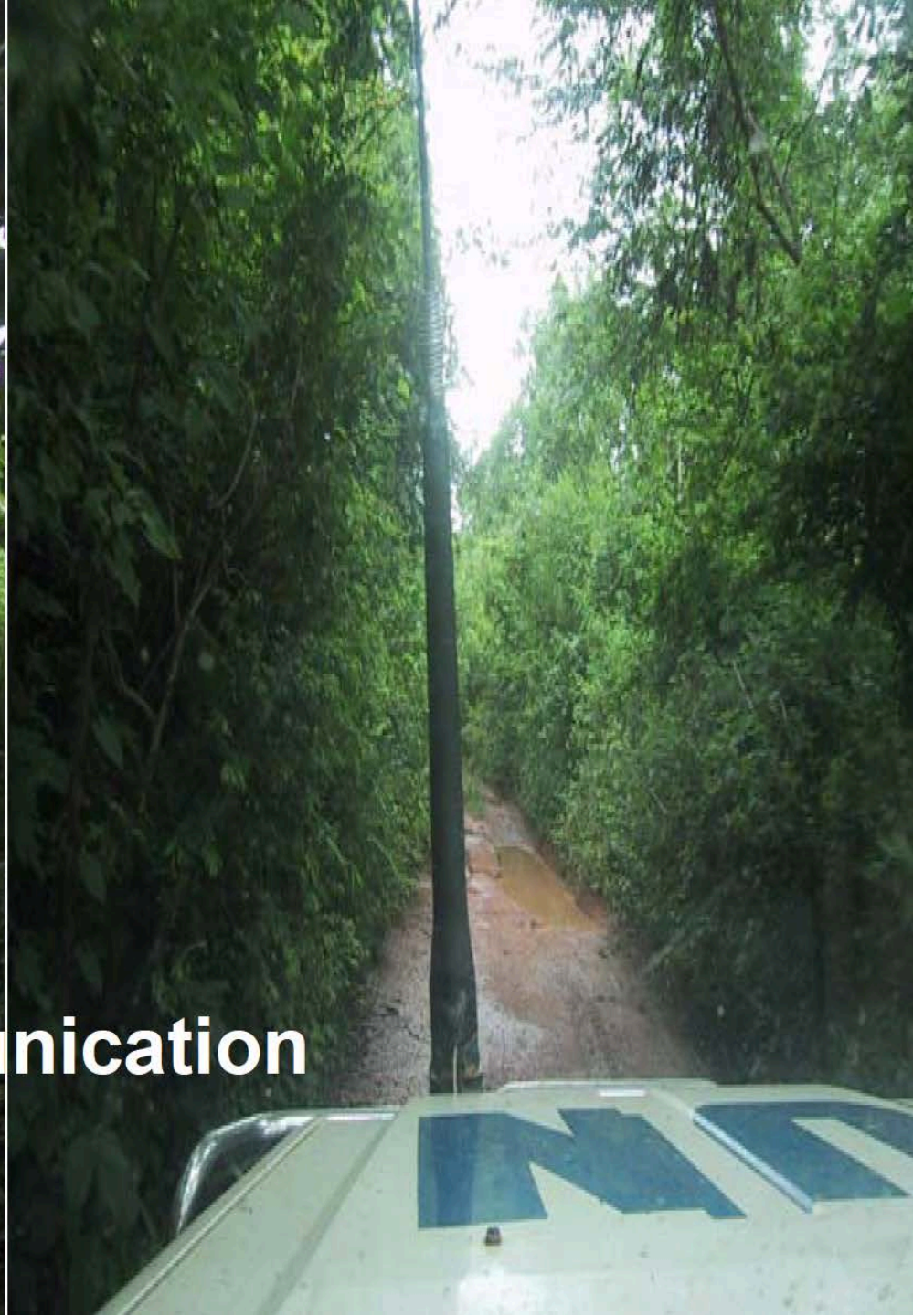 - controlling infection in health care settings. Training. PPE.

Contact tracing and fever monitoring for 21 days

Logistics and communication challenges

EBOLA

Signs and Symptoms

FEVER

BLEEDING

DIARRHOEA, SOMETIMES BLOODY

HEALTH CENTRE

SKIN RASH

VOMITING, SOMETIMES BLOODY

MUSCLE OR JOINT PAIN
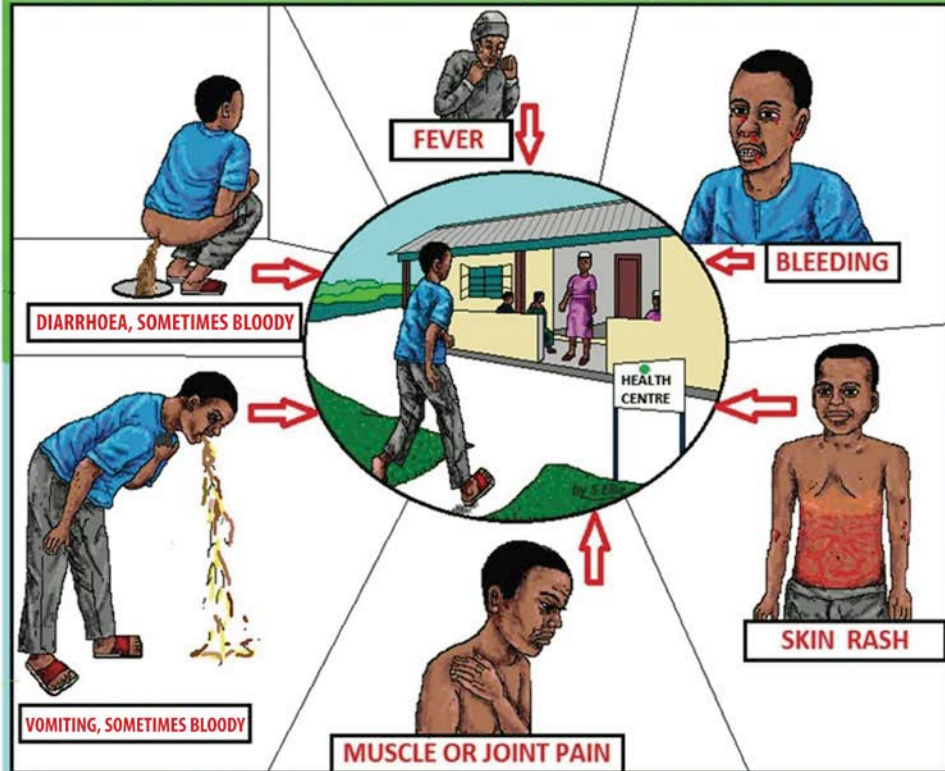
IF YOU HAVE FEVER, DIARRHOEA, OR VOMITING GO IMMEDIATELY TO THE NEAREST HEALTH FACILITY

For more information call 117 (Toll Free)

PROTECT YOURSELF
PROTECT YOUR FAMILY
PROTECT YOUR COMMUNITY

from the Ebola virus

✓ DO   ✗ DO NOT

✓ DO	✗ DO NOT
Always wash your hands with soap and	Do not touch people with signs of Ebola or have died of Ebola
Always cook your food properly	Do not touch clothes & bed cloths of people who have died of Ebola
Go to health facility anytime you have head ache, fever, pain, diarrhea, red eyes rash and vomiting	Do not touch vomit, saliva, urine, blood and poo poo of people who have signs and symptoms of Ebola
Tell everyone you meet about Ebola so they can be informed	Do not play with monkeys and baboons
Call for help or questions 0886520581 or 0886374733	Do not eat bush meat
	Do not eat plums eaten by bats

Let's stop the spread of Ebola together

unicef
Healthy Life

Ebola and impact on social determinants of health

- Trading, industry, agriculture, tourism
- Worsening poverty
- Orphans and family disruption
- Stigma
- School closures
- Other diseases not being treated
- Lack of preventive care: prenatal care, EPI vaccination

Lessons Learnt

- We failed to control this outbreak because of
  - dysfunctional health systems in affected countries
  - high population mobility
  - local customs
  - densely populated capitals
  - lack of trust in authorities after years of armed conflict.
- Demonstrated the limited ability of public health systems to respond to rare, highly virulent communicable diseases.
- During and after this outbreak their will likely be more deaths from childbirth, malaria, TB and HIV/AIDS as health system is overwhelmed
- Fear and resistance has played a major role; technical vs culture

Will Ebola change the game? Ten essential reforms before the next pandemic. The report of the Harvard-LSHTM Independent Panel on the Global Response to Ebola

Suerie Moon, Devi Sridhar, Muhammad A Pate, Ashish K Jha, Chelsea Clinton, Sophie Delaunay, Valnora Edwin, Mosoka Fallah, David P Fidler, Laurie Garrett, Eric Goosby, Lawrence O Gostin, David L Heymann, Kelley Lee, Gabriel M Leung, J Stephen Morrison, Jorge Saavedra, Marcel Tanner, Jennifer A Leigh, Benjamin Hawkins, Liana R Woskie, Peter Piot

"We do not have the capacity to respond to this crisis on our own. If the international community does not stand up, we will be wiped out. We need your help. We need it now."

Naimah Jackson, Team Leader, Médecins Sans Frontières Ebola Treatment Center, Monrovia. Address to the UN Security Council, Sept 18, 2014[1]

Outbreak investigations: Laboratory Diagnostic Needs

	Chlamydia pneumoniae	**SARS**	**Flu**	**Ebola**	**Zika**
	Small towns and nursing homes, Canada 1996	Global 2003-4	Global 2009	Africa 2014	Brazil/Americas 2015
Causative pathogen	Recognised in 1989	Not known at the time of outbreak	Novel mutation of known virus	Known Virus	Virus first documented in Uganda in 1947
Outbreak investigation	Atypical pneumonia; ruled out all traditional causes				Public health emergency - association with microcephaly
Lab diagnosis	Direct immunofluoresence; PCR Need for easier test that can be done in nursing homes	None Need to identify the pathogen	PCR (rapid test for flu A) Need to adapt test to detect new strain	PCR Need a rapid and easier test	Serologically not distinguishable from other Flaviviruses; PCR Need a more specific test
Treatment	Azithromycin	-	$\pm$		-