Disease Detectives

The Scenario

- On Thursday night, all of you attended a dinner party in the Montgomery High School Cafeteria.
- Now, some of you have fallen ill with various different symptoms.
- Based on the available information, our job is to determine what disease you are all infected with, where the disease is coming from, and how to stop the disease before it spreads further.
- Along the way, we'll learn all about Epidemiology!

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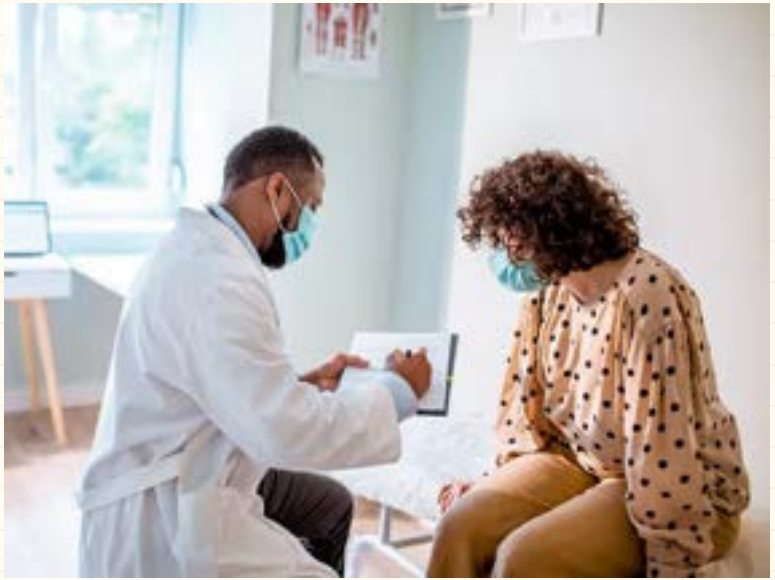
What is epidemiology?

Epidemiology

- the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems
- Role of Epidemiology in Public Health:
  - analyze the factors that affect health
  - determine the causes of disease, disability, and death
  - identify populations most at risk of a disease or condition
  - evaluate the effectiveness of health programs or other interventions

Public Health vs. Clinical Approaches

- Clinical Health Approach: primary role is diagnosis and treatment of illness in individuals
- Public Health Approach: primary role is in control and prevention of disease in populations or groups of individuals
- **There can be significant overlap!**

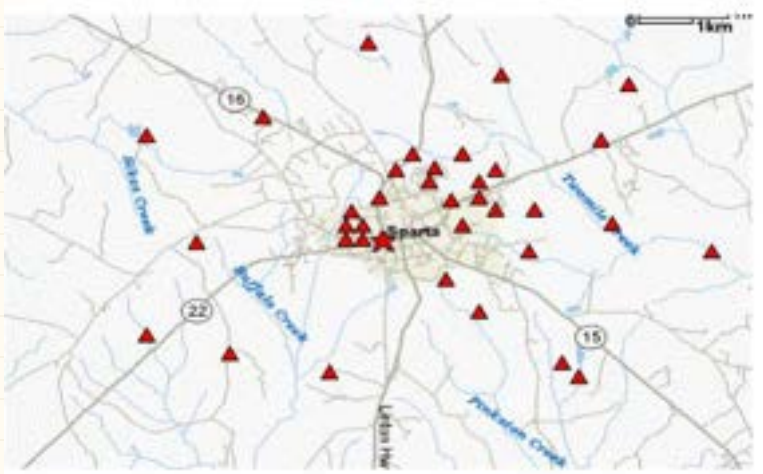


02

Establishing Existence

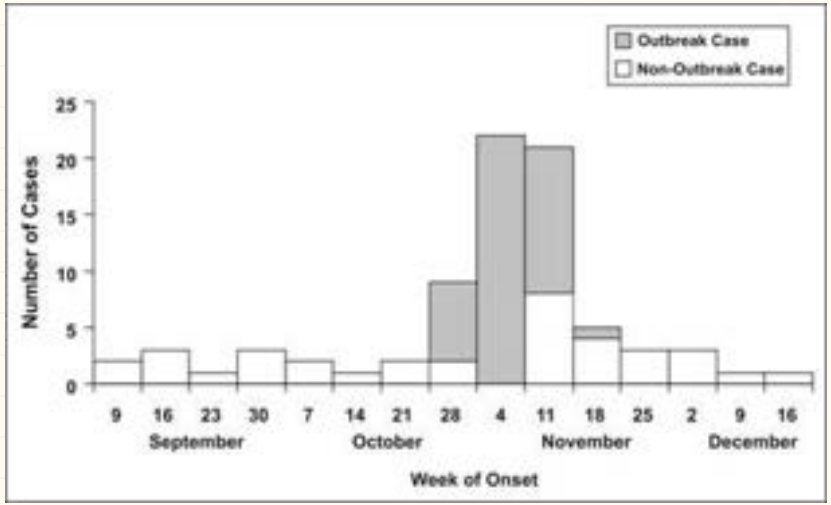
Clusters

- an unusual aggregation of health events that are grouped together in time and space
  - ex. in John Doe High School, 50 cases of influenza occur within a week



Outbreaks

- the occurrence of disease cases in excess of normal expectancy
  - ex. in John Doe high school, 50 cases of malaria occur within a week, but there are usually no cases of malaria each week



Epidemics

- an outbreak which occurs within a specific geographical area
  - ex. there is a large and sudden increase in the number of whooping cough cases in New York City which exceeds expected number

Pandemics

- an outbreak which occurs over a wide geographical area spanning multiple continents or even the entire globe
  - ex. the COVID-19 Pandemic spread to every country in the world

Try it yourself!

Is this epidemiological event an example of a cluster, outbreak, epidemic, or pandemic?

How do you know?

03

Data Collection and Organization

Data Collection

- data collection should include the following information:
  - Identifying information: name, address, phone number, email
  - Demographic information: age, sex, race, occupation, etc.
  - Clinical information: symptoms, date of symptoms onset, duration of illness, etc.
  - Risk factor information: possible exposures
  - Reporter information: how the information was received (doctor, hospital, lab, etc.)

Line Listings

Dengue Fever Line Listing

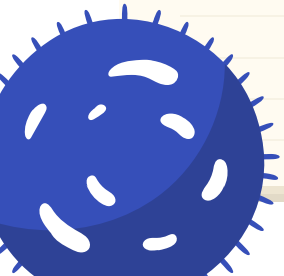
Name	Date of Birth	Onset Date	Rash	Fever? If yes, temp	Other symptoms	Lab results
Elizabeth Hatch	21 Jun, 1970	July 6	Yes	Yes – 39°	Vomiting, muscle aches	Yes
Mary Ridgeway	12 Dec, 1971	July 6	No	Yes - 38°	Headache, muscle ache	Yes
Stephen Mara	3 Jul, 2004	July 7	Yes	No	Headache, vomiting	No
Rajnesh Ram	23 Sep, 2000	July 2	Yes	No	Vomiting	Yes
Lauan Korovavala	4 Apr, 1995	July 10	No	Yes – 38.5°	Headache	No

Try it yourself!

Let’s make a line listing in some smaller groups.

Constructing a Case Definition

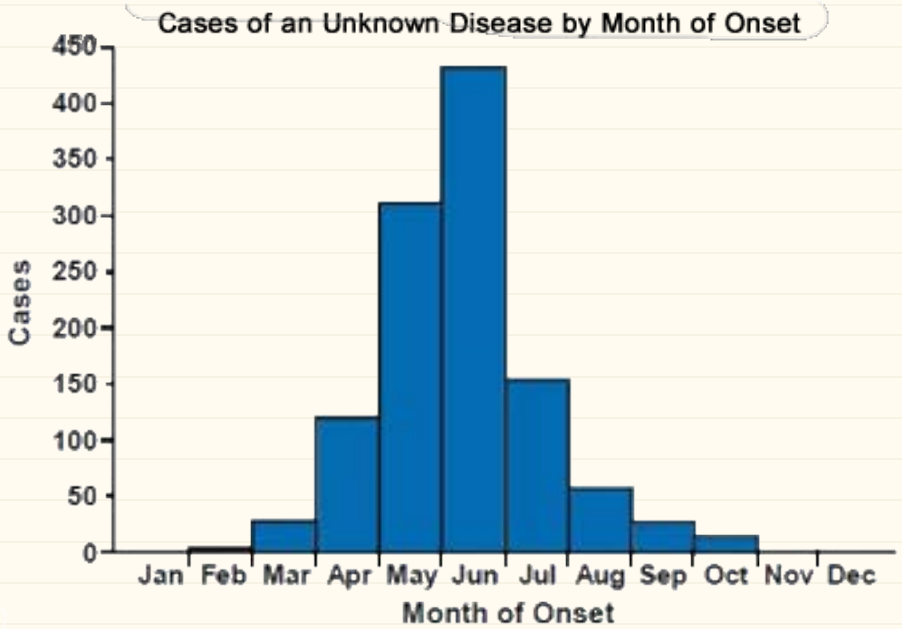
- Case definition: a criteria used to determine who has the disease or condition
  - contains four key components:
    - Clinical Information: information about the disease or condition like symptoms, causative agent, etc.
    - Person: characteristics of the population that is affected by the disease or condition
    - Place: the geographical location of the outbreak, as specific as possible
    - Time: when the outbreak occurred



Try it yourself!

Let’s write a case definition for this epidemiological event as a class.

Epi Curves

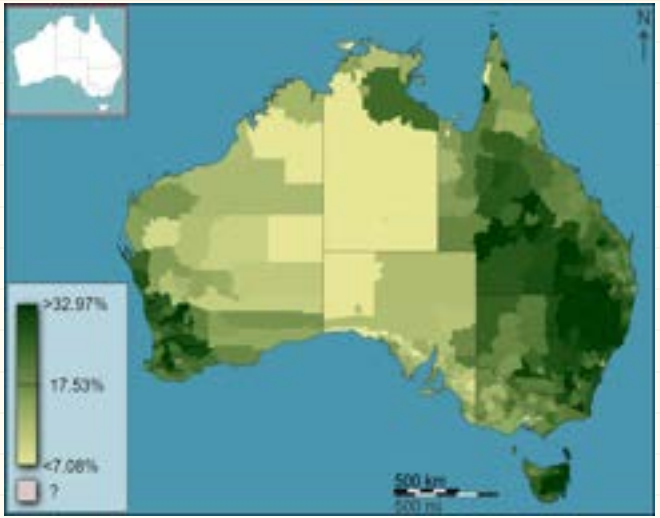

Cases of an Unknown Disease by Month of Onset
Cases
450
400
350
300
250
200
150
100
50
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month of Onset

Try it yourself!

Let’s make an epi-curve for this epidemiological event as a class.

Try it yourself!

Spot Maps and Choropleth Maps

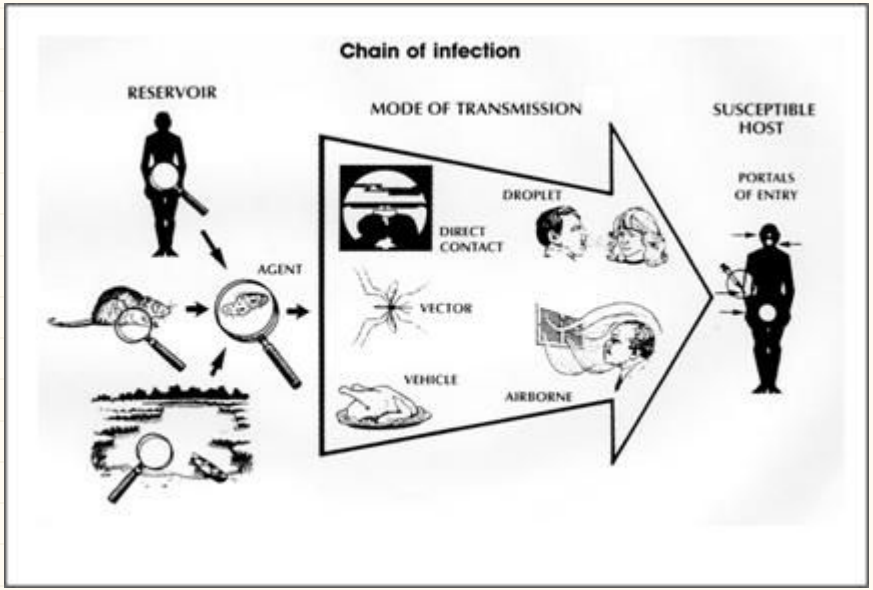


04

Developing a Hypothesis

Chain of Infection

1. agent
2. reservoir
3. portal of exit
4. mode of transmission
5. portal of entry
6. susceptible host



Modes of Transmission

- direct
  - direct contact
  - droplet
- indirect
  - vehicle
  - vector
    - biological
    - mechanical

Try it yourself!

Let’s develop some hypotheses.

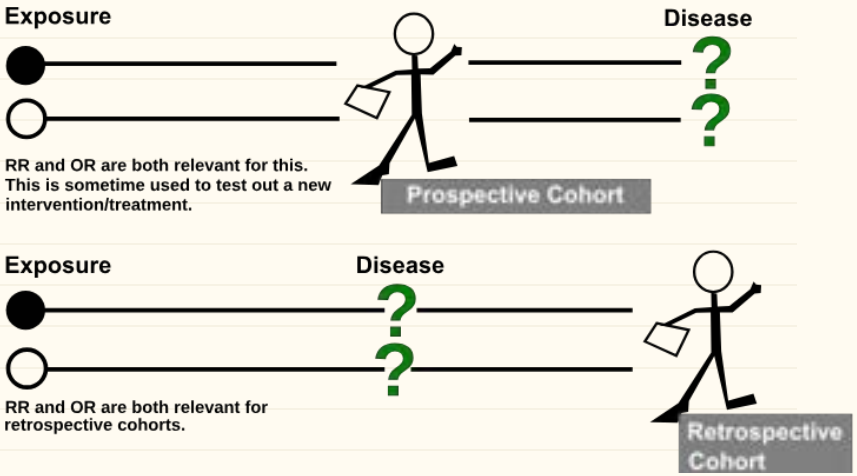
How do you think this disease was transmitted?

05

Hypothesis Testing

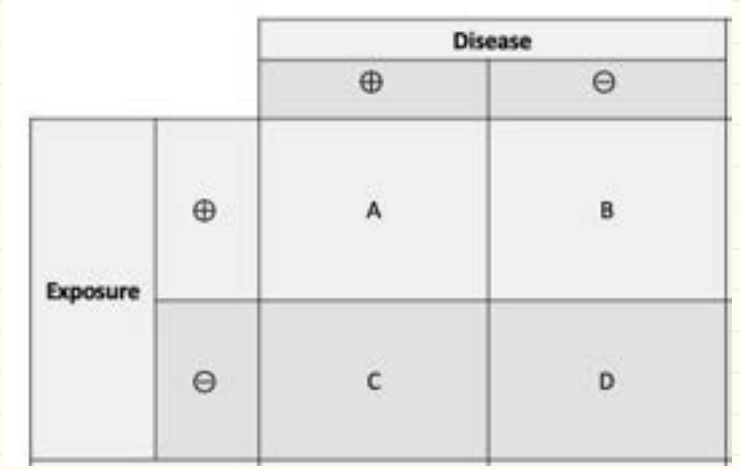
Cohort Study

- divides study participants into exposed and unexposed
- follows exposed and unexposed over time, tracks health outcome
- compares exposed to unexposed in order to determine if the exposure was a cause of the disease



Relative Risk

- measure of association between exposure and disease
- risk of exposed group is a/(a+b)
- risk of unexposed group is c/(c+d)
- relative risk is (risk of exposed group)/(risk of unexposed group)
- relative risk > 1 suggests association between exposure and disease
    - no association otherwise



Try it yourself!

Let’s test our hypotheses!

06

Control and Prevention

Control and Prevention

- control: the reduction of disease occurrence to an acceptable level through deliberate efforts
- prevention: actions aimed at reducing the likelihood of disease or injury, interrupting or slowing disease progression, or minimizing disability

Try it yourself!

What are some ways to control or prevent.