

Roles of epidemiology in public health

- Surveillance
- Outbreak Investigation
- Epidemiological Study
- Evaluation of Public Health Measures

Source: RM Page, et al. "Basic epidemiological methods and biostatistics, 1995 p.32

Definition of outbreak

- The occurrence of cases of an illness, specific health-related behaviour, or other health-related events clearly in excess of normal expectancy. The area and the period in which the cases occur are specified precisely.

Excess of normal expectancy

- **More than**
 - 5-Yr median or
 - Average number + 2sd of previous 5 yr
 - or
 - Average number of previous few wks or months
- **2 cases with epidemiologic linkage in short time**
- **1 cases of a new emerging disease**

Terms

- **Epidemic** = Outbreak
(Outbreak -> sense of urgency,
Epidemic -> sense of wide spreading)
- **Cluster** = an aggregation of cases in a given place & time
- **Pandemic** = Epidemic that spreads over many countries of regions of the world
- **Endemic** = Disease that routinely occurs in a given place

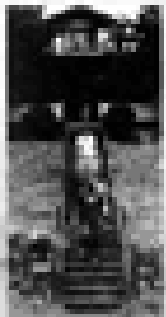
Surveillance is a way for outbreak detection

NATO authorizes Kosovo strikes — page 17

The Times Herald

RECORD

Concord closed for 2 weeks
— page 5



Newburgh lures new home buyers
— pages 4-5

10 ways to avoid common cold

Another death



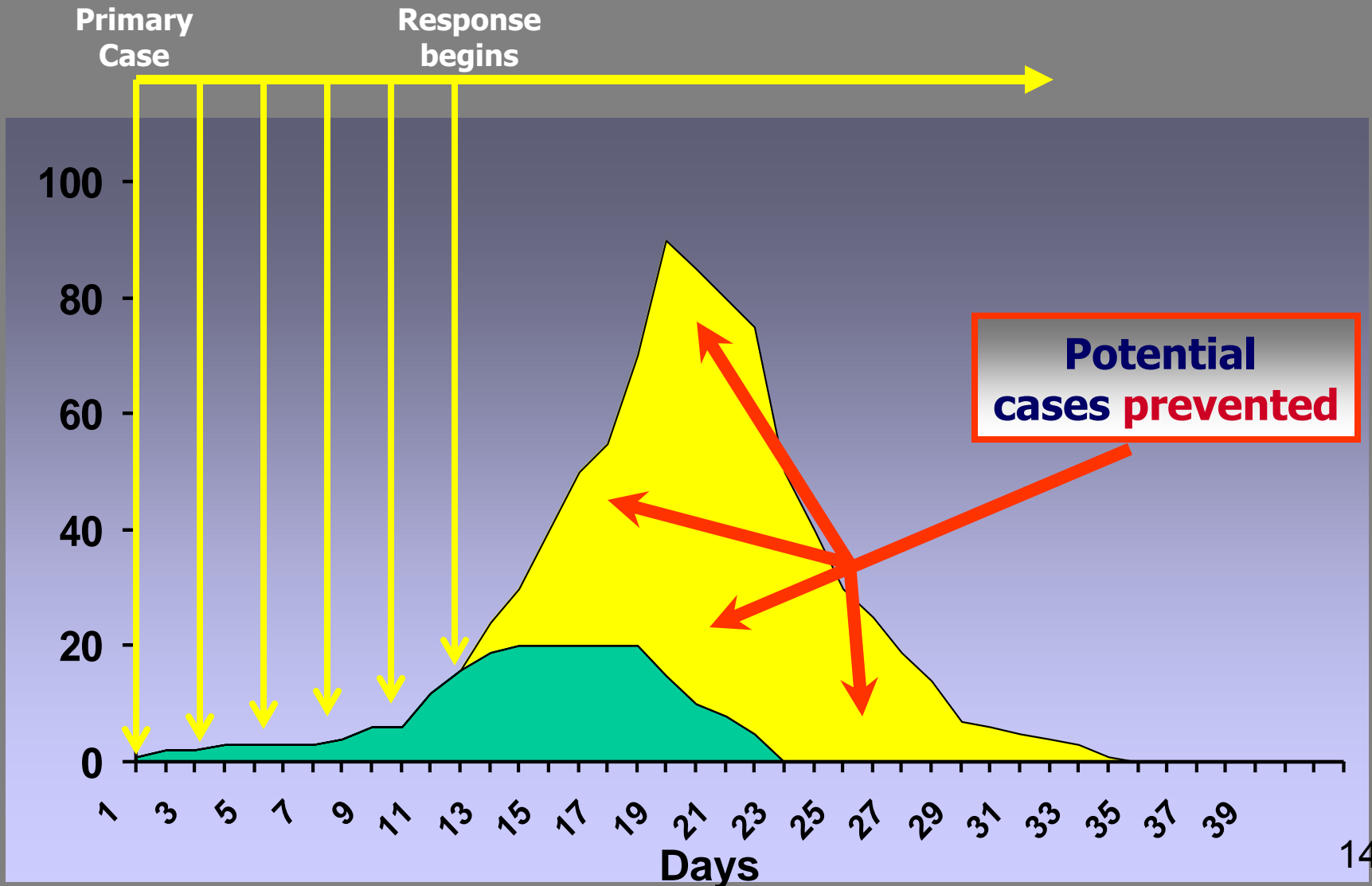
Legionnaires' bacteria confirmed in 3 of 5 who died
— page 3

The media:
main source
of outbreak-
related
information

Objectives of outbreak investigation

- ❑ To control the current outbreak
- ❑ **To prevent occurrence of future outbreak**
- ❑ Research for more knowledge of the diseases
- ❑ **To evaluate the effectiveness of prevention programmes**
- ❑ To evaluate the effectiveness of the existing surveillance
- ❑ **To train health professionals**
- ❑ To respond to public or political or legal concern

“Ideal” sequence of events



Relative priority: investigation and control of an outbreak

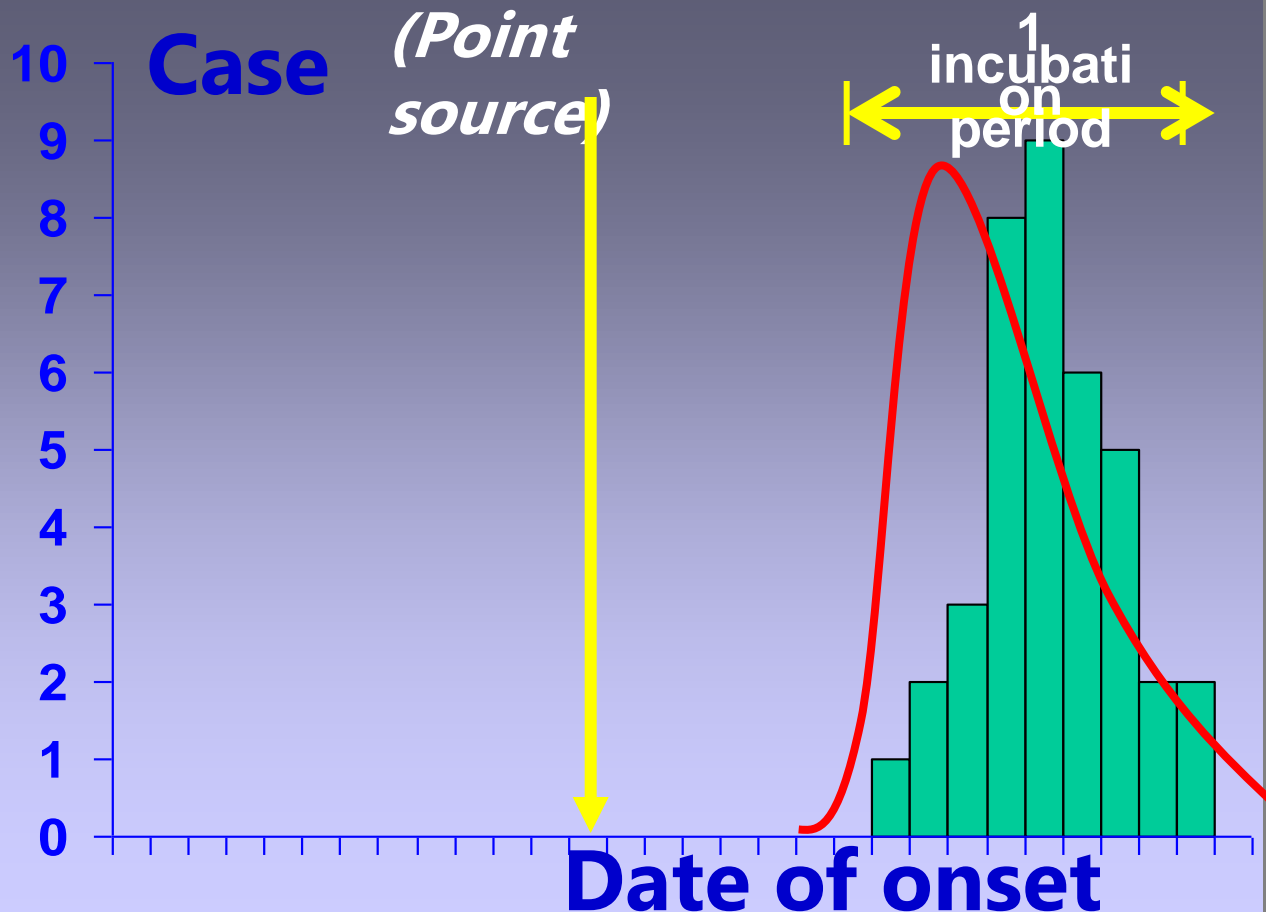
| Agent | Source/Mode of transmission | |
|---------|-----------------------------|--------------------|
| | Known | Unknown |
| Known | inv.+ contr.+++ | inv.+++ contr.+ |
| Unknown | contr.+++ inv.+++ | inv.+++ contr.+ |

Note: inv. = investigation and contr. = control

Outbreak patterns

- **Common source outbreak**
 - **Point**
 - **Intermittent**
 - **Continuous**
- **Propagated source outbreak**
(person-to-person)

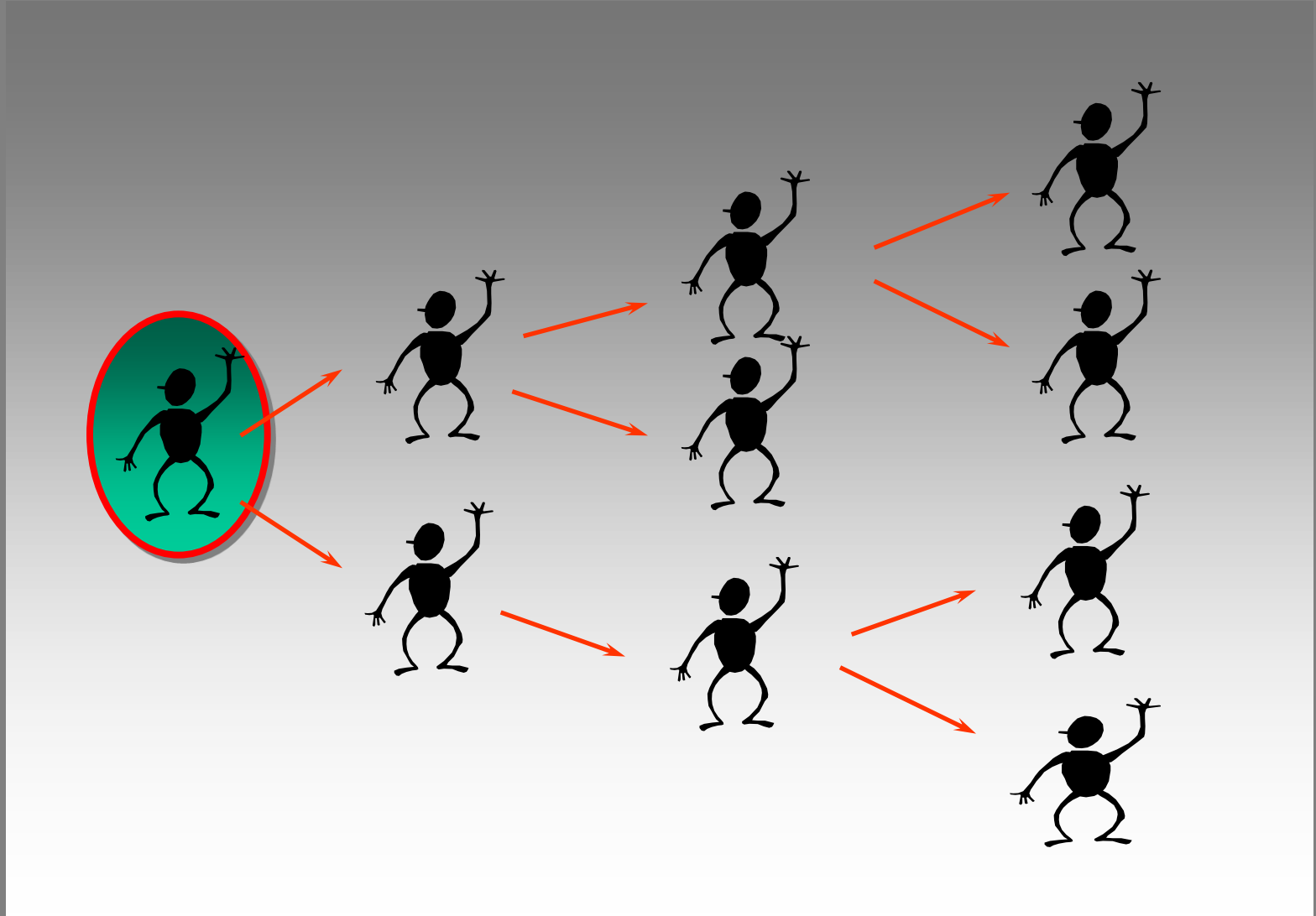
Epidemic curve of common source outbreak



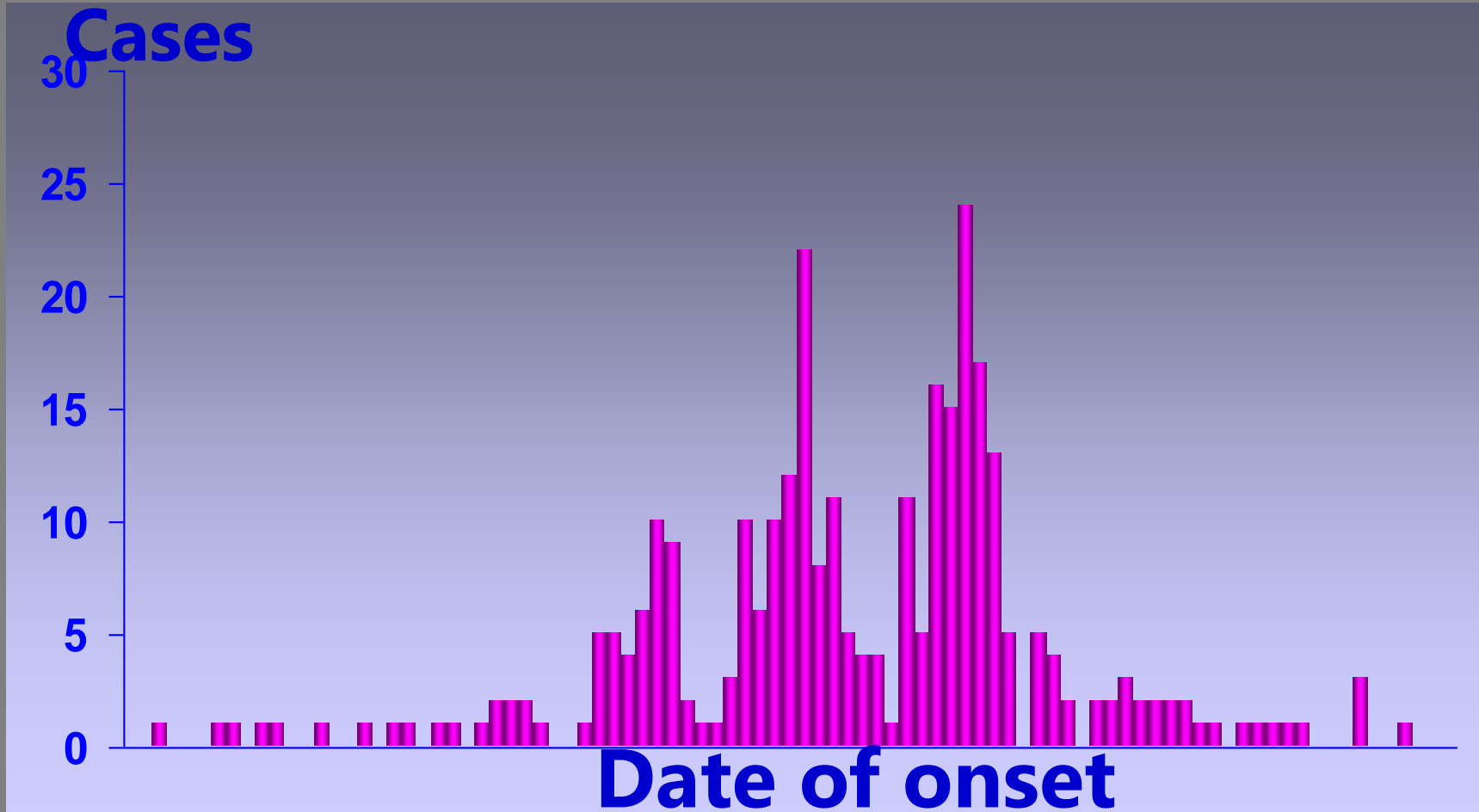
Point source

- All cases occur in 1 incubation period
- **Steep upslope**
- More gradual down slope
- **Able to predict exposure period**

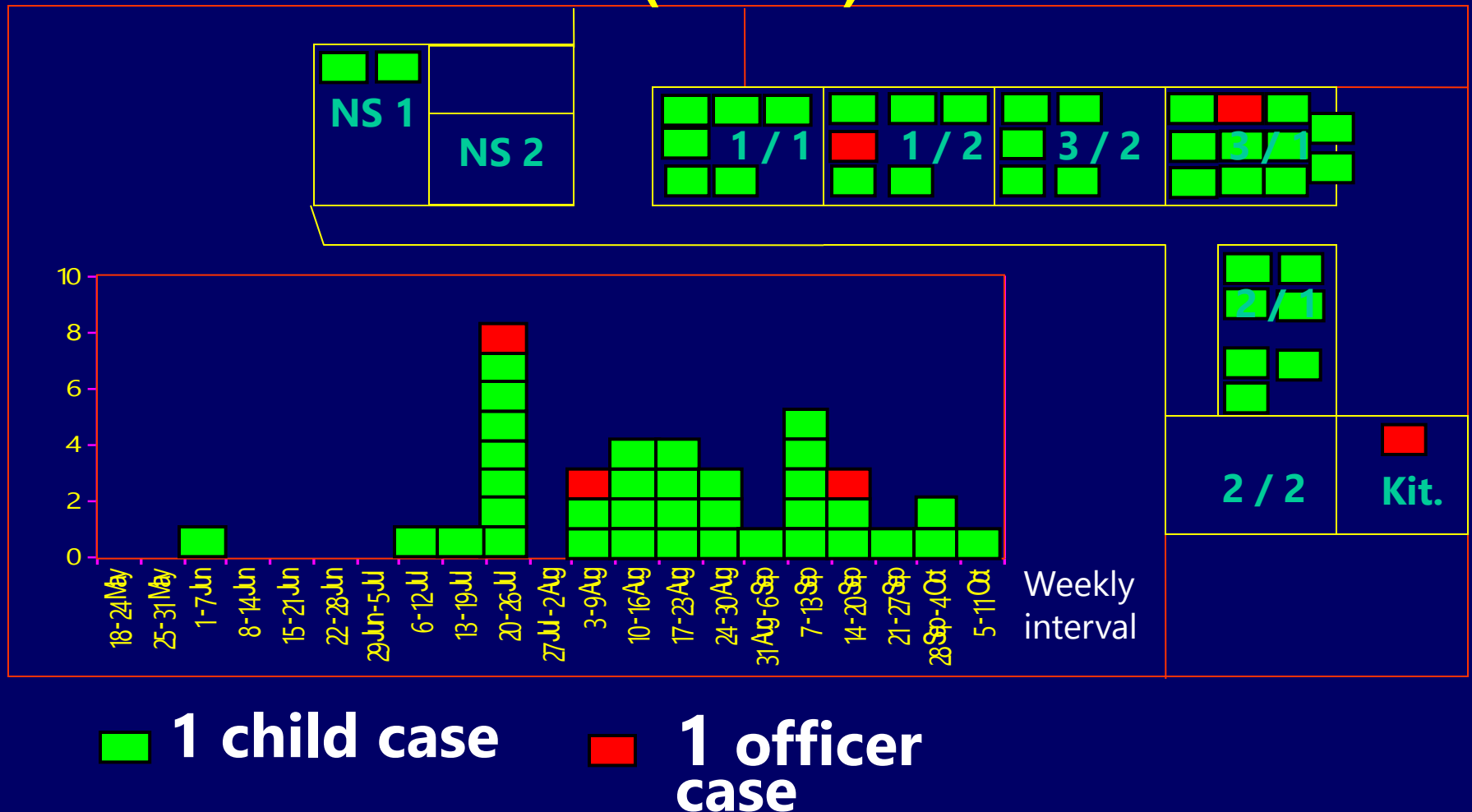
Propagated source outbreak



Epidemic curve of propagated source outbreak



Mump cases by onset and classroom, Kindergarten "A", Maehongson, Thailand, May – September 1999 (N = 38)



Source: Laosiritaworn, Propagated source outbreak, a single case of mumps lead to a school-wide outbreak

Steps of an outbreak investigation

1. Prepare for Field Work: Rapid Response Team
2. Confirm outbreak and diagnosis
3. Define case and start case-finding
4. Descriptive data collection and analysis
5. Develop hypotheses
6. Analytical studies to test hypotheses
7. Special studies, e.g., environmental and laboratory studies
8. Communicate conclusions and recommend control measures
9. Implement control measures
10. Follow-up the control implementations

1.

Prepare for field work : Rapid Response Team

- A. Investigation: knowledge, equipment, specimen collection, transportation, etc.**
- B. Administration**
- C. Consultation**

2. Confirm outbreak and diagnosis

- Is a number of cases **REALLY rising**???
- How many patients diagnosed?
Clinical? With Lab?
 - What is an expected number of cases?
 - Surveillance data, OPD card, Hospital Discharge Registry, etc.

Confirm outbreak and diagnosis

Is this an
outbreak?

What is the
diagnosis?

Link between cases?
Higher than expected?

Clinical manifestation
Laboratory result

Always ask yourself: What can be done now to intervene the outbreak?

Scenario 1

Many adults in a remote village were sick with fever, severe joint and muscle pain and rash all over the body

- Is this an outbreak?
- What is the likely diagnosis?
- **Which intervention should be started?**
- Should we start the investigation?

Outbreak confirmed ✓

Maybe measles, rubella, dengue etc.

Investigation warranted

Shall we start the vaccination or spray mosquitoes?

**Outbreak confirmed,
further investigations warranted**



**Form Outbreak
Investigation & Control
Team**

**Epidemiologist
Microbiologist
Clinician
Environmentalist
Administrator
Press officer
Others**



**Team conducts
field investigation**

3.

Define case and start case-finding

Case definition

- Standard set of criteria for deciding if a person should be classified as suffering from the disease under investigation
- Clinical criteria, restrictions of time, place, person
- Simple, practical, objective
- Sensitivity versus specificity

Case definition

- **Components**

- Time
- Place
- Person
- Clinical symptoms & signs

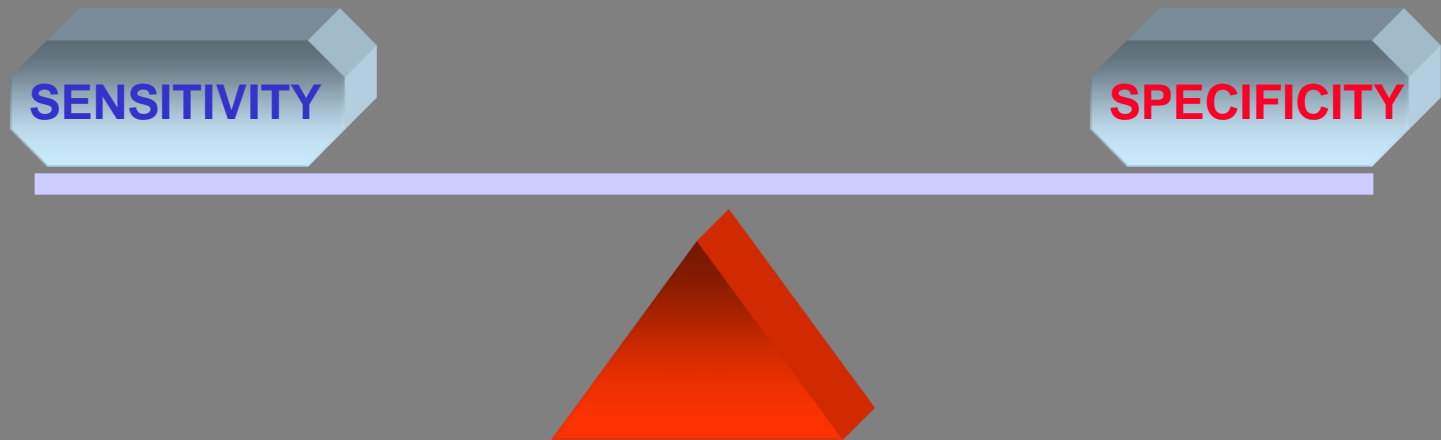
- **Sources**

- Textbook
- Expert

Case definition: example

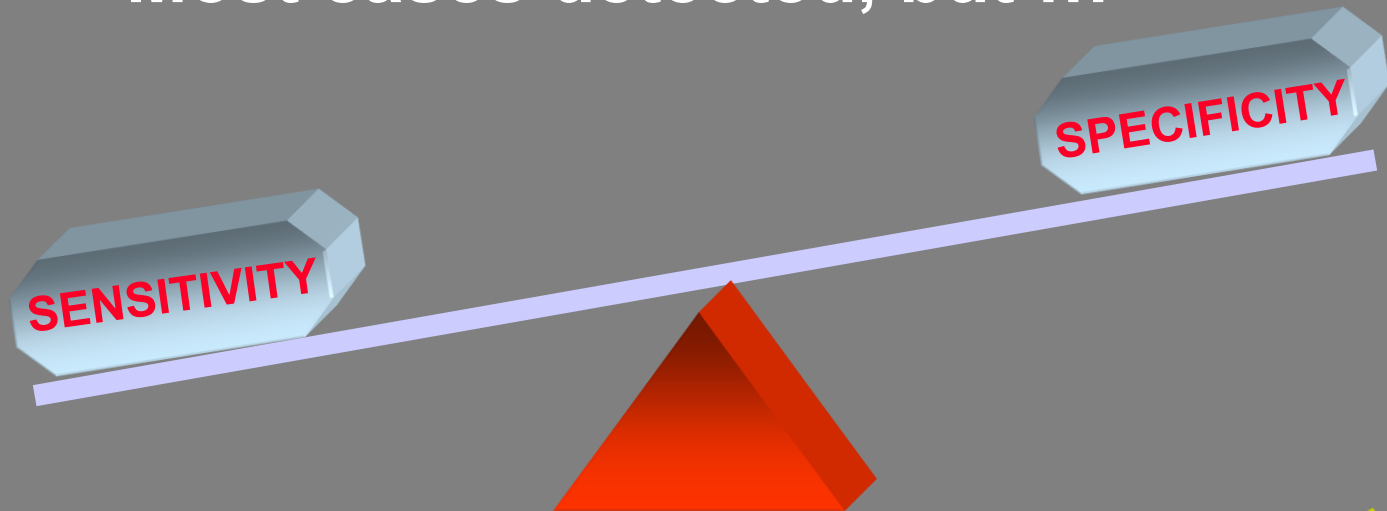
**Patient older than 5 years
with severe dehydration or
dying of acute watery
diarrhoea in town “x”
between 1 June and 20
July 1999**

Sensitivity versus specificity



Sensitive case definition

Most cases detected, but ...

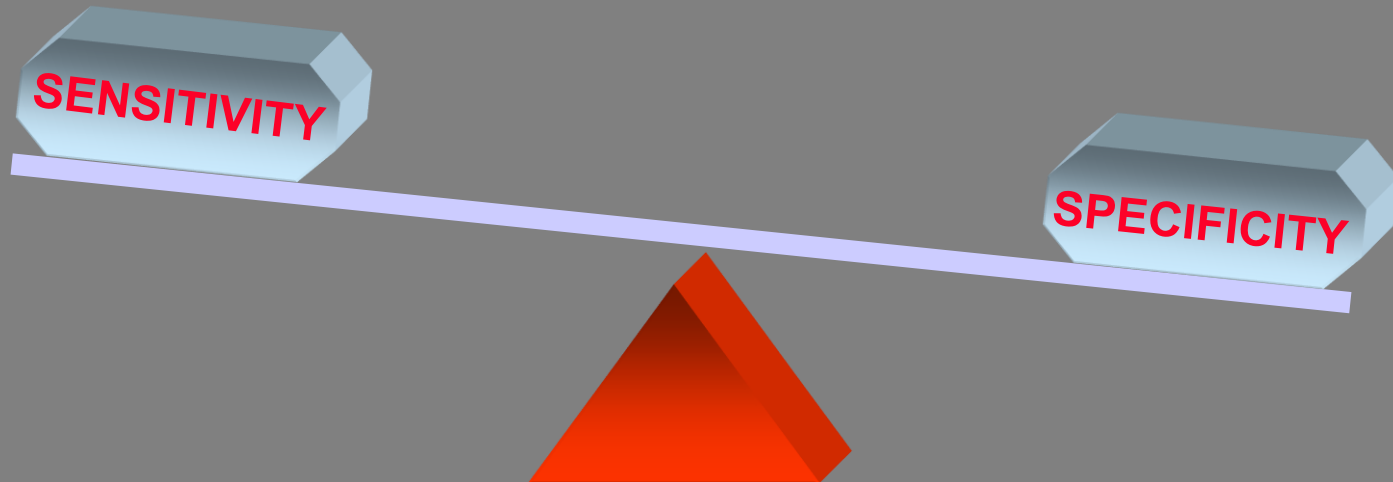


Many false positives
Many specimens to be tested
Low% of specimen tested +ve

Danger of overload

Specific case definition

Cases missed, but ...



Few false positives
Fewer specimens to be tested
High% specimens tested +ve

Danger of under-report

Multiple case definition

- **Suspect**

- Patient with severe diarrhoea ...

- **Probable**

- Patient older than 5 years with severe dehydration or dying of acute watery diarrhoea ...

- **Confirmed**

- Isolation of *Vibrio cholerae* from stool of patient ...

Active case finding



**Identify &
count cases**

Perform in clear defined population

- Attended the party
- Visited a festival
- Live in a village
- Work at a factory
- Hospitals, laboratories
- etc.

survey

**Record
review**

Why do active case finding ...

4.

Descriptive data collection and analysis



**Obtain
information**

Identifying information
Demographic information
Clinical details
Risk factors

Identifying info.

Survey of hepatitis B cases in a male juvenile detention, Saraburi, Thailand, November 1999

| | | |
|--------------------------|--------------------|---------------------------|
| Date of interview | Interviewer's name | Patient number |
| Patient's name (Surname) | Age (in years) | Number of dormitory (1-5) |
| Study field | 1. Mechanic | 2. Carpenter |
| | 3. Electrician | 4. Barber |
| | 5. Musician | 6. Agriculture |

Demographic info.

Clinical symptoms (sick inside the juvenile detention since 1 Jan 99)

| | Nb | Yes | Onset of symptoms |
|--|----|-----|-------------------|
| Jaundice | | | |
| Nausea/Vomiting | | | |
| Fatigue | | | |
| This hepatitis cases is laboratory confirmed | Y | | N |

Clinical info.

| Possible risk factors | | |
|-----------------------|---|---|
| Tattooing | Y | N |
| Homosexual | Y | N |
| Injected drug user | Y | N |

Risk factors

```
graph TD; A[Identify & count cases] --> B[Obtain information]; B --> C[Analysis of descriptive data];
```

**Identify &
count cases**

**Obtain
information**

**Analysis of
descriptive data**

Orienting cases in

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

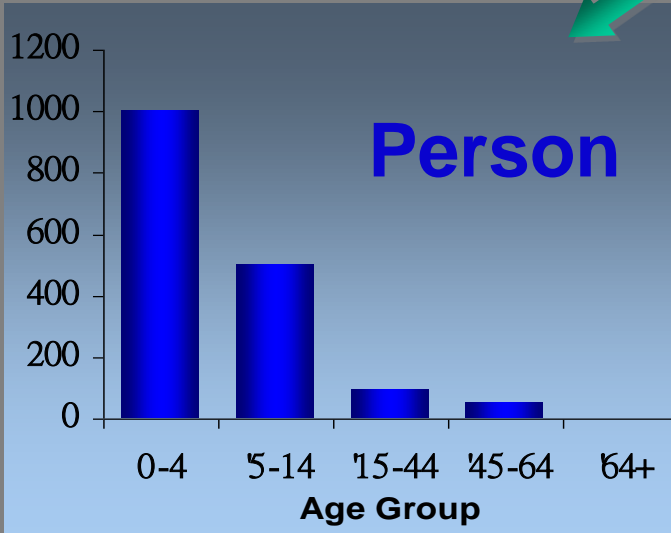
5. Develop hypotheses

- Who is at risk of becoming ill?
- What is the source and the vehicle?
- What is the mode of transmission?

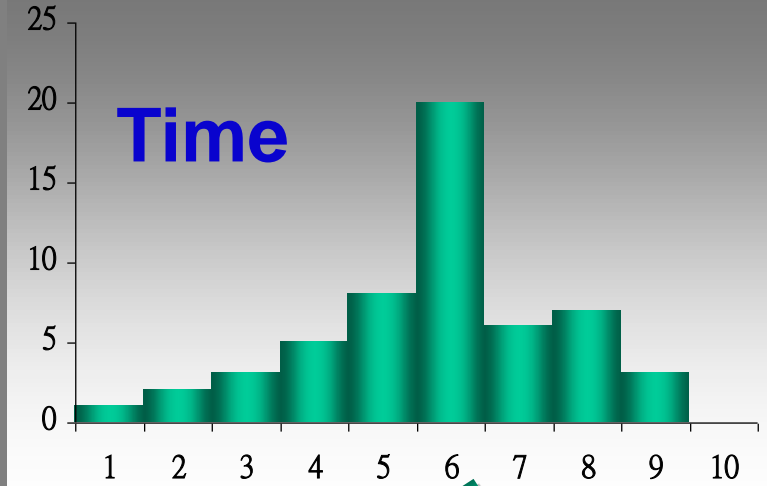
Examples

- Tattooing was the risk of getting hepatitis B infection, because 13 out of 15 cases had new tattoos.
- **A shallow well was the source of shigella, because most of case used water from there.**
- Juice from the school cafeteria caused the illness, because a pass-by visitor got sick after drank a glass of juice. (outlier case)

Cases



Place



Evaluate information

Pathogen?

Source?

Transmission?

Develop hypotheses from gathered information

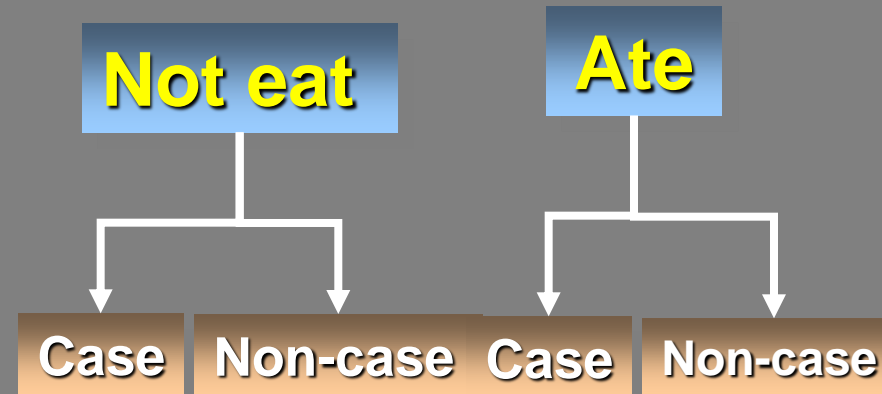
6. Analytic studies to test hypotheses

Cohort study

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

| | Case | Noncase | Total |
|---------|------|---------|-------|
| Eat | 9 | 16 | 25 |
| Not eat | 7 | 113 | 120 |

RR = 6.2, 95% CI 2.5, 15.1



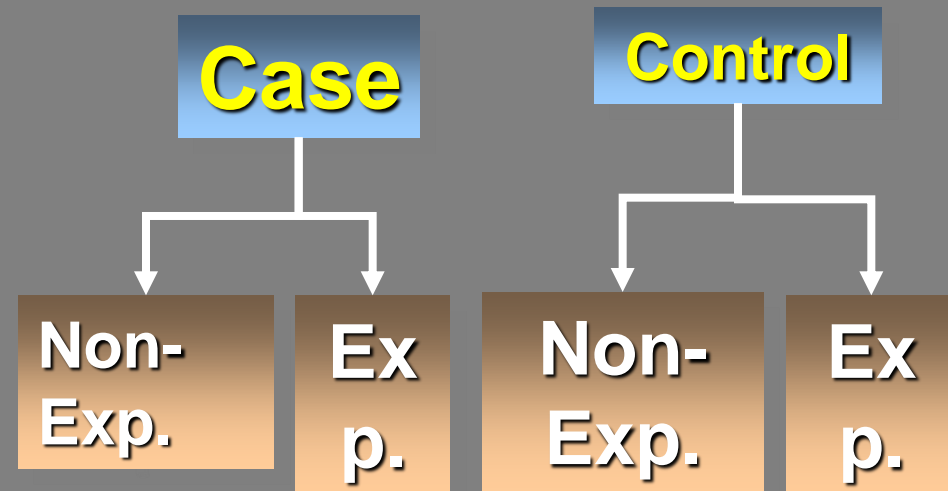
A person who ate the fermented vegetable was 6.2 times more likely to be ill than a person who did not eat...

Case-control study

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

| | Case | Contd | Total |
|-------|------|-------|-------|
| Eat | 13 | 4 | 17 |
| Nteat | 1 | 63 | 64 |

OR = 201, 95%CI 18, 5410



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

7.

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

From: Typhoid Fever Outbreak in Sor-O Village, Tak, Thailand, 1999.
A contaminated spring (drinking) water was the source of infection.

Test of water quality

Almost of all households had sanitary latrine

Drinking water came from spring, well, mountain pipe water: unsanitary and villagers did not boil it

Garbage was destroyed by burning in the field

| Sample | Coliform bacteria (MPN/100ml) | Fecal coliform bacteria(MPN/100ml) |
|------------------|-------------------------------|------------------------------------|
| origin of spring | 170 | 20 |
| midstream | 200 | 50 |
| well | 30 | 30 |
| one case house | 300 | 300 |
| pipe water | 170 | 4 |

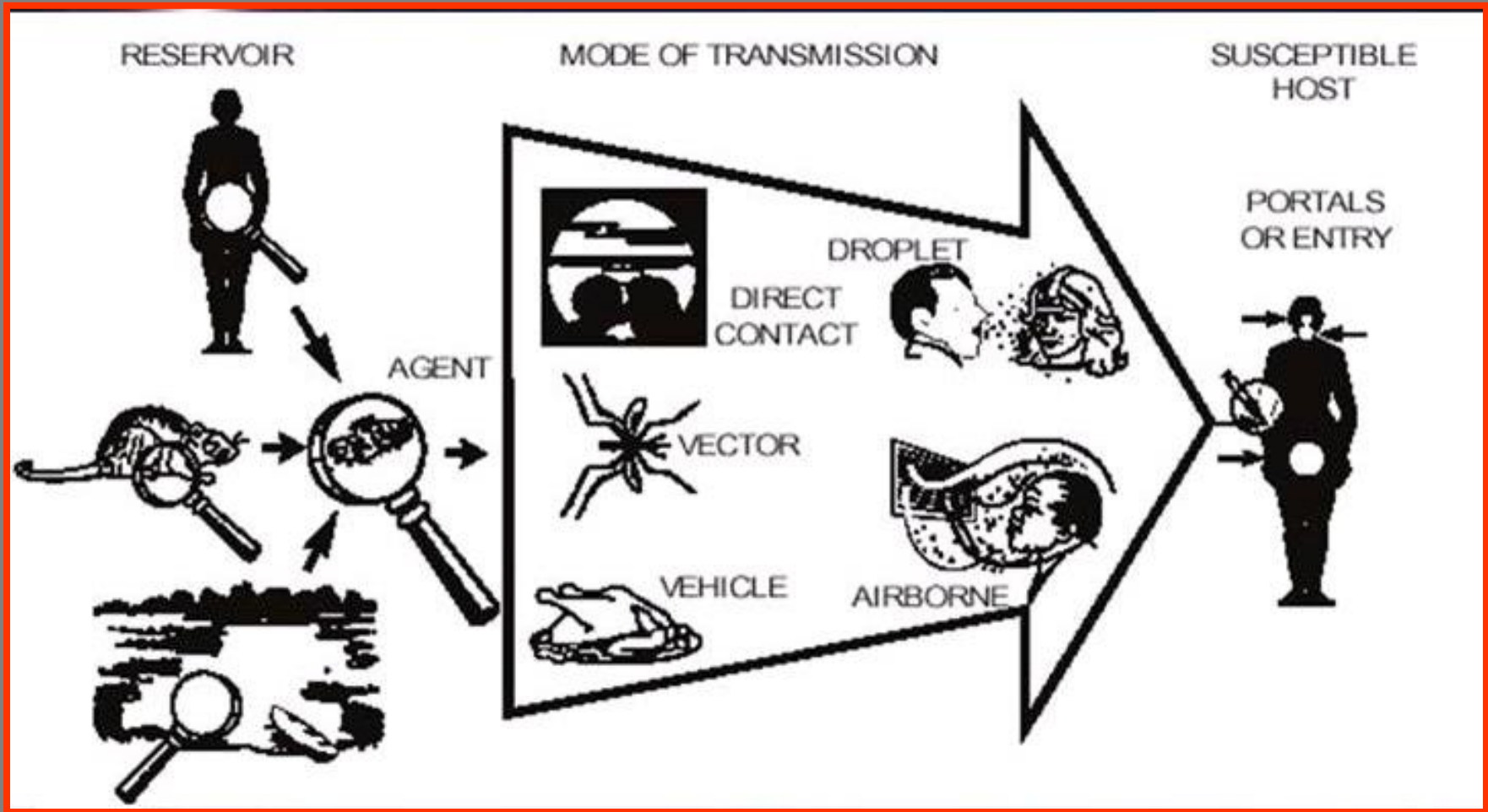
Source: Kanlayanaphotporn J.

8.

Communicate conclusions and recommend control measures

9-10.

Implement and follow-up the control measures





- Remove source of contamination
- Remove persons from exposure
- Inactivate / neutralise the pathogen
- Isolate and/or treat infected persons



Interrupt transmission

- Interrupt environmental transmission
- Control vector transmission
- Improve personal sanitation



Modify host response

- Immunise susceptibles
- Use prophylactic chemotherapy

At the end

- **Prepare written report**
- **Communicate public health messages**
- **Influence public health policy**
- **Evaluate performance**