

Introduction to infectious disease data

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Clinic on the Meaningful Modeling of Epidemiological Data
and BSc Honours Course in Biomathematics
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What is an infectious disease?

Disease

A deviation from the normal physiological status of an organism that negatively affects its survival or reproduction

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Infectious Disease

A disease in one organism (the host) that is caused by another organism (pathogen or parasite) which has entered the host's body

Case definition

“a set of standard criteria for deciding whether a person has a particular disease [or infection]”

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Person:

Place:

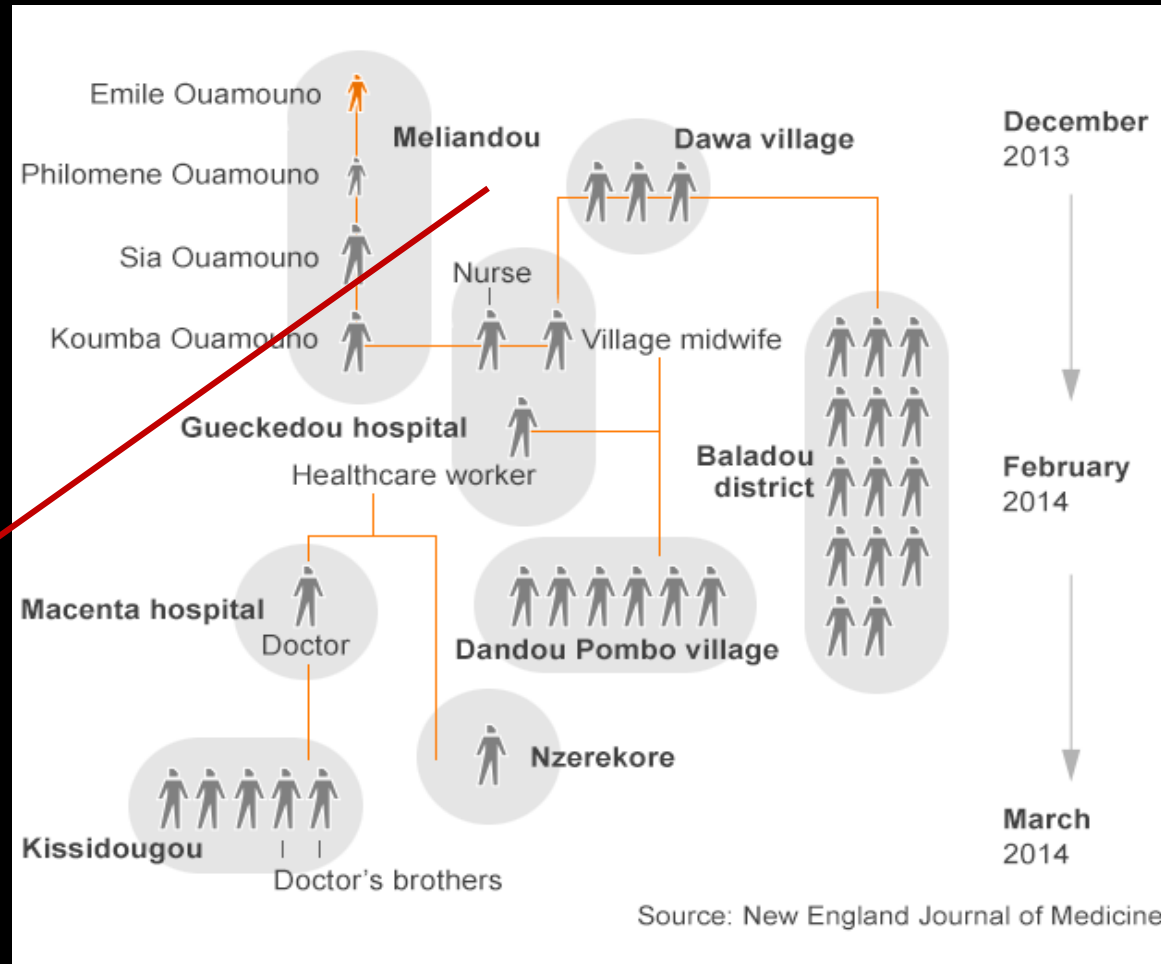
Time:

Clinical description:

A “case” study



West Africa



Case definition

“a set of standard criteria for deciding whether a person has a particular disease [or infection]”

Person: Residents of Meliandou, recent visitors to Meliandou

Place: West Africa, Guinea

Time: On or after November 15, 2013

Clinical description: Elevated body temperature or subjective fever or symptoms, including severe headache, fatigue, muscle pain, vomiting, diarrhea, abdominal pain, or unexplained hemorrhage



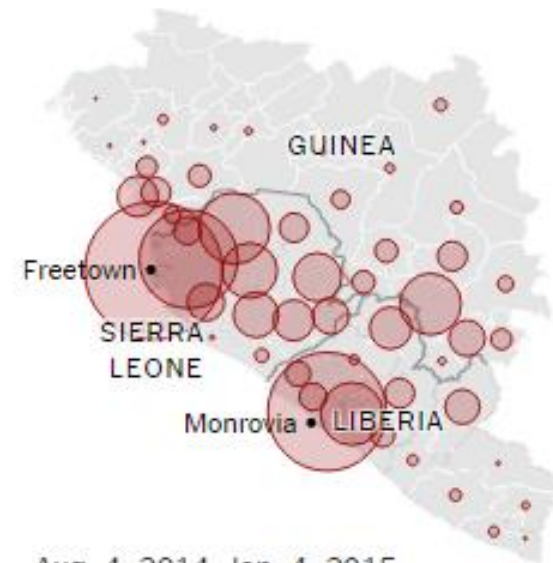
Dec. 30, 2013–May 4, 2014

The Outbreak Begins



May 5–Aug. 3, 2014

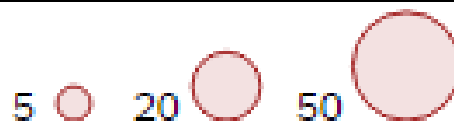
New Cases Rise Rapidly

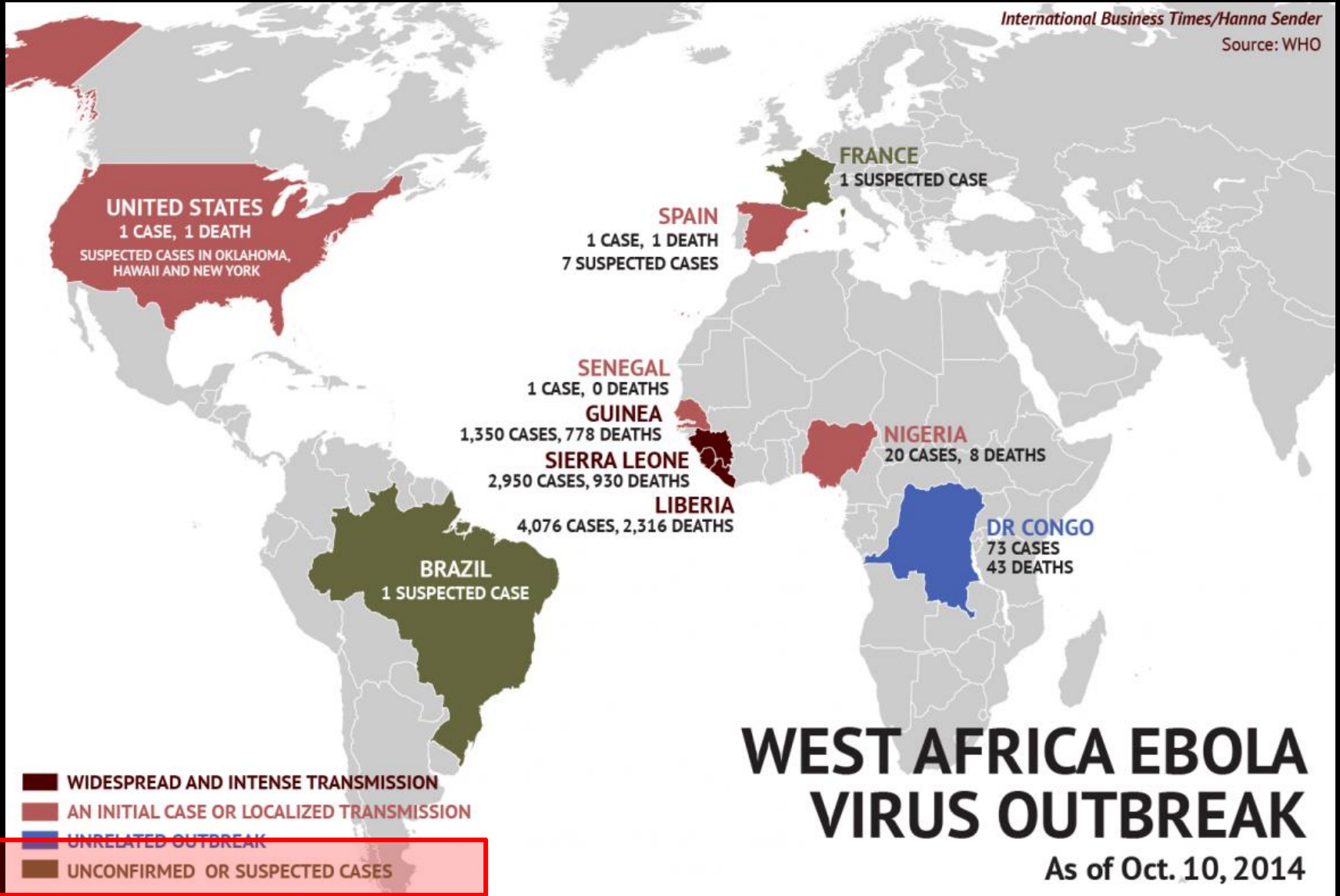


Aug. 4, 2014–Jan. 4, 2015

W.H.O. Sounds the Alarm

Average new cases each week





UNCONFIRMED OR SUSPECTED CASES

Confirmed case: signs and symptoms *plus* laboratory confirmation

Probable case: signs and symptoms in an individual meeting person, place, and time criteria *plus* contact with a known case *or* more specific clinical signs

Possible case: signs and symptoms in an individual meeting person, place, and time criteria *plus* a physician diagnosis

Suspect case: signs and symptoms in an individual meeting person, place, and time criteria

Not a case: failure to fulfill the criteria for a confirmed, probable, possible, or suspect case

Case definition

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Person:

Place:

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Case definition for Ebola

Person: Residents of and recent visitors to West Africa, including Senegal, Guinea, Sierra Leone and Liberia, as well as their close contacts or others in their community

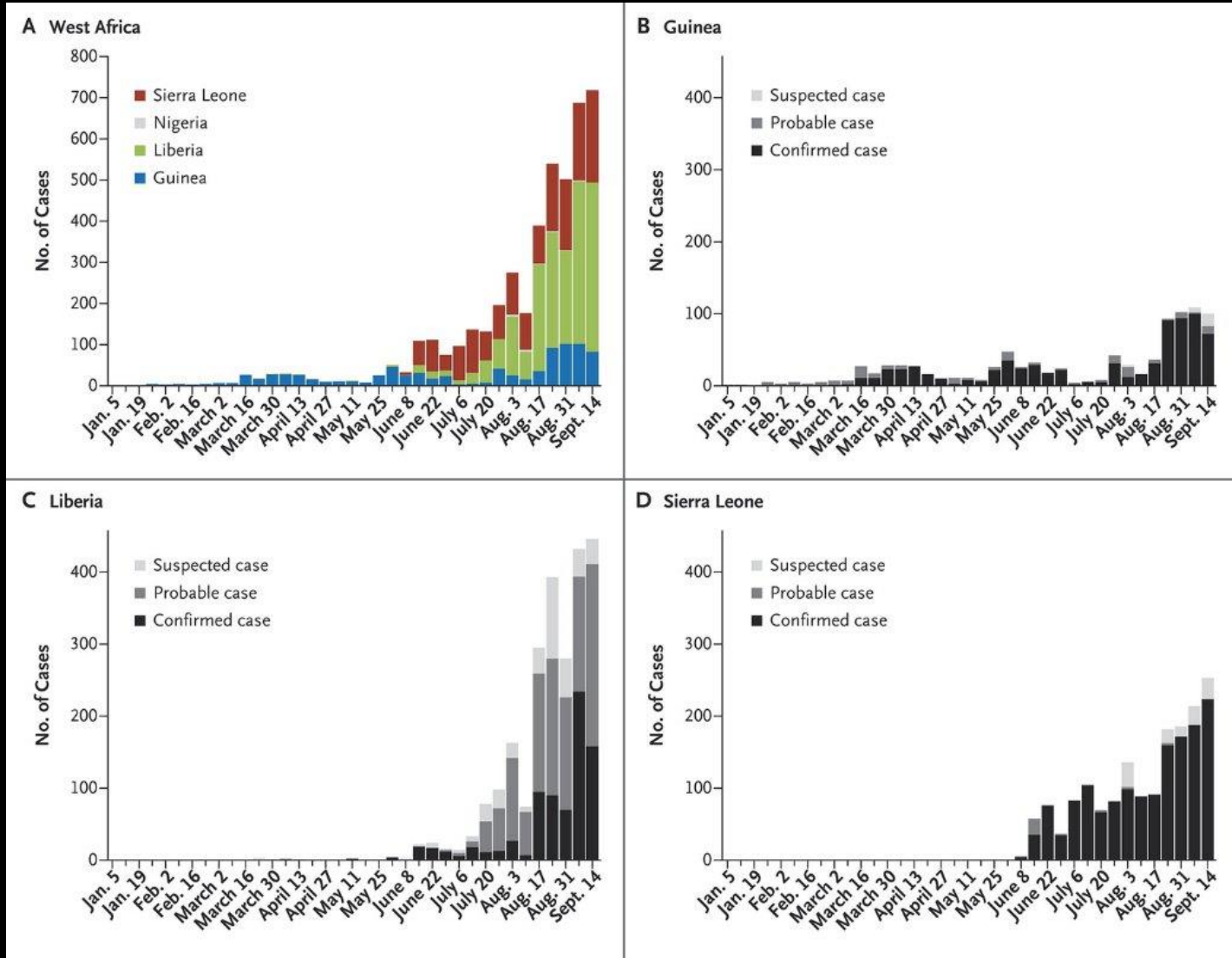
Place: Worldwide

Time: On or after November 15, 2013

Clinical Description: Illness with onset of fever and no response to treatment for usual causes of fever in the area, and at least one of the following signs: bloody diarrhoea, bleeding from gums, bleeding into skin (purpura), bleeding into eyes and urine.

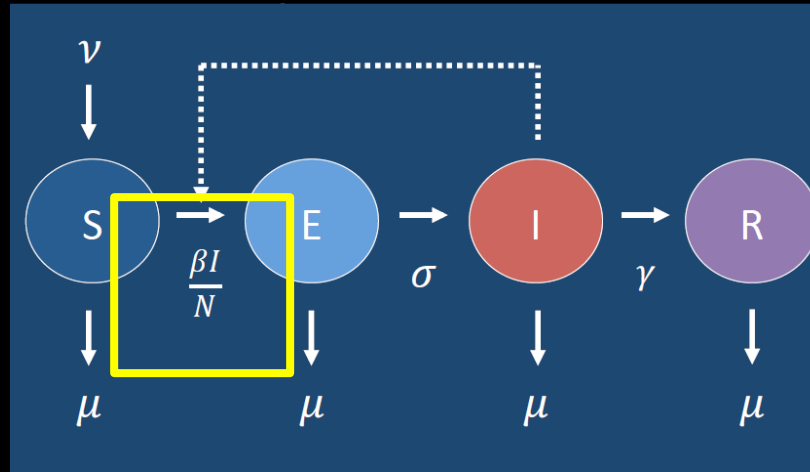
Incidence of disease

Weekly incidence of confirmed, probable and suspected Ebola cases in West Africa



Incidence of infection

Mathematical expression?



SEIR Model

$$\frac{dS}{dt} = \nu - \frac{\beta SI}{N} - \mu S$$

ν birth rate

$$\frac{dE}{dt} = \frac{\beta SI}{N} + \sigma E - \mu E$$

μ mortality rate

$$\frac{dI}{dt} = \sigma E - \gamma I - \mu I$$

σ 1 / latent period

$$\frac{dR}{dt} = \gamma I - \mu R$$

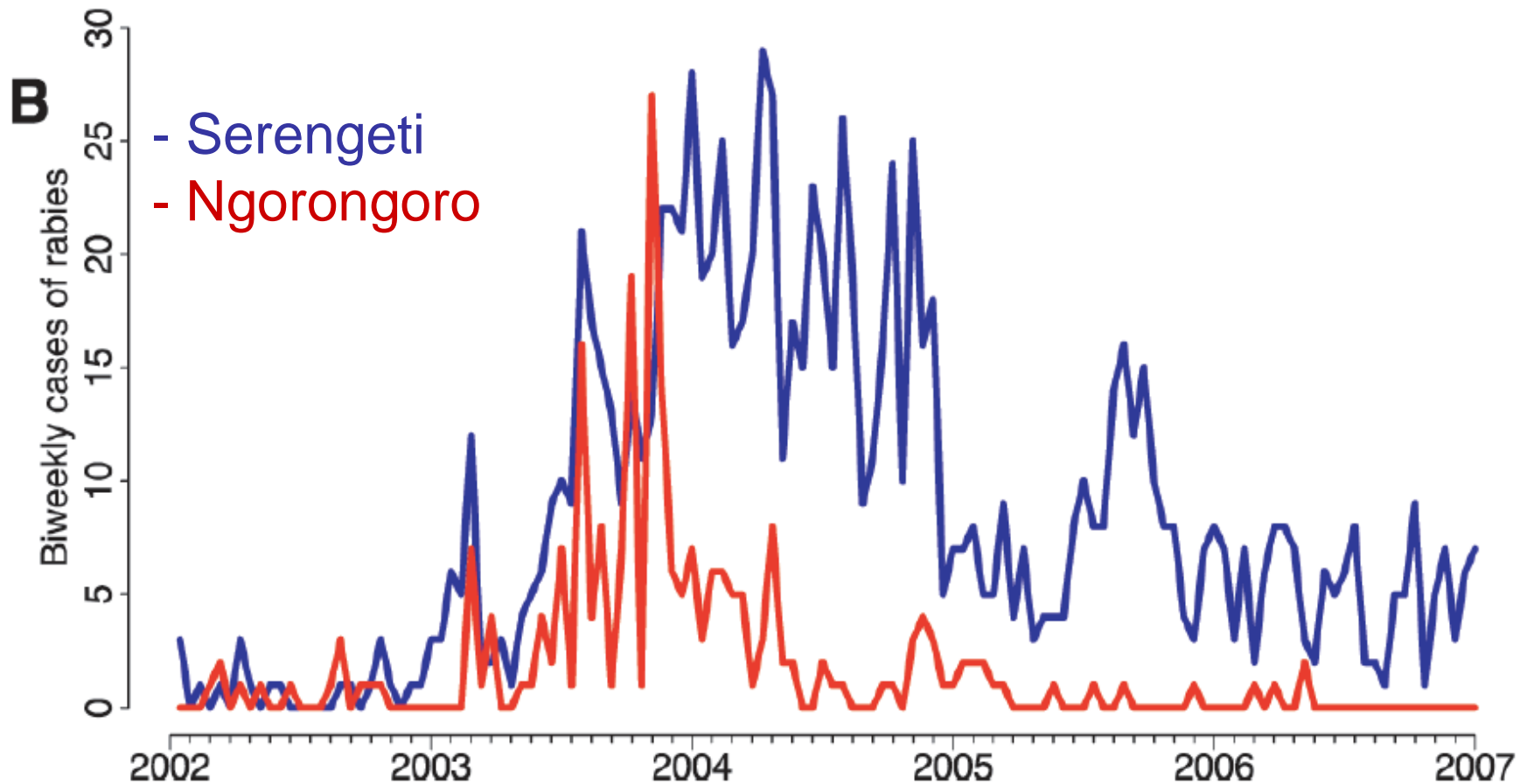
γ 1 / infectious period

β transmission coefficient

Ways of collecting data on cases

Surveillance

+ Contact Tracing/Outbreak investigation



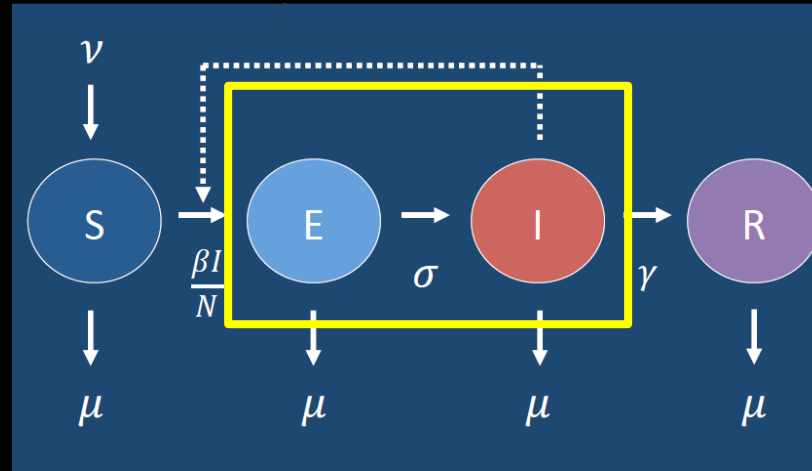
Ways of collecting data on cases

- Passive
- Active

Epidemiological studies

- Case-series
- Case-control
- Cohort
- Outbreak investigations

Prevalence



$$\frac{E + I}{N}$$

Mathematical expression?

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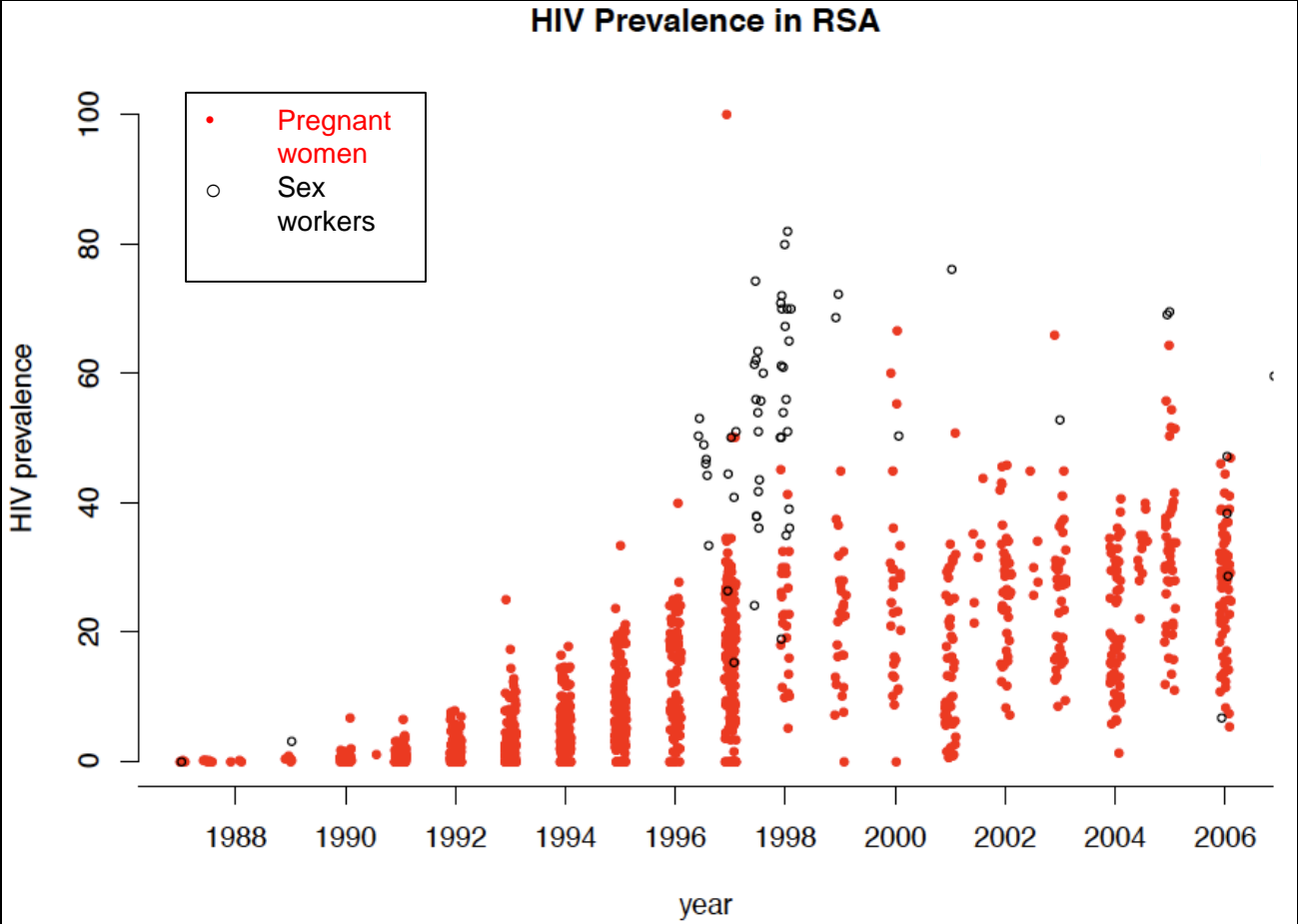
of infection

of disease

of antibodies

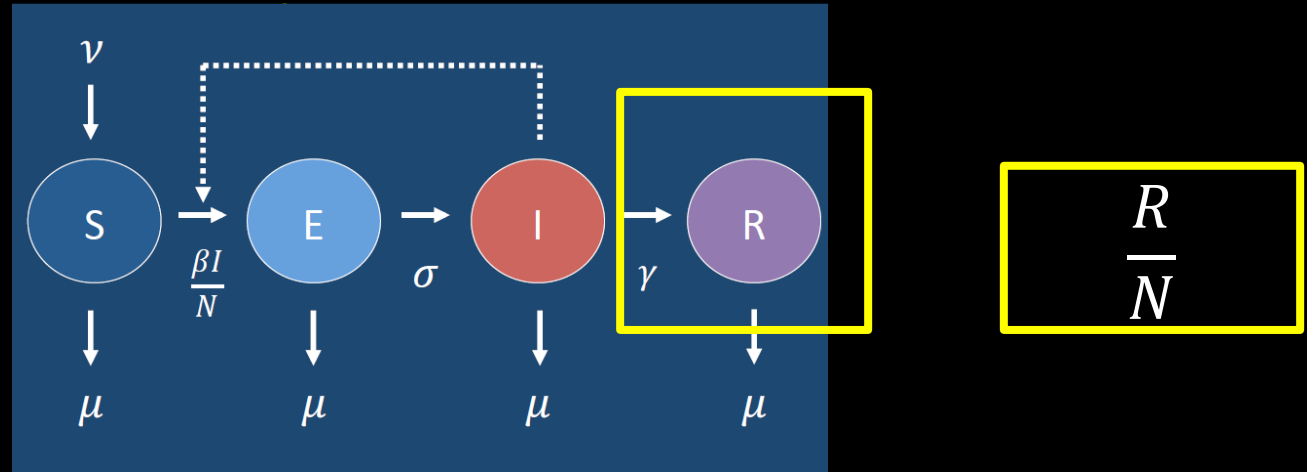
(seroprevalence)

Prevalence



Source: UNAIDS HIV Surveillance Database

Prevalence



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Mathematical expression?

of infection

of disease

of antibodies
(seroprevalence)

Seroprevalence

Can be related to:

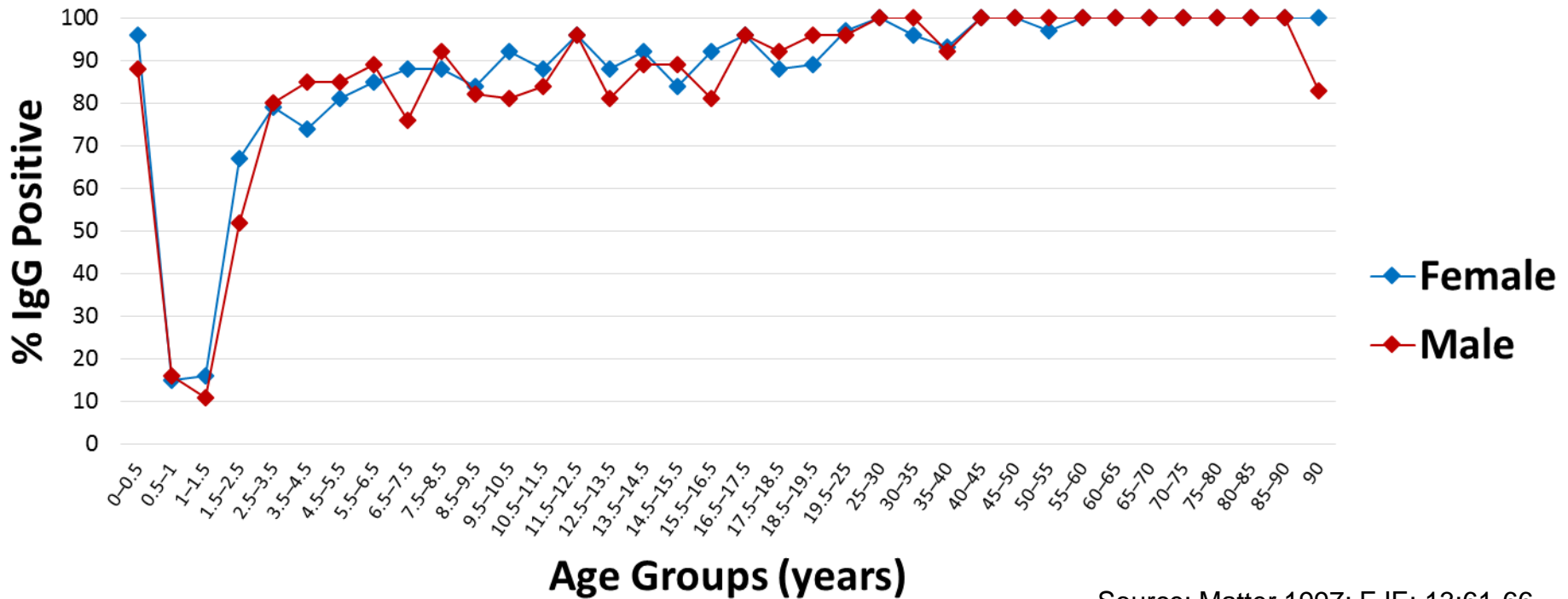
- * Prevalence of infection
- * Past exposure

May or may not be:

- * Prevalence of resistance
- * Specific to infection of interest

Seroprevalence

Prevalence of IgG Antibodies against Measles



Source: Matter 1997; EJE; 13:61-66

Can be related to:

- Prevalence of infection
- Past exposure

May or may not be:

- Prevalence of resistance
- Specific to infection

Levels of data aggregation

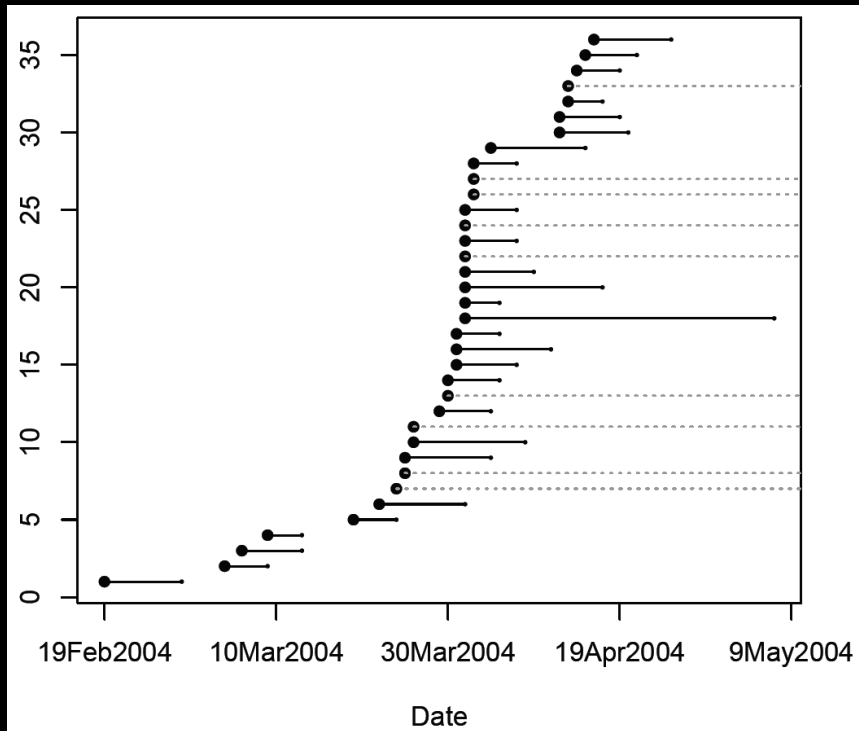
Aggregated data

De-identified data

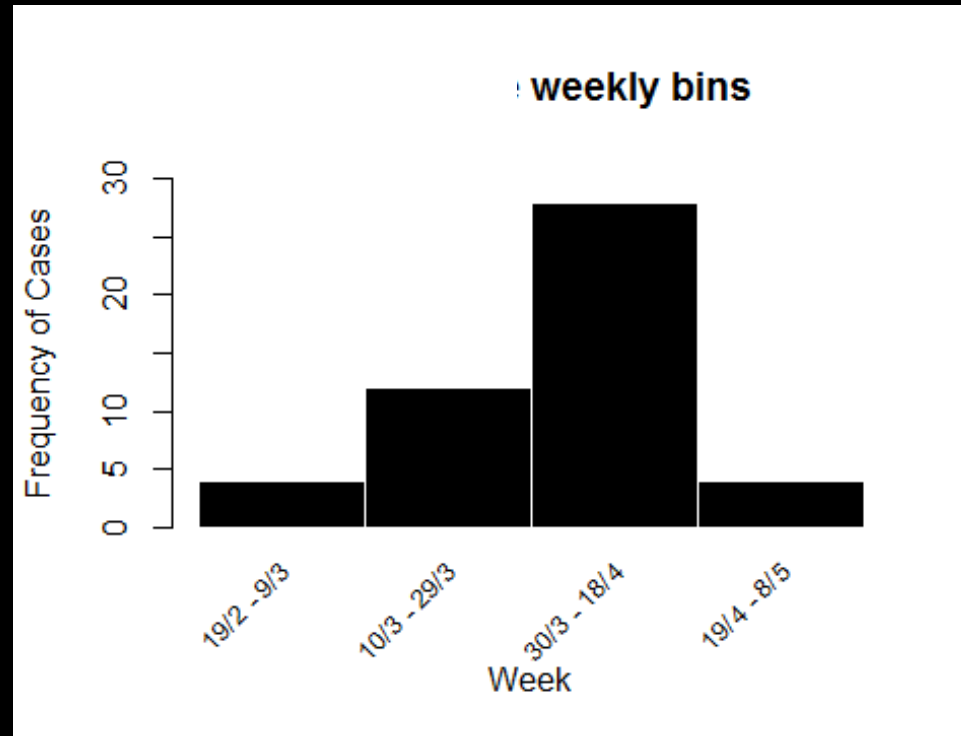
Personally identifying data

Levels of data aggregation

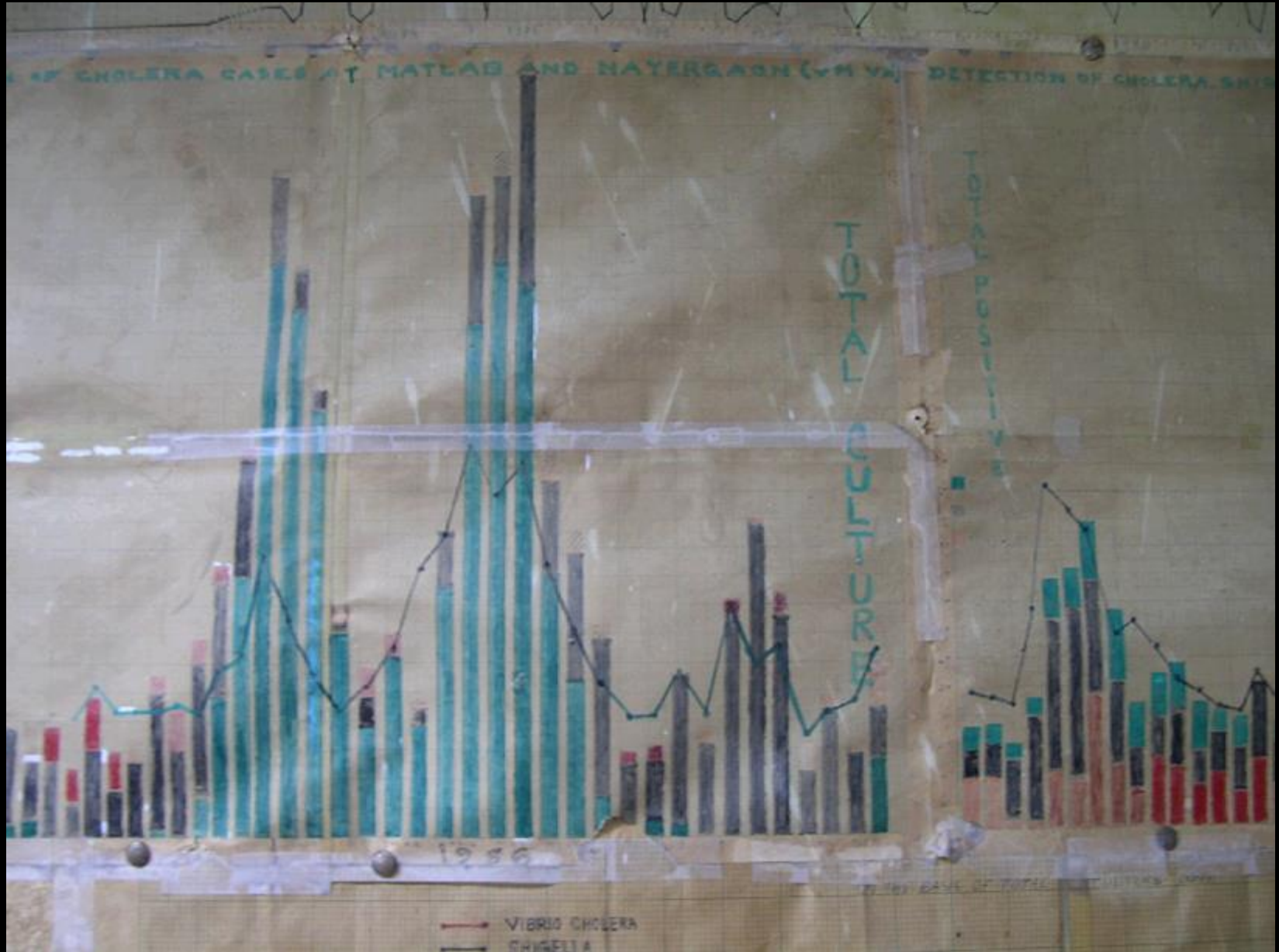
De-identified data



Aggregated data



Visualizing data before R...



End – Thank you!