Overview on Study Design for Outbreak Investigation

A workshop

NPW, Myanmar, Nov 27-Dec 1, 2017

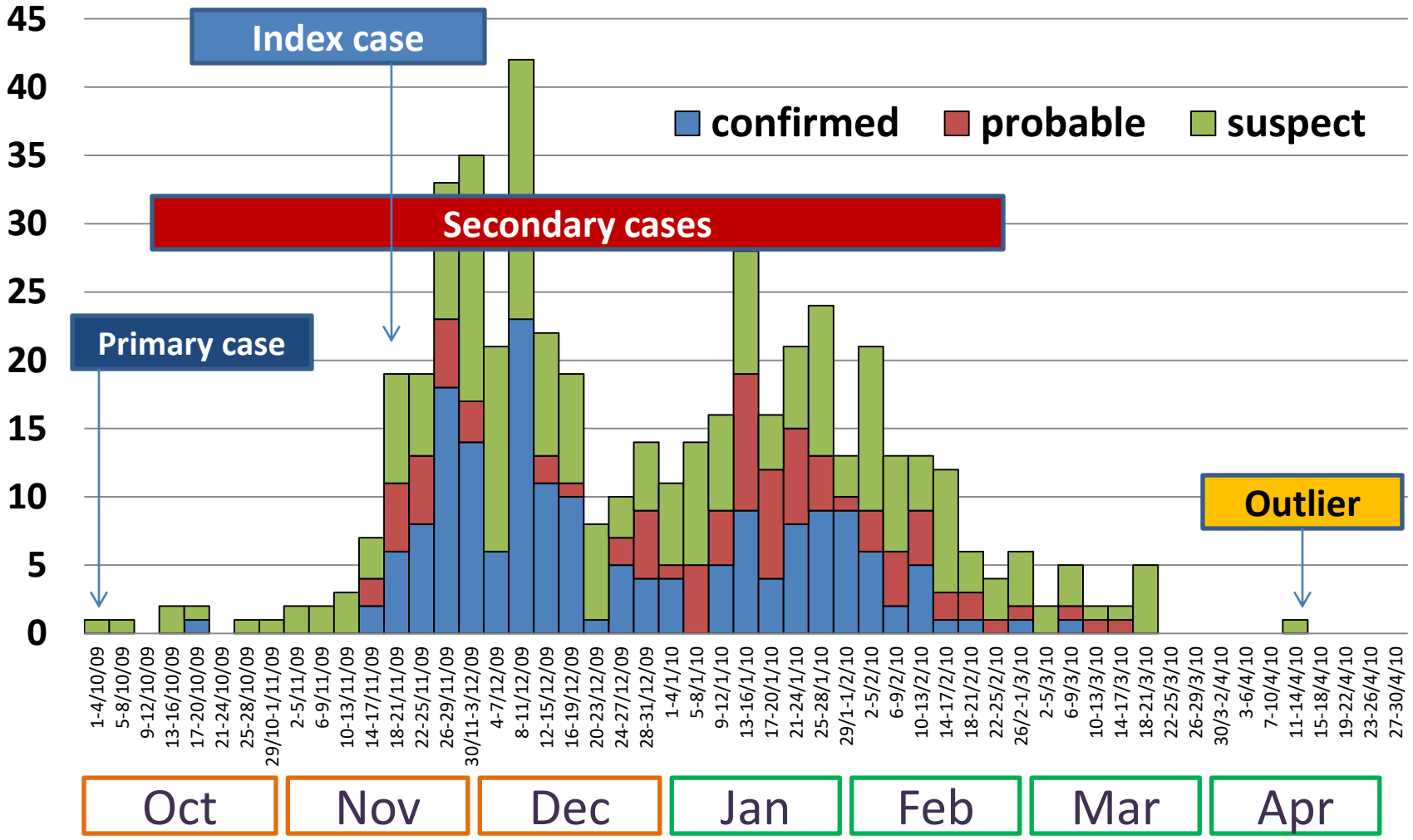
Terms

- Epidemic = Outbreak
  (Outbreak -> a sense of emergency,
  Epidemic -> a sense of wide spreading)
- Cluster = an aggregation of cases in a given place & time
- Pandemic = The epidemic that spreads over many countries or regions of the world
- Endemic = A disease that normally occurs in an area

Terms

- **Index case:** the first disease case brought to the attention of the epidemiologist. The index case is not always the primary case
- **Primary case:** the first disease case in the population (or family)
- **Secondary cases**: those persons who became infected from contact with the primary case or other previous secondary cases
- Outlier: observation differing so widely from the rest of the data.

Example of Epidemic curve



typ

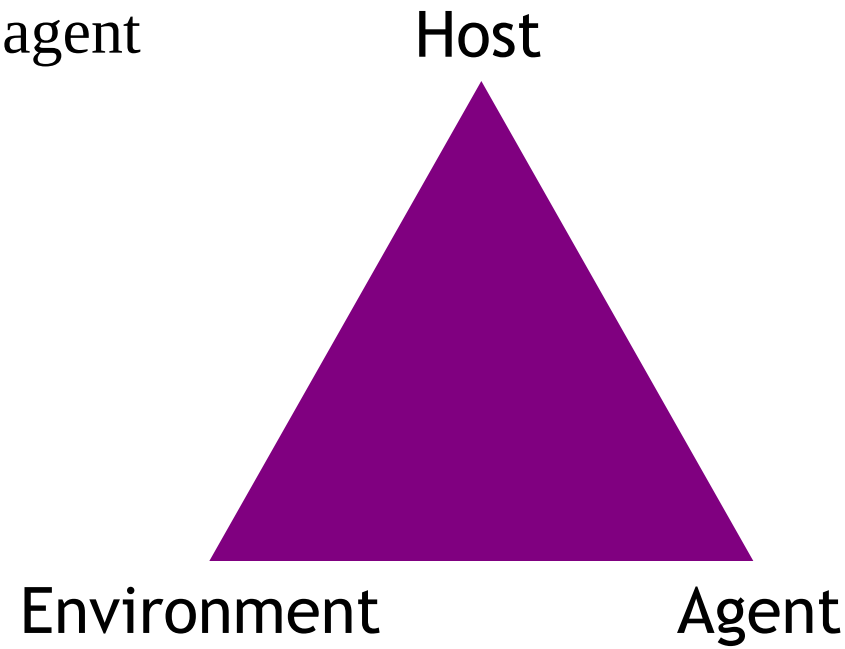
General Purposes of Outbreak Investigation

- Control the current outbreak
- Prevent occurrence of future outbreak
- Respond to public or legal concern
- Research for more *knowledge* of the diseases
- *Evaluate* effectiveness of prevention programs
- *Evaluate* effectiveness of the existing surveillance

- Train health professionals

Specific objectives of investigation

1. Verify outbreak and diagnose the agent
2. Characterize magnitude, severity, & distribution
3. Identify population at risk
4. Identify source, mode of transmission, and risk factors
5. Provide appropriate prevention and control measures



An outbreak comes from a change in the way the host, the environment and the agent interact:
This interaction needs to be understood to propose recommendations

The design of Outbreak Investigation primary consideration

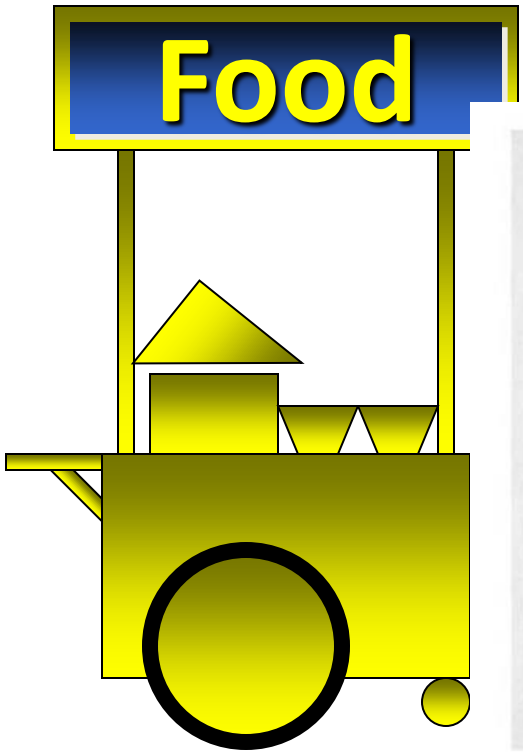
- No rule of Thumb
- Context of the outbreak, situation
- Settings
- Descriptive of the outbreak – patterns
- Natural history of diseases
- Ultimate goal for outbreak control and prevention
- Mix approach “One Health” are common

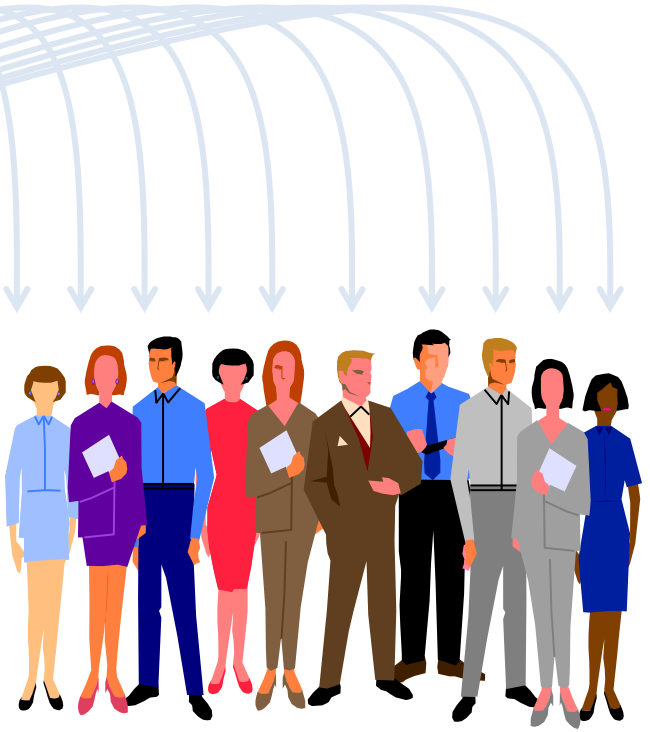
Type of Outbreak Source

- Common source
  - Point
  - Intermittent
  - Continuous
- Propagated source

  = person-to-person transmission
- Mixed source

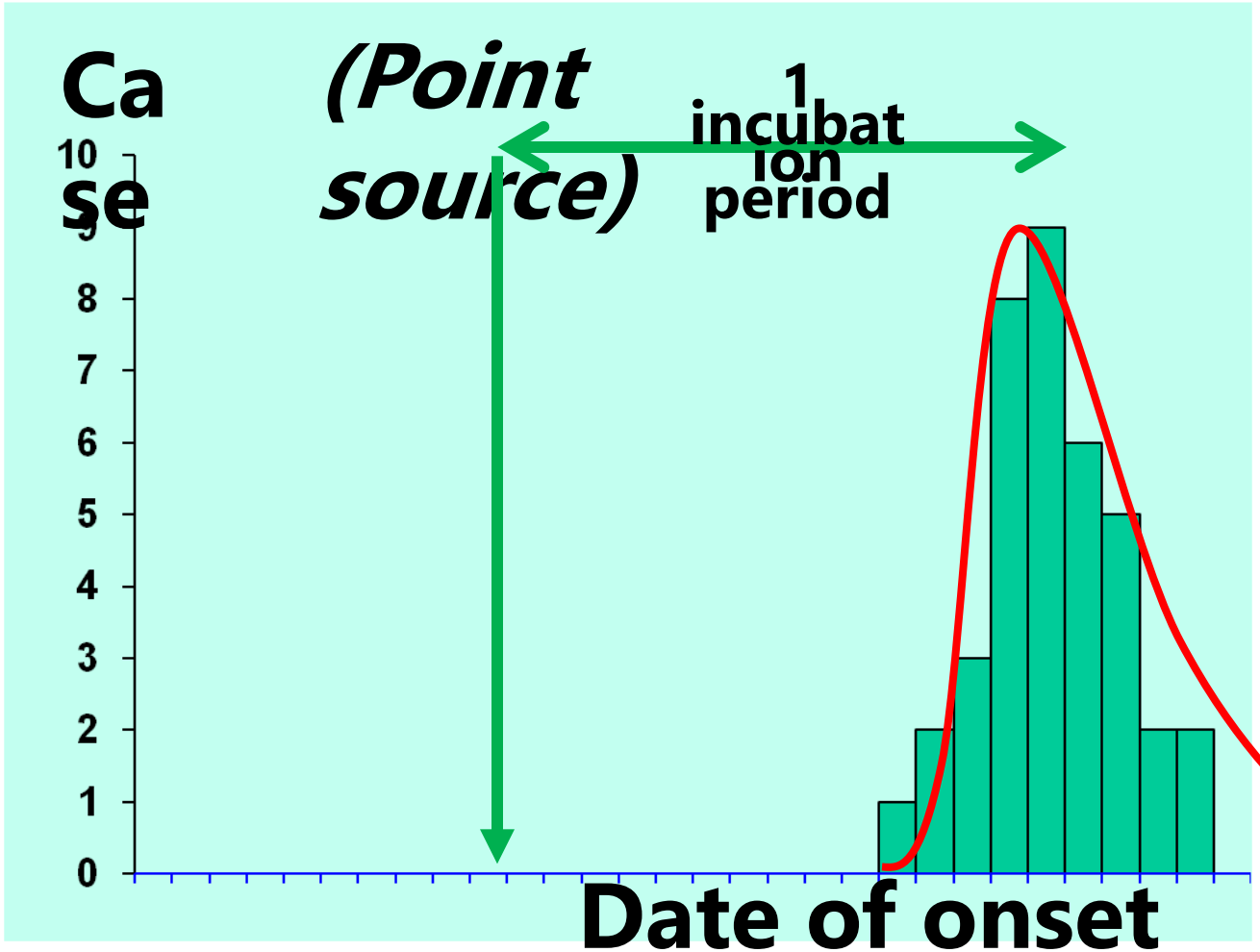
Common source outbreak





- People are exposed just once, or continuously or intermittently to a harmful source
- Period of exposure may be brief or long

Epidemic curve of point common source outbreak

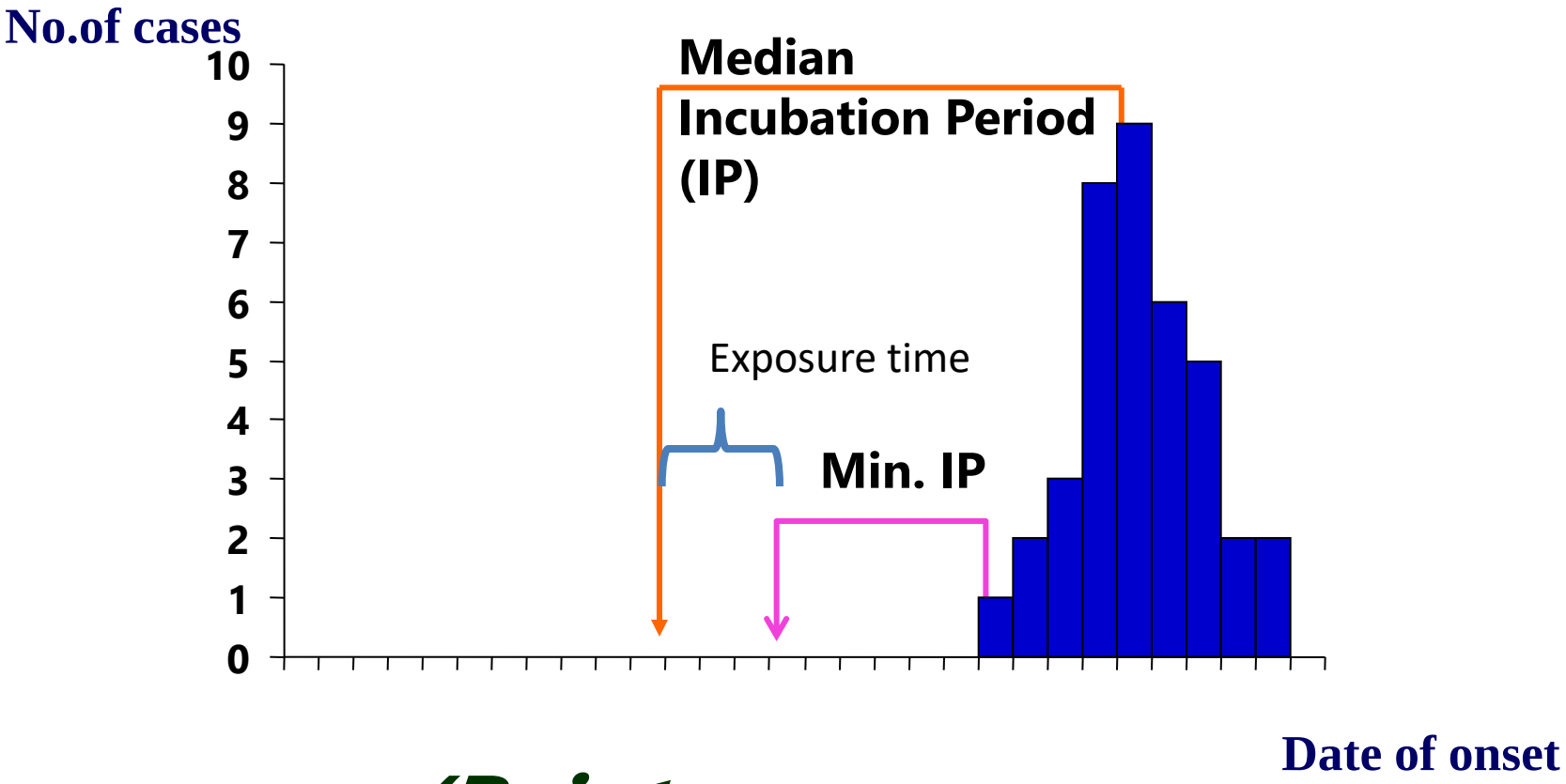


Point source

- All cases occur in 1 incubation period
- Sharp upward
- More gradual down slope
- Able to predict exposure period

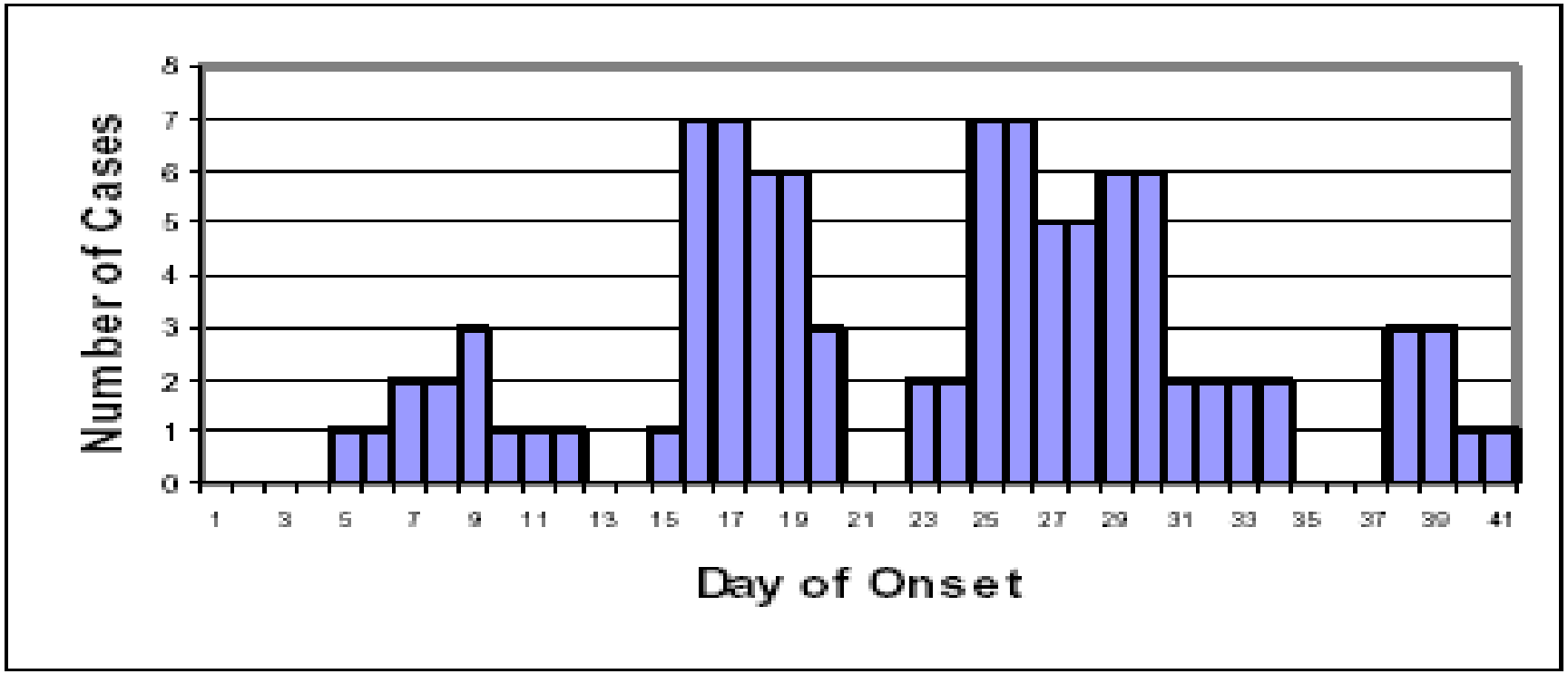
How to calculate exposure time

Example: typhoid fever --median incubation period is 15 days
Minimum 3 days, maximum 60 days

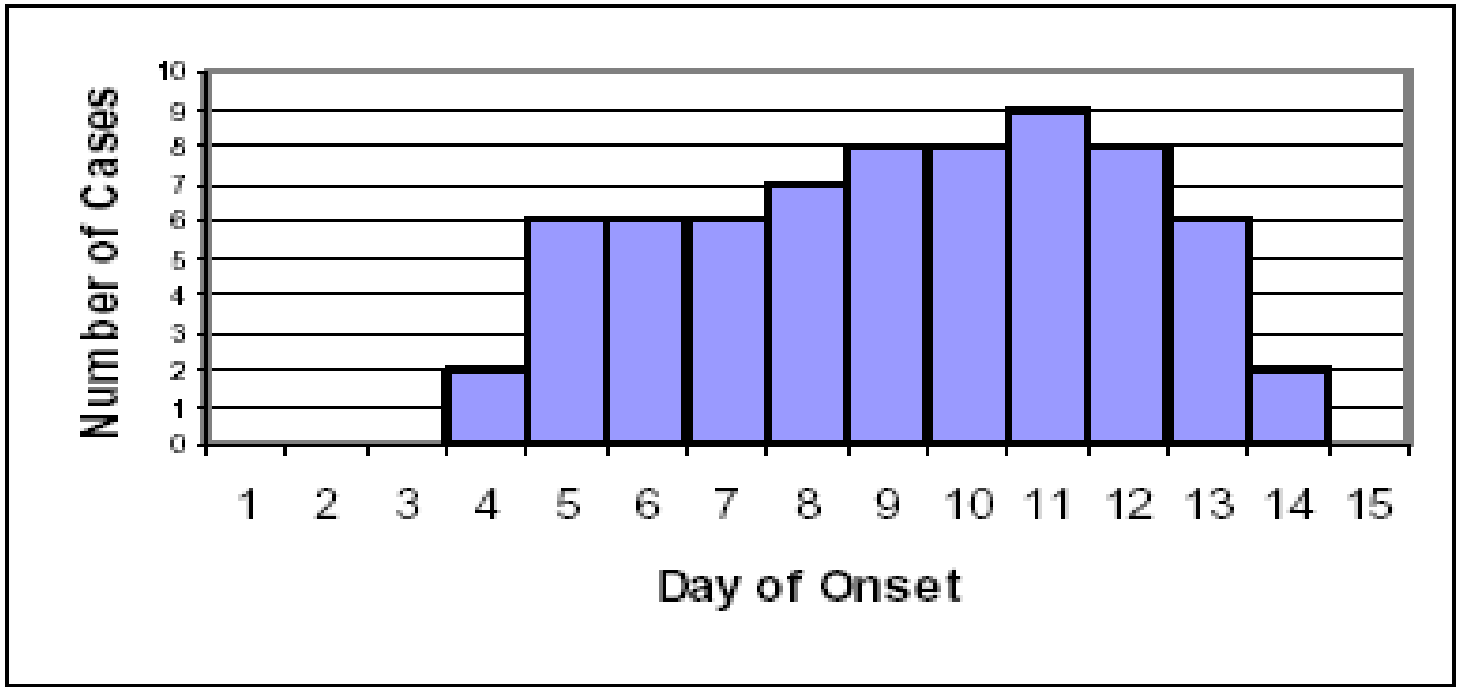


(Point source outbreak)

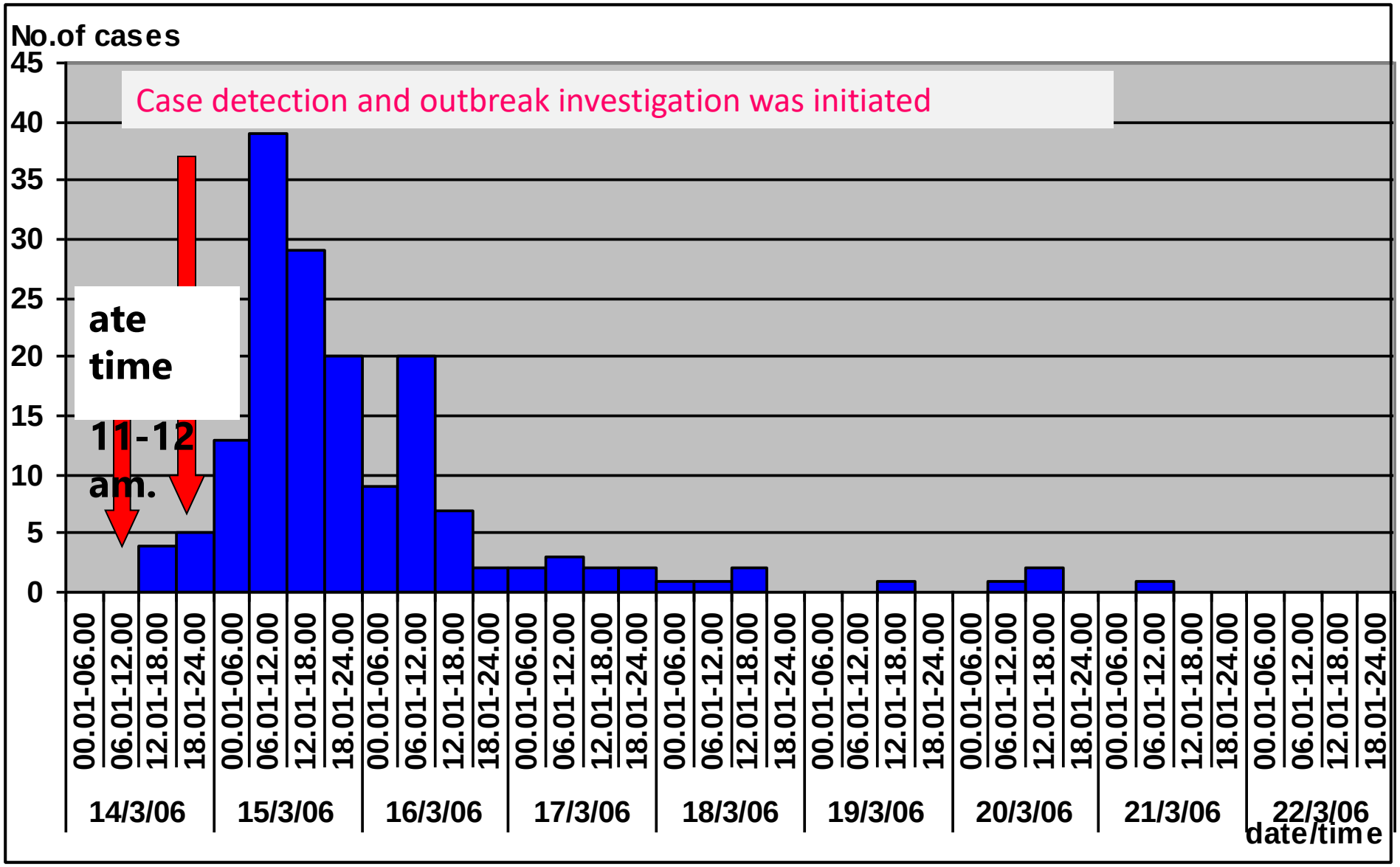
Example of an Epi-Curve for a Common Source Outbreak with Intermittent Exposure



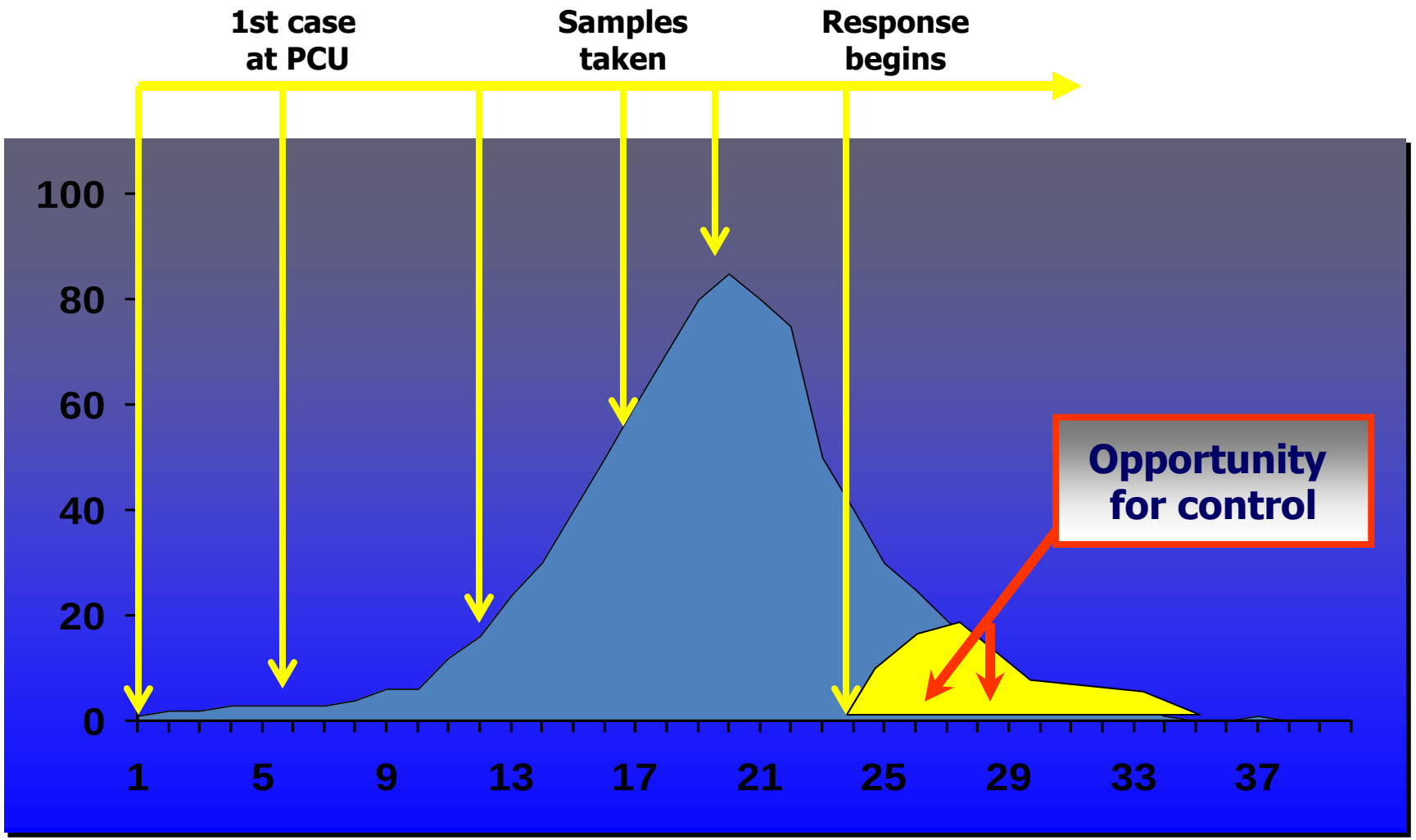
Example of an Epi-Curve for a Common Source Outbreak with Continuous Exposure



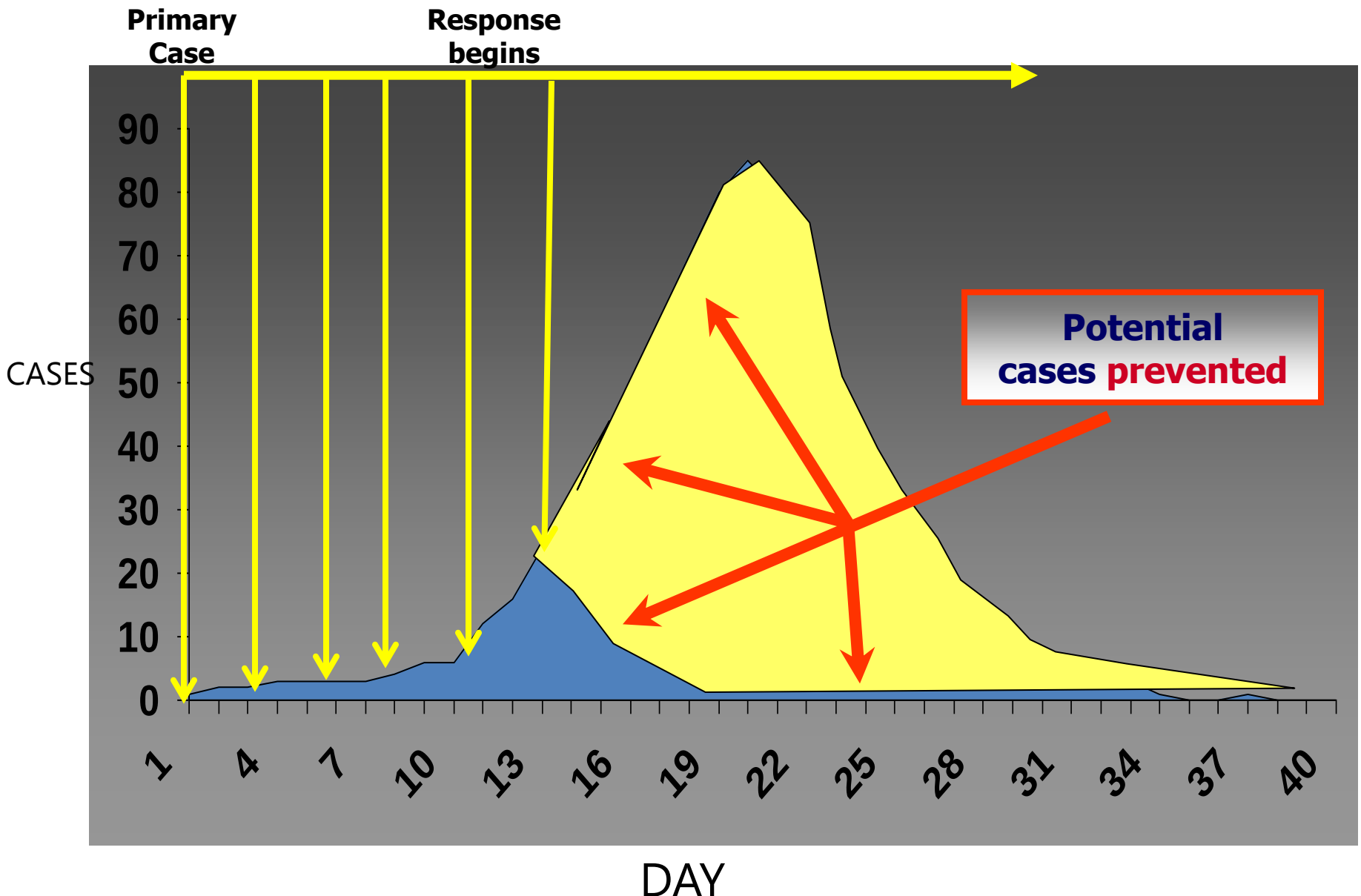
Distribution of suspected Botulism cases by time and date of onset, 14-22 March (N=180)



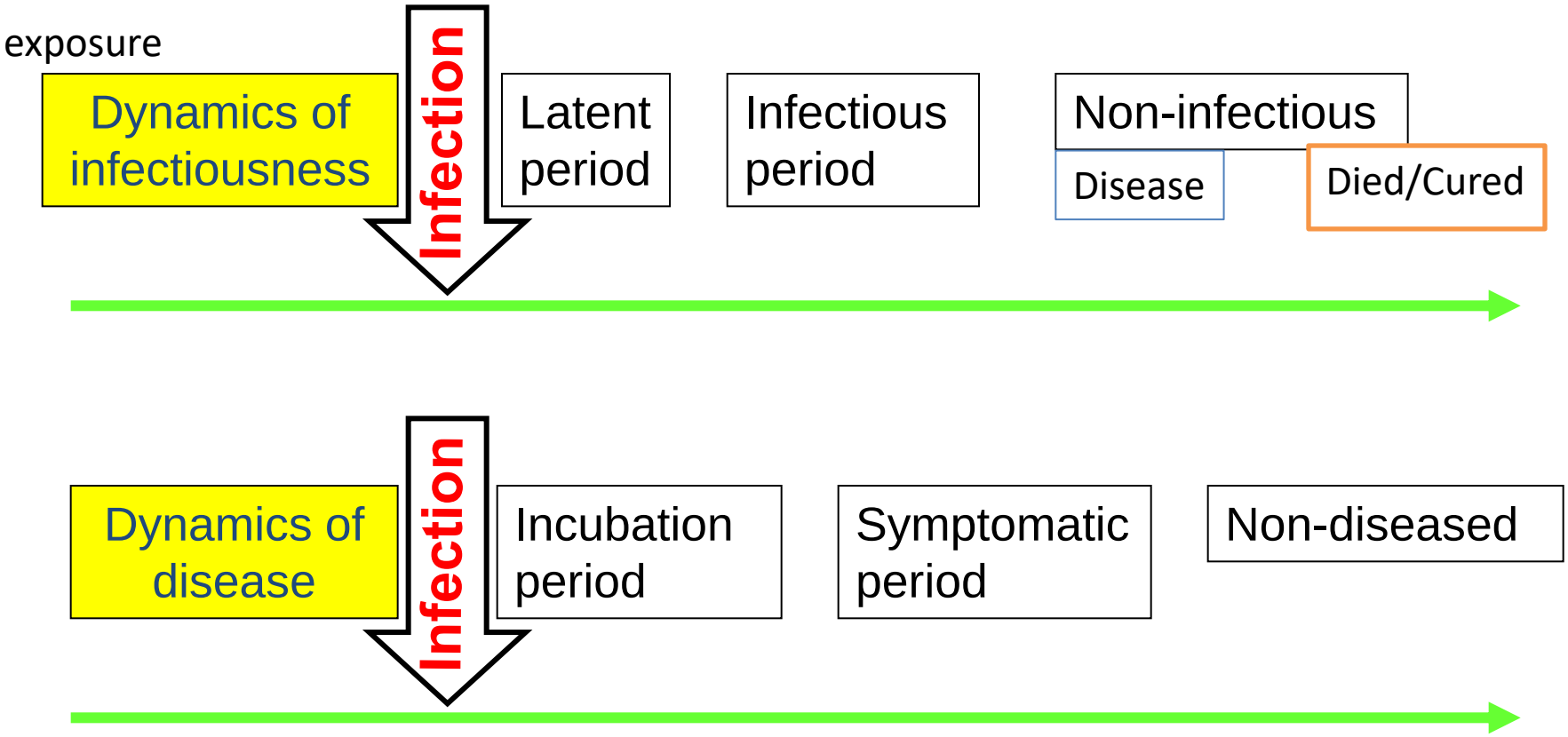
“Usual” sequence of events



“Ideal” sequence of events



Exposure, time to infection and disease



susceptibility **Incubation**

symptoms **disease/died/cured**

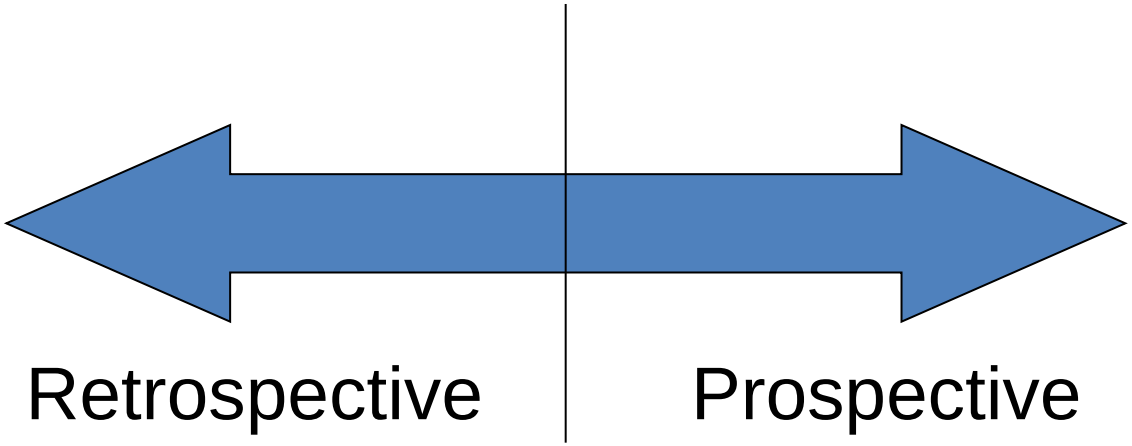
The study of the Outbreak

- Case Investigation (individual case, important for …. Diagnosis, detail of disease manifestation, emerging problem)
- Cases Series: collection of cases to describe the problem and descriptive characteristics
- Survey (active) - less common
- Descriptive study (Describe – pattern of occurrence in Place-Time-Person)
- Analytic Study (study the determinants, etiology, risk factor by analysis, testing hypothesis and evidences from laboratory /biological / environmental data)

Epidemiology Study

Very important to obtain and apply knowledge to prevent and control disease/outbreak

- Type :Observation vs. Experiment
- Retrospective or Prospective

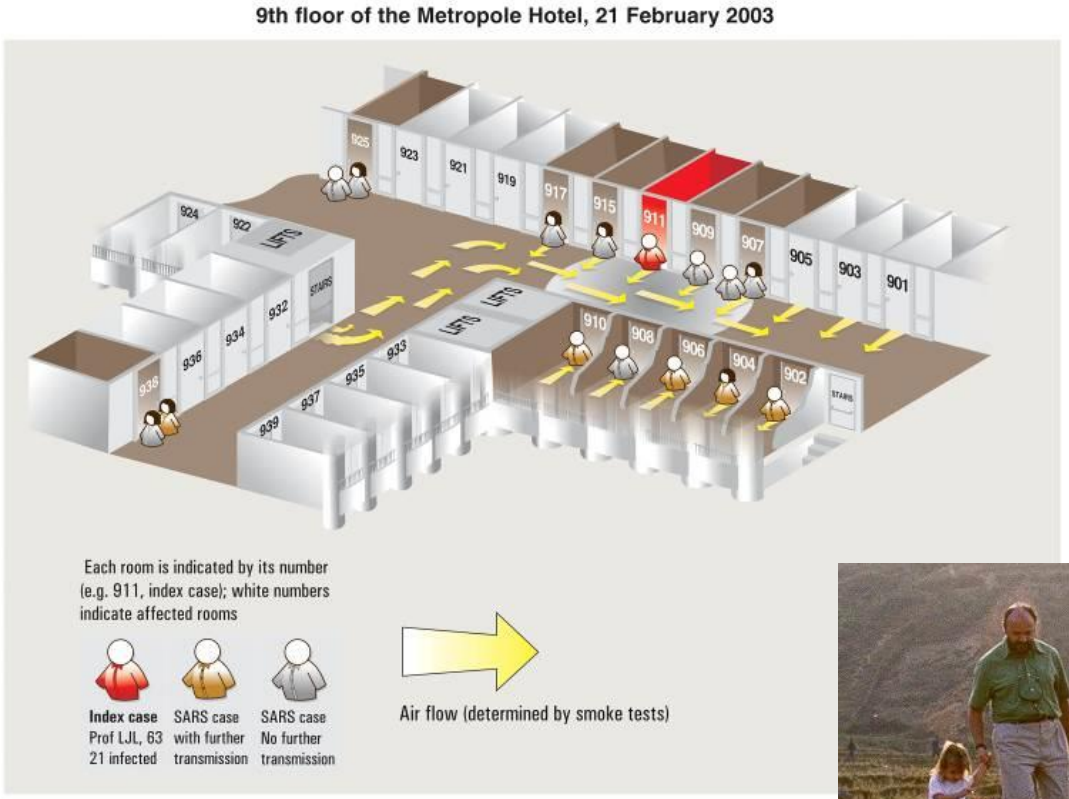


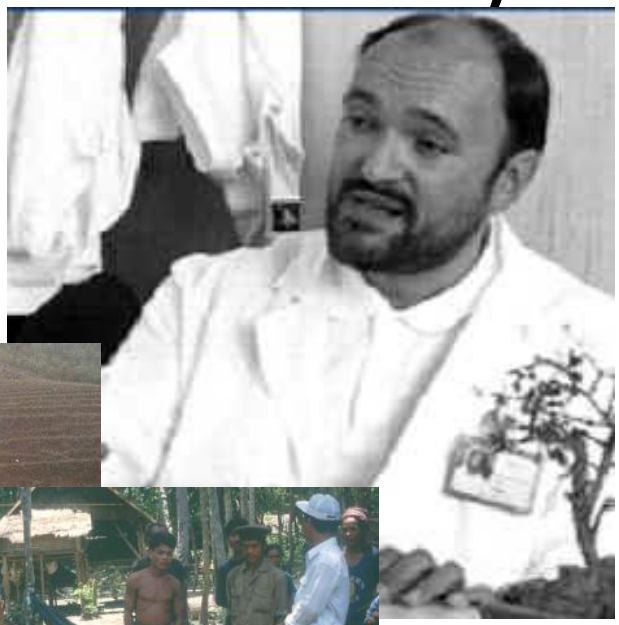
Cross-sectional

Case Investigation

- Important in emerging disease (novel infection)
- SARs
- Avian Influenza
- MERS
- Severe community illness
- Hospital Infections, AMR
- Unusual cases
- New Threats : H7N6, SARI
- Animal Disease

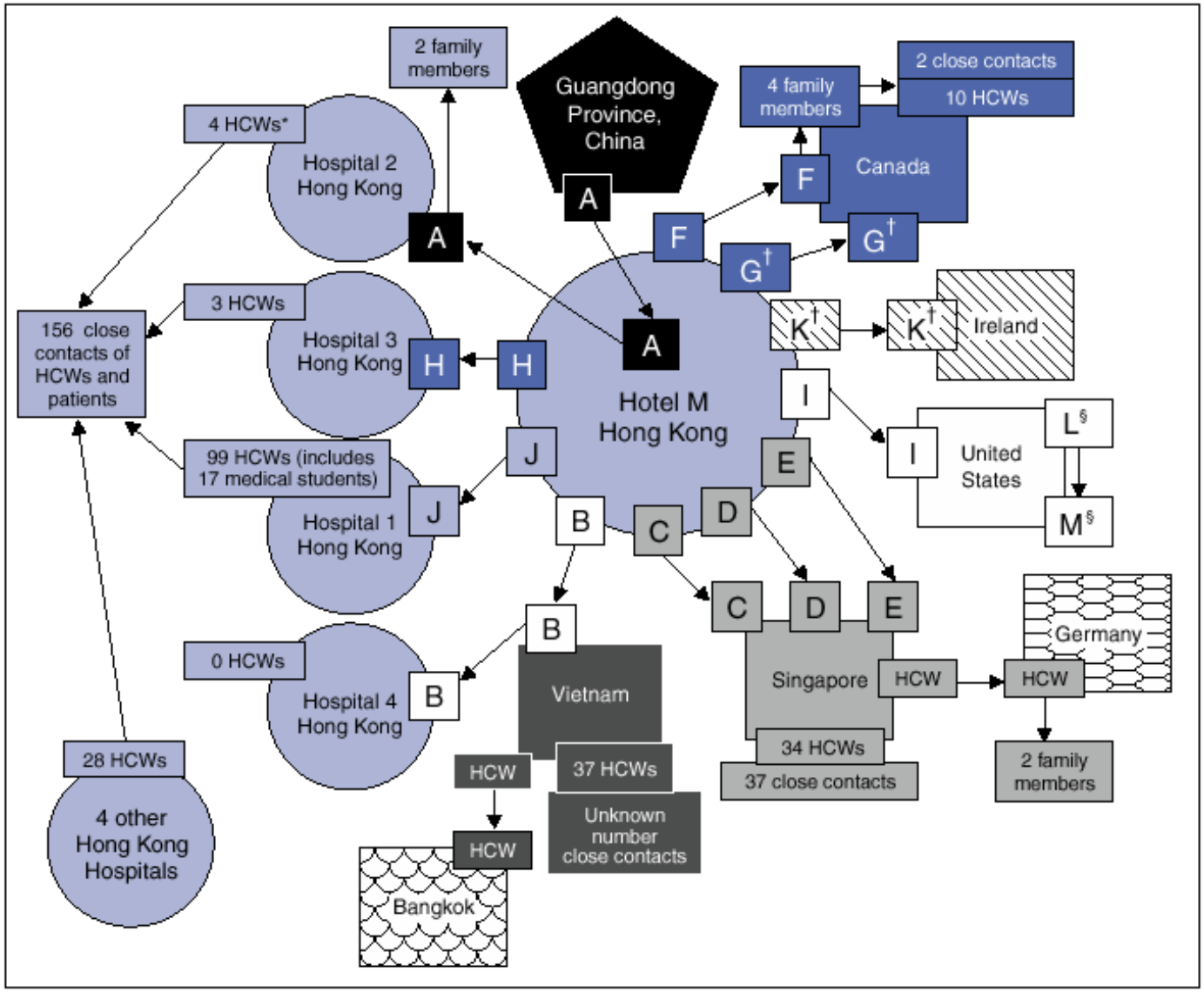
Dr. Carlo Urbani (1956-2003)





Dr. Urbani was the first World Health Organization (WHO) officer to identify the outbreak of this new disease, in an American businessman who had been admitted to a hospital in Hanoi. Because of his early detection of SARS, global surveillance was heightened and many new cases have been identified and isolated before they infected hospital staff.

FIGURE 1. Chain of transmission among guests at Hotel M — Hong Kong, 2003



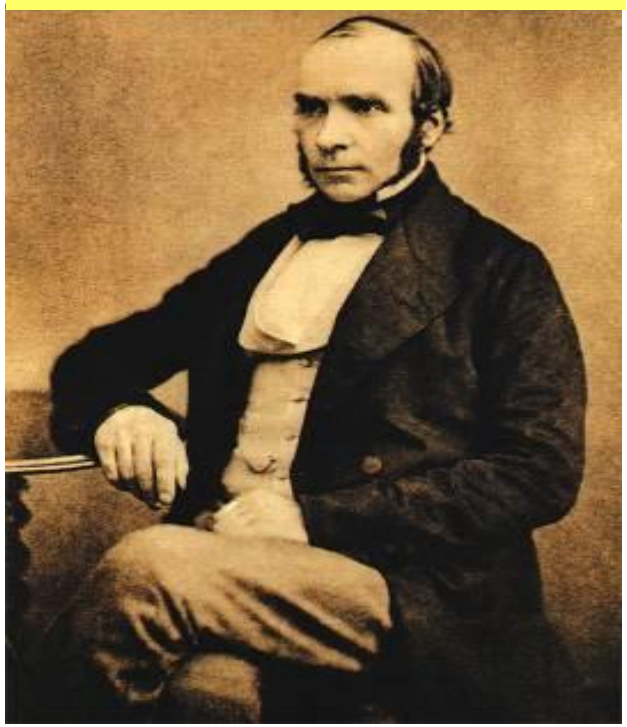
* Health-care workers.
† All guests except G and K stayed on the 9th floor of the hotel. Guest G stayed on the 14th floor, and Guest K stayed on the 11th floor.
§ Guests L and M (spouses) were not at Hotel M during the same time as index Guest A but were at the hotel during the same times as Guests G, H, and I, who were ill during this period.

First MERS in Korea and transmission

Descriptive Study

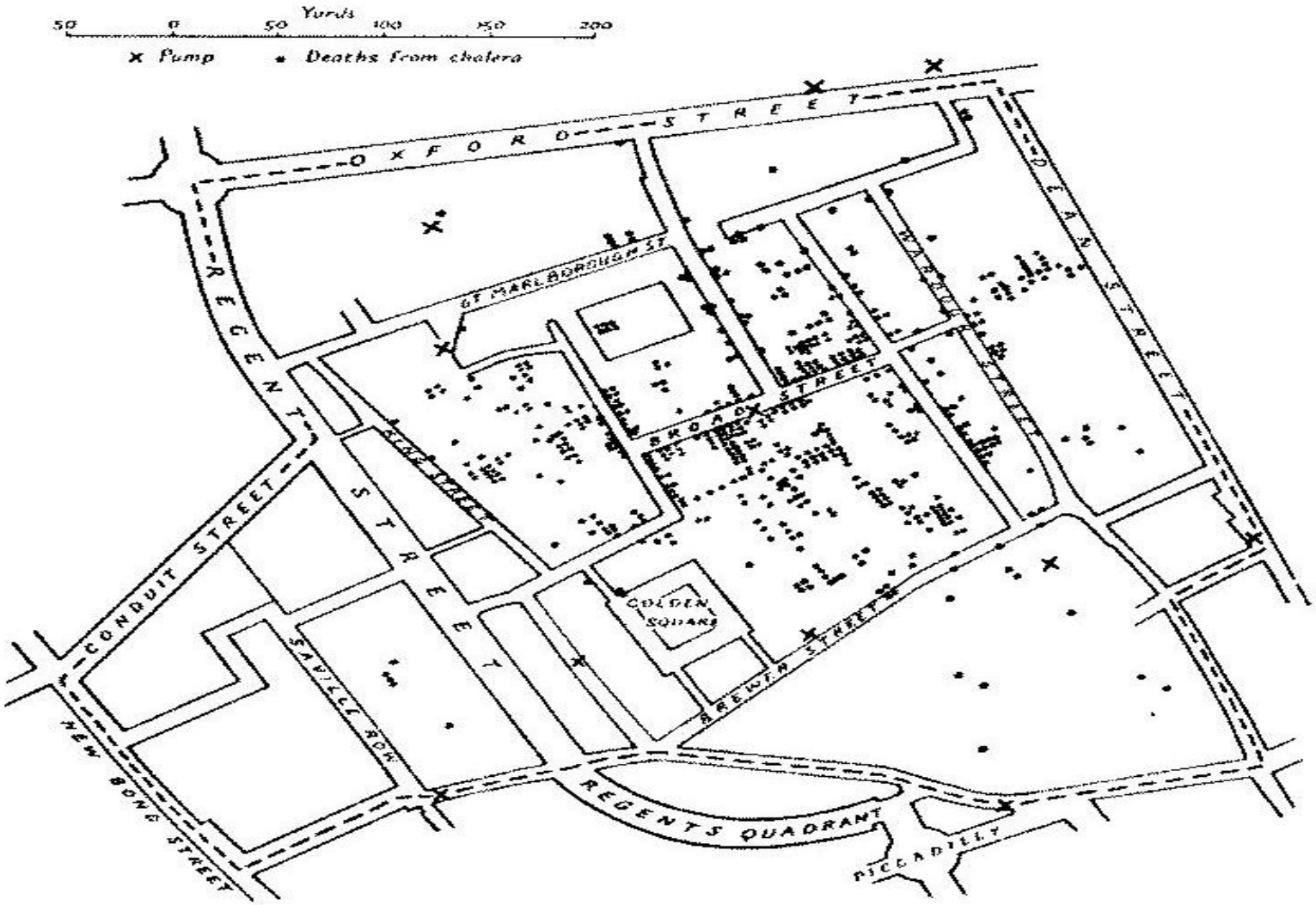
John Snow investigation of Severe Diarrhea in London 1854

John Snow, M.D.
(1813 -1858)



Diarrhea deaths : 500 in only 10 days

Map : Place –Time – Patient and comparison study



Descriptive comparison study

Water company	Household	HH with cases	Death per 10000 HH
Southwark & Vauxhall Company	40,046	1,263	315
Lamberth Company	26,107	98	37
Rest of London	256,423	1,422	59

Descriptive data collection and analysis

Obtain information

Identifying information

Demographic information

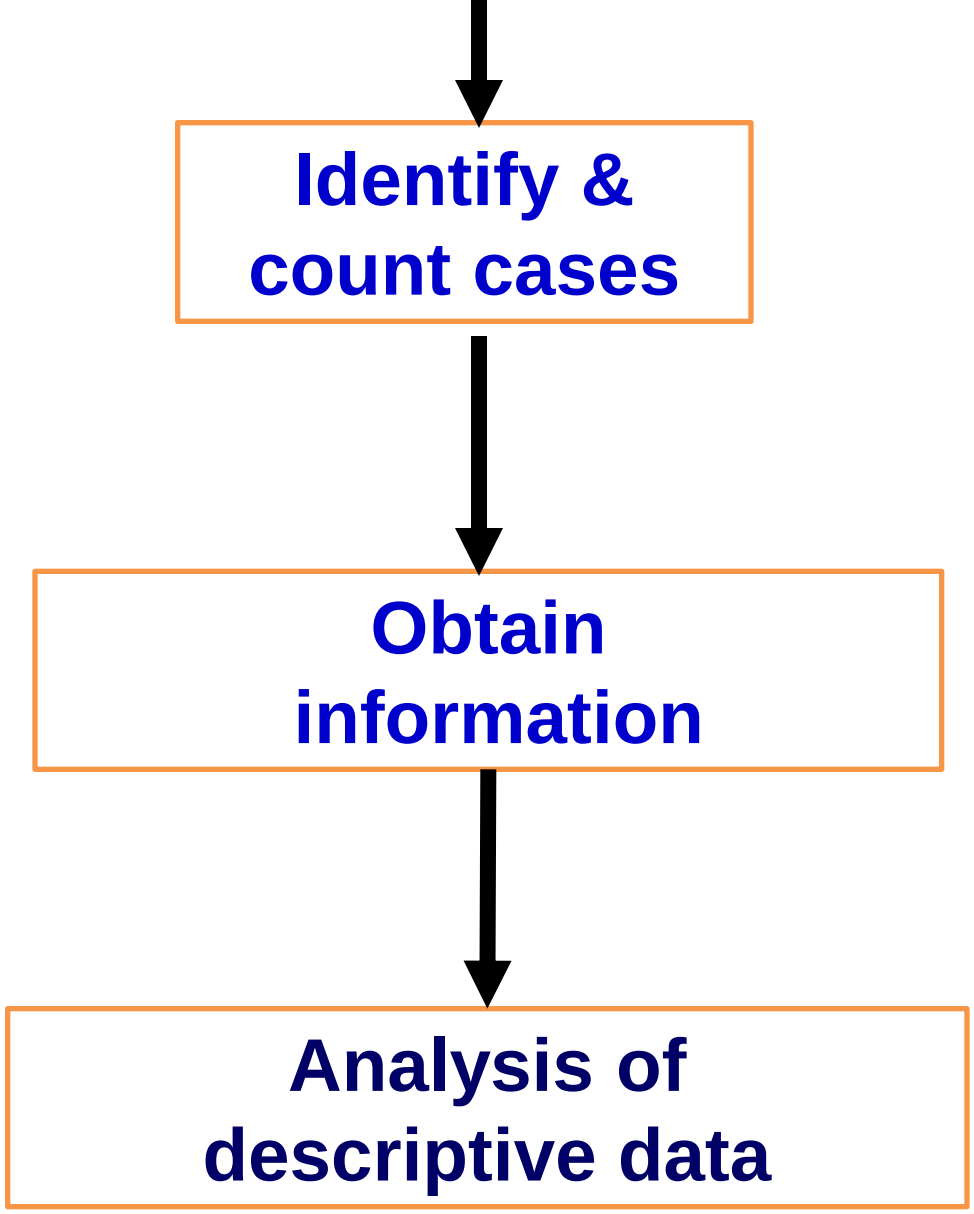
Clinical details

Risk factors

Time

Place

Person

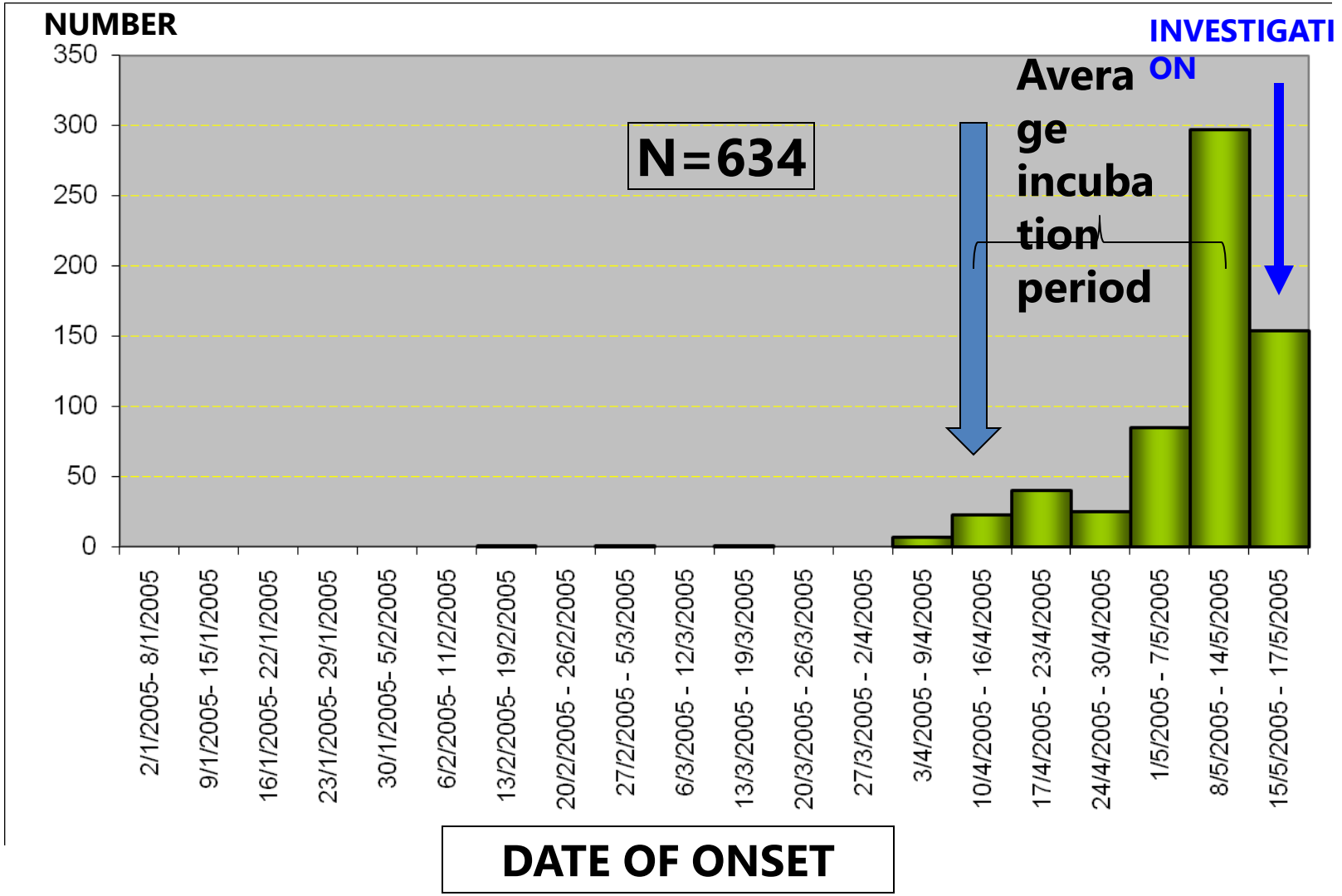


Present cases in

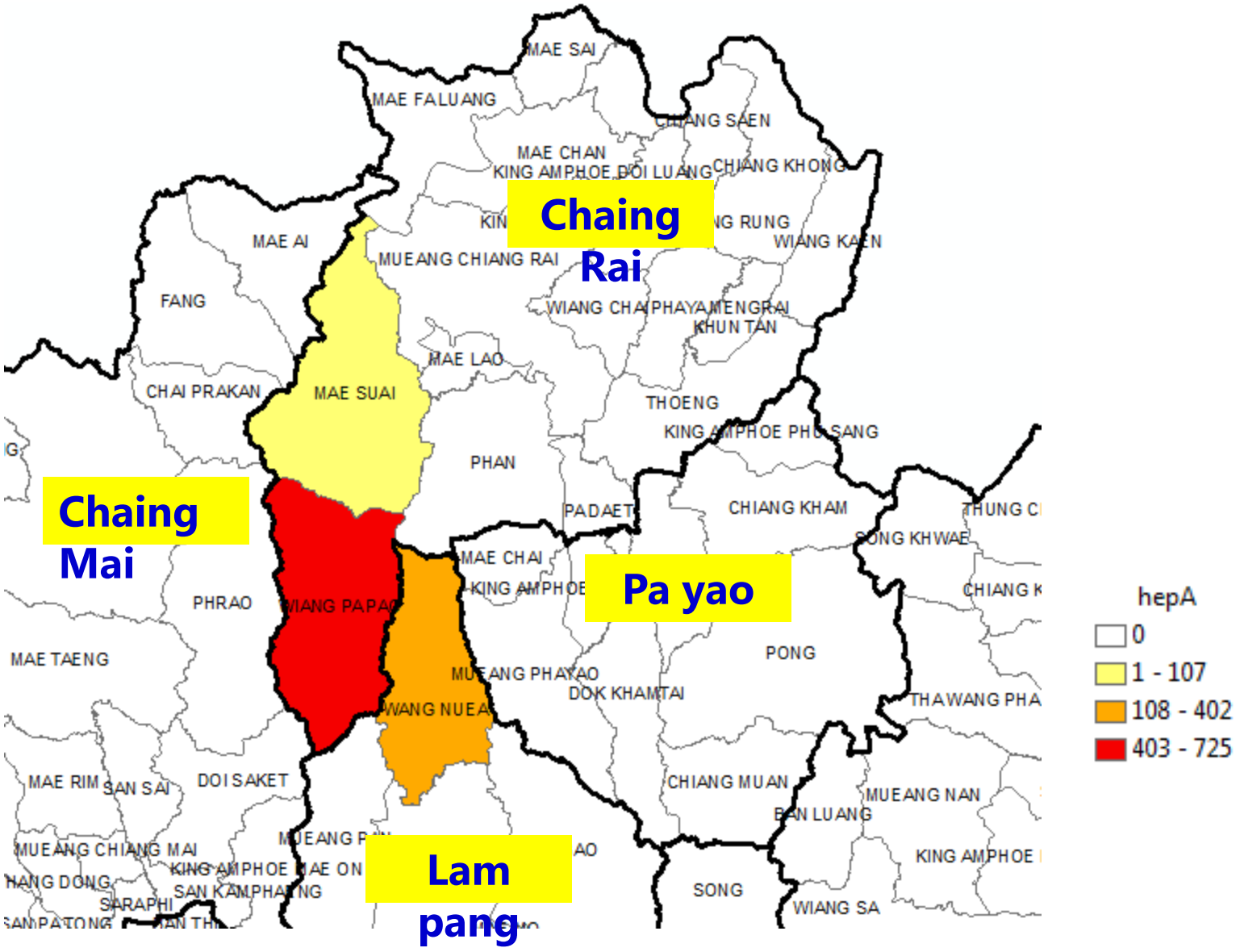
- **time**
- **place**
- **person**

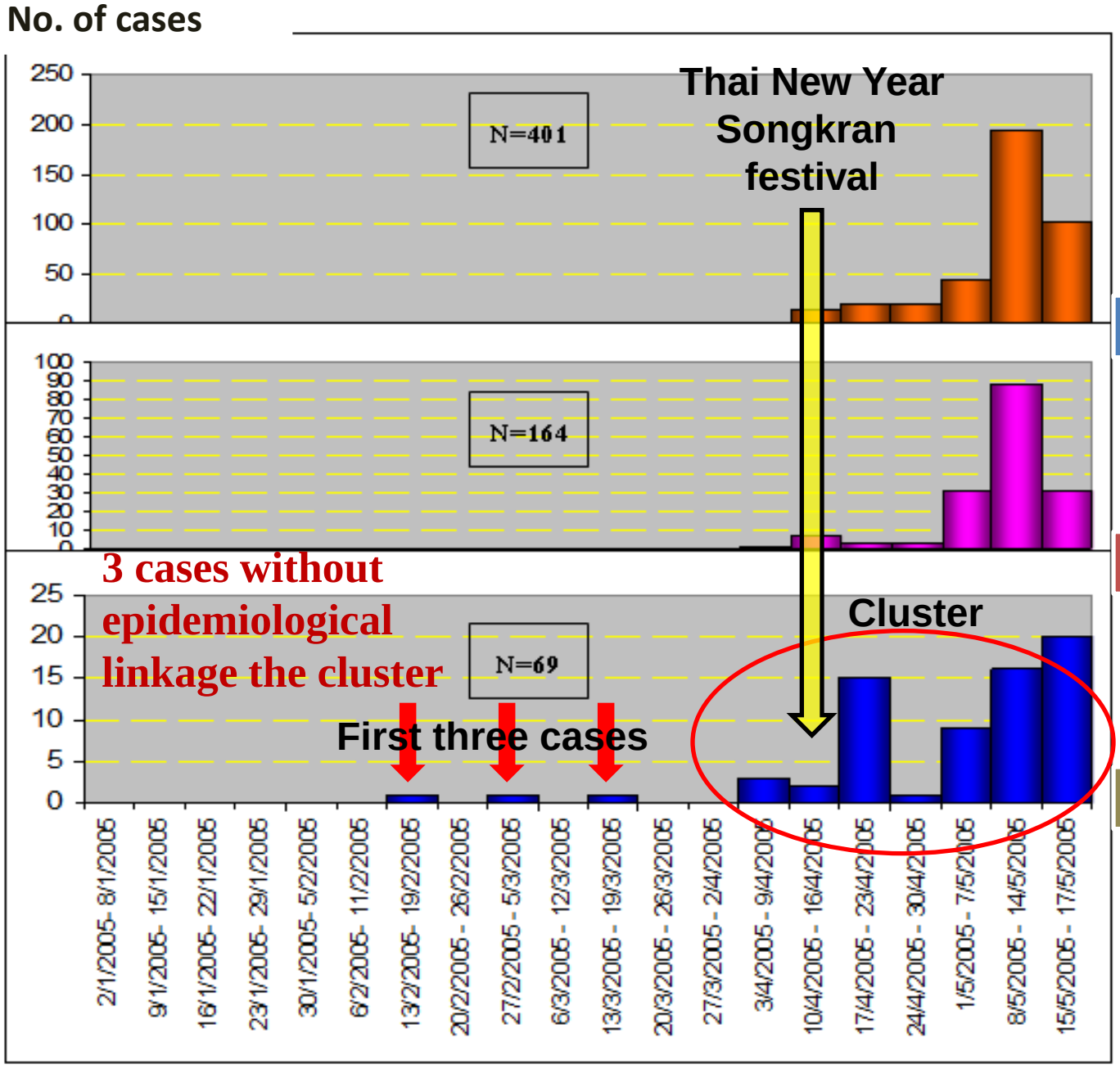
Distribution by Time: Epidemic curve

Number of Hepatitis A cases by date of onset,
total of 3 affected districts, 1 Jan 05-17 May 05



Distribution by Place: Map of Number of Case
Distribution of Hepatitis A morbidity by district





Attack rate (per 100,000 pop.)

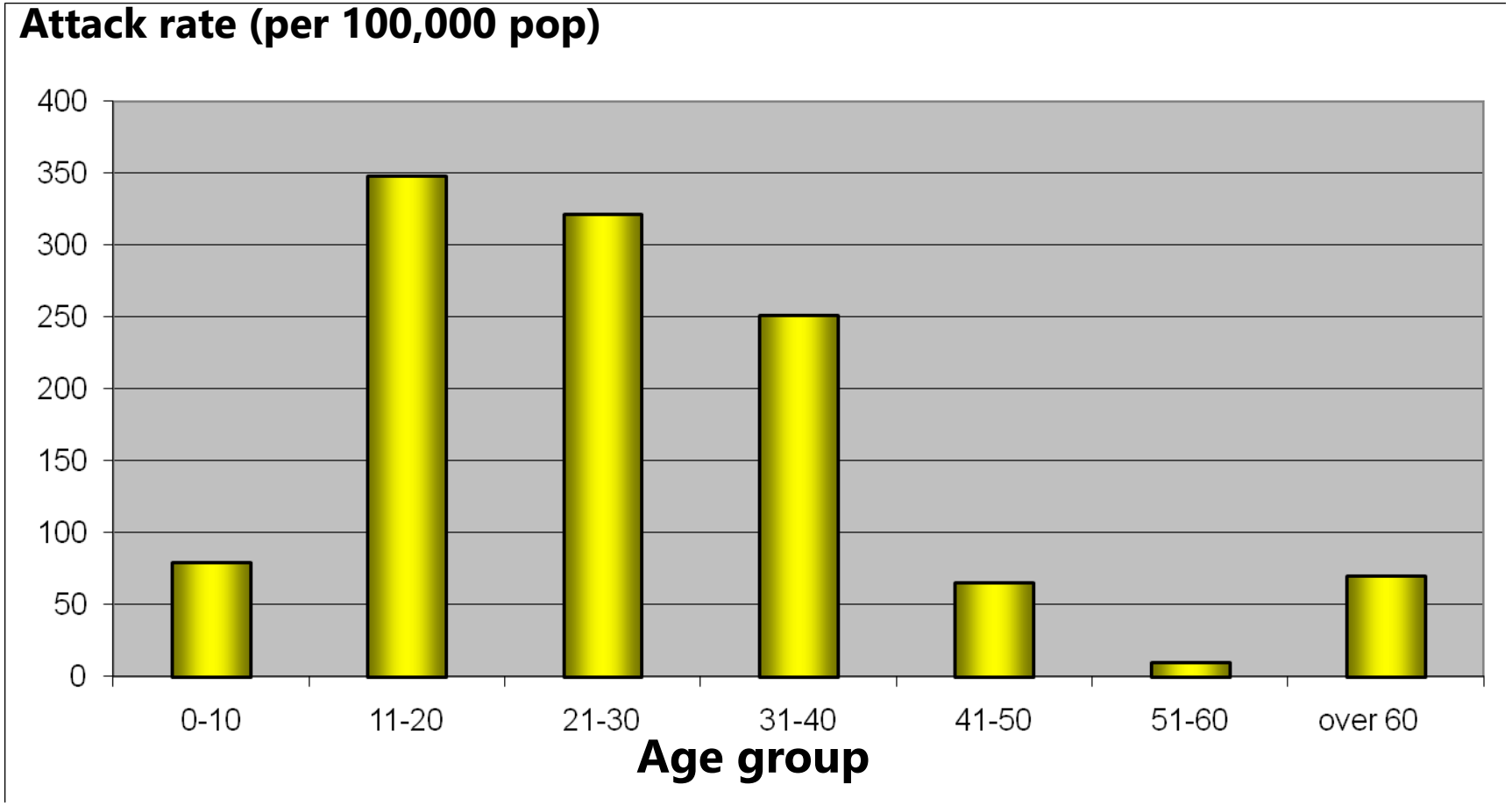
WP	725
WN	402
MS	107

Source: Panithee Thammawijaya

Distribution by Person: Specific Attack Rate

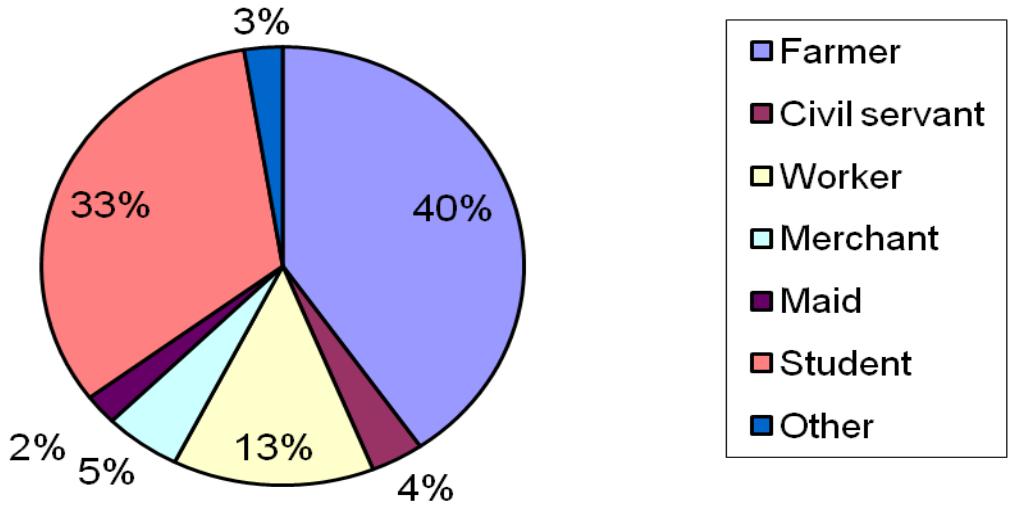
Hepatitis A Attack Rate by Age Group,

total of 3 affected districts, 1 Jan 05-17 May



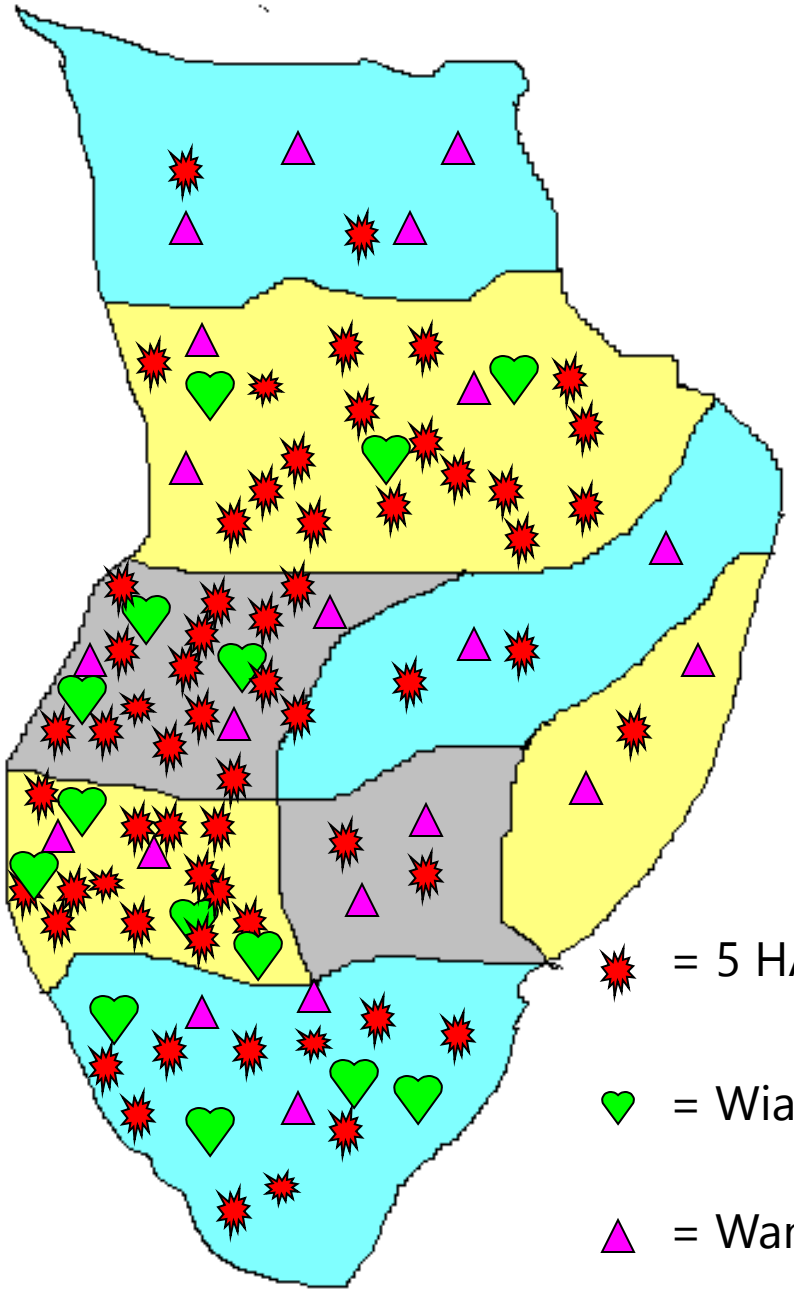
Distribution by Person: Occupation and Gender Distribution

Percentage of the Hepatitis A cases by occupation, total of 3 affected districts, 1 Jan 05-17 May 05



Male : Female ratio =

1.6 : 1



Map of Wangnua district:
Distribution of HAV cases and Ice,
1 Jan 05-17 May 05

Attack rate of

Subdistrict that have Wiangpapao Ice = 528

Subdistrict that not have Wiangpapao Ice = 82

(Or 6.4 times!!)

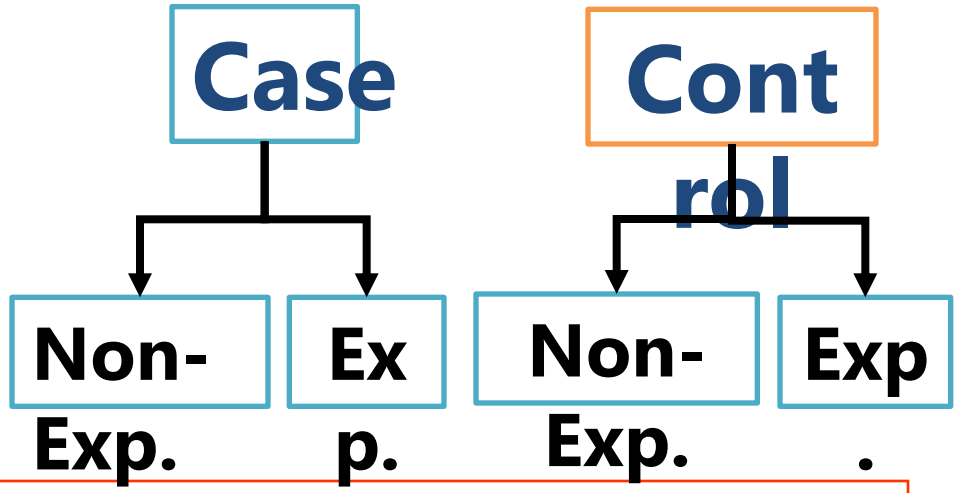
Case Control

Ex: Case-Control Study

In a botulism outbreak, home-canned bamboo shoots was suspected to be the implicated food

	Case	Control
Eat	13	4
Not eat	1	63
Total	14	67

OR = 201, 95%CI 18, 5410



Odds of eating bamboo shoots was 201 times greater among cases than controls.

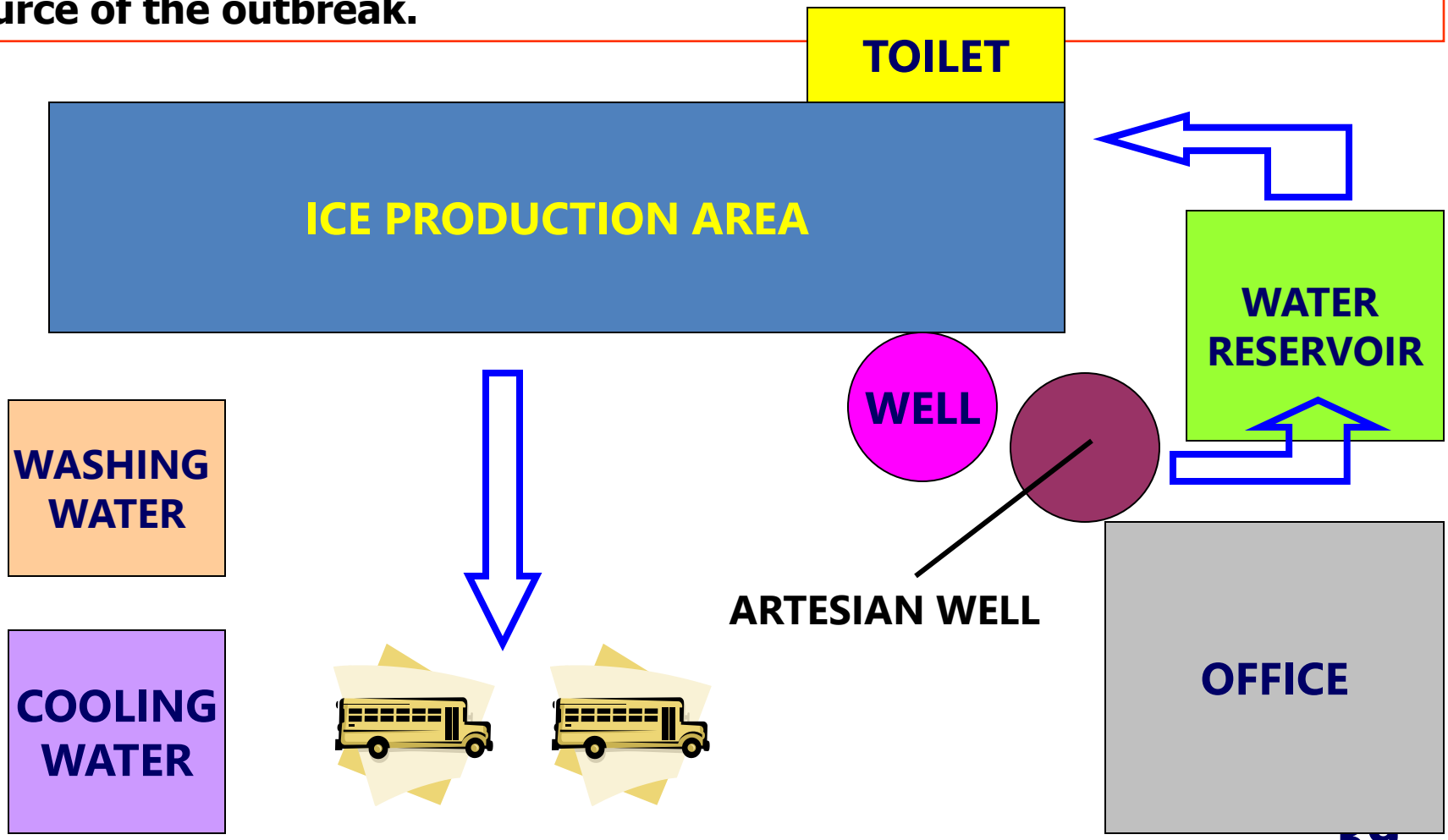
Result:
Case-control study in Hepatitis A Outbreak

- Case 70: Control 98

Risk factors	Adjusted OR*	95%CI
Ice (Any)	1.51	0.57 - 4.35
Ice from Wiangpapao	3.55	1.76 - 7.17
Ka Nom Jeen	0.93	0.44 – 1.95
Party	1.10	0.54 - 2.30
Restaurant	1.20	0.62 – 2.32
Bottle water	1.37	0.70 – 2.65
Tap water	0.89	0.32 – 2.36

Special studies, e.g., environmental and laboratory studies

scenario: Contaminated ice from Wiang Pa pao was the most suspected source of the outbreak.



Pitfalls in the production process of the ice factory

<u>Field testing</u>:
Was the well water fecal contaminated?
Was chlorination adequate?

Result: Laboratory result of environment

Source	Specimen	Result
Wiangpapao Ice factory (10 June 2005)	Water from well	Positive for HAV-RNA (RT-PCR)
Wiangpapao Ice factory (10 June 2005)	Water from reservoir	Positive for HAV-RNA (RT-PCR)
A patient's house (10 June 2005)	Water from well	Positive for HAV-RNA (RT-PCR)
Wiangkalong drinking water factory(10 June 2005)	Drinking water	Negative for HAV-RNA (RT-PCR)
Wangnua drinking water factory (10 June 2005)	Drinking water	Negative for HAV-RNA (RT-PCR)
Juice (10 June 2005)	Juice	Negative for HAV-RNA (RT-PCR)

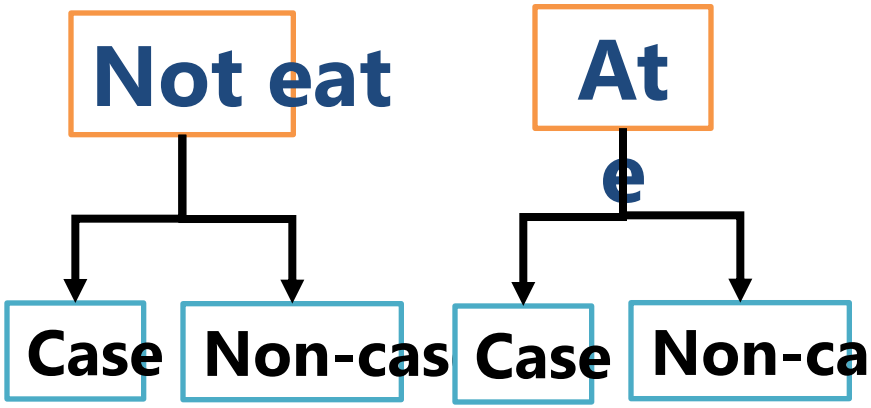
Source: Panithee T, BOE

Cohort Study

Ex: Retrospective Cohort Study

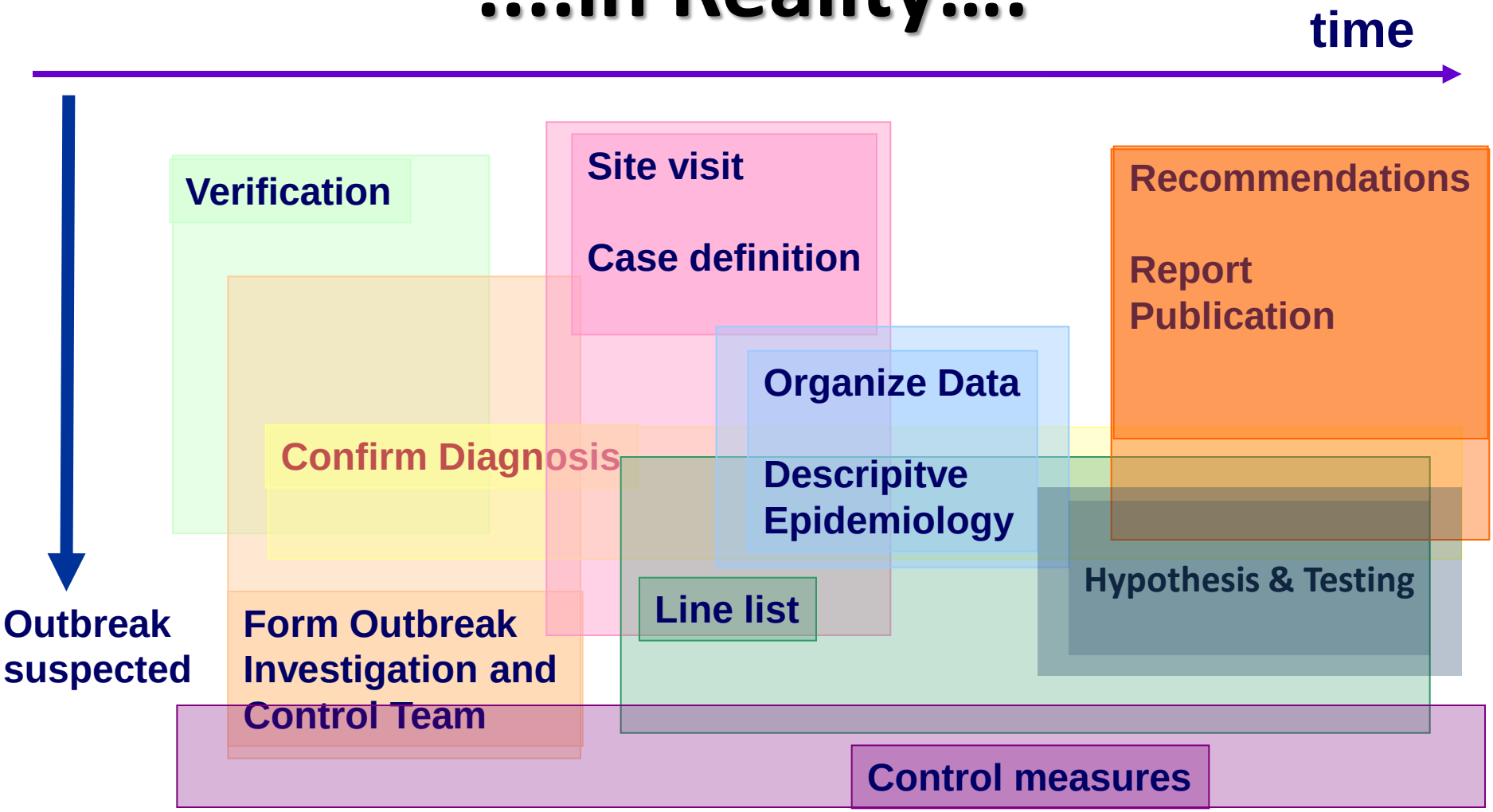
In a shigellosis outbreak, fermented vegetable was suspected to be the implicated food

	Case	Non-case	Total
Eat	9	16	25
Not eat	7	113	120
RR = 6.2, 95%CI 2.5, 15.1			



A person who ate the fermented vegetable was 6.2 times more likely to be ill than a person who did not eat…

Outbreak Investigation ....in Reality....



Thank you

Q/A