Disease Detectives 301

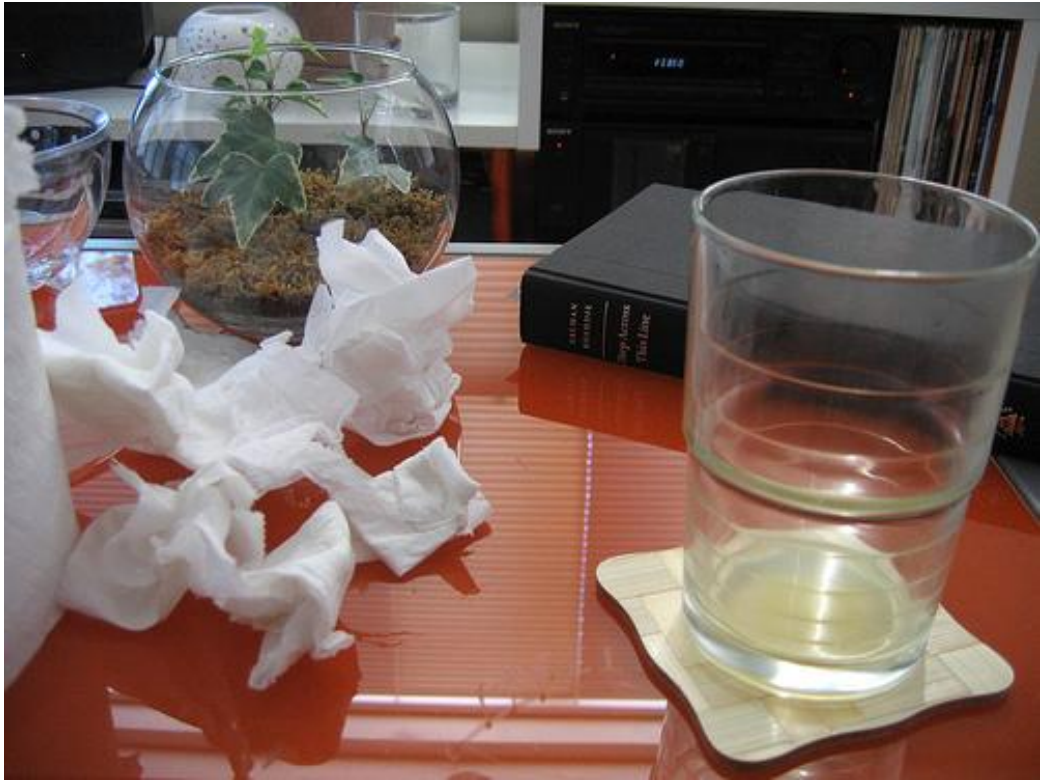
Facilitated by: Ralph Cordell and Katherine Gora Combs

Session Goals

- Address questions that participants may have encountered about epidemiology
- Have a series of “seed questions” that students often ask.

What is the difference between fomite and vector?

Fomites

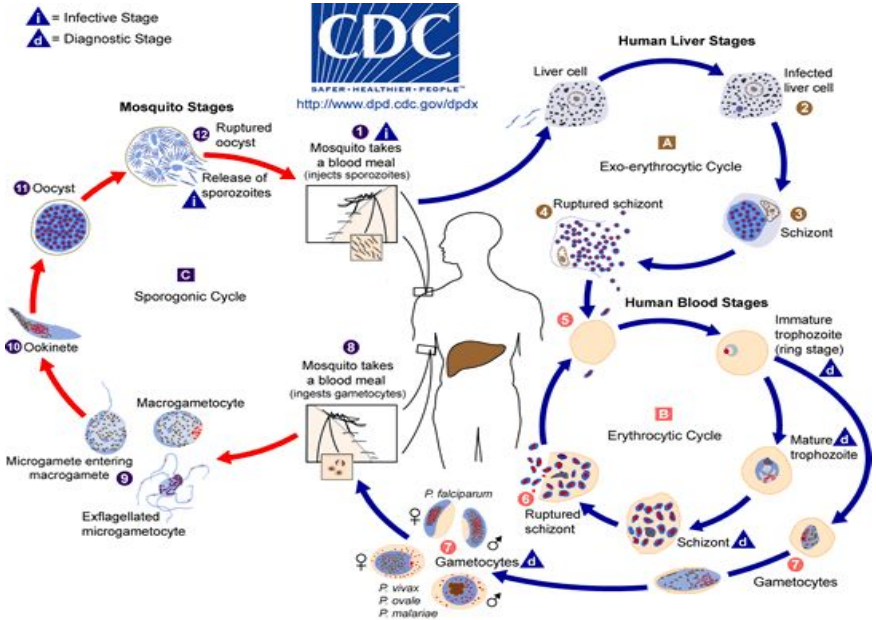


An **inanimate object** that can be the vehicle for transmission of an infectious agent (e.g., bedding, towels, or surgical instruments).

Vectors

A ***living*** intermediary that carries an agent from a reservoir to a susceptible host (e.g., mosquitoes, fleas, or ticks). May be mechanical or biologic

trachoma



Why can case-control studies be prospective sometimes (and vice versa for cohort studies)?

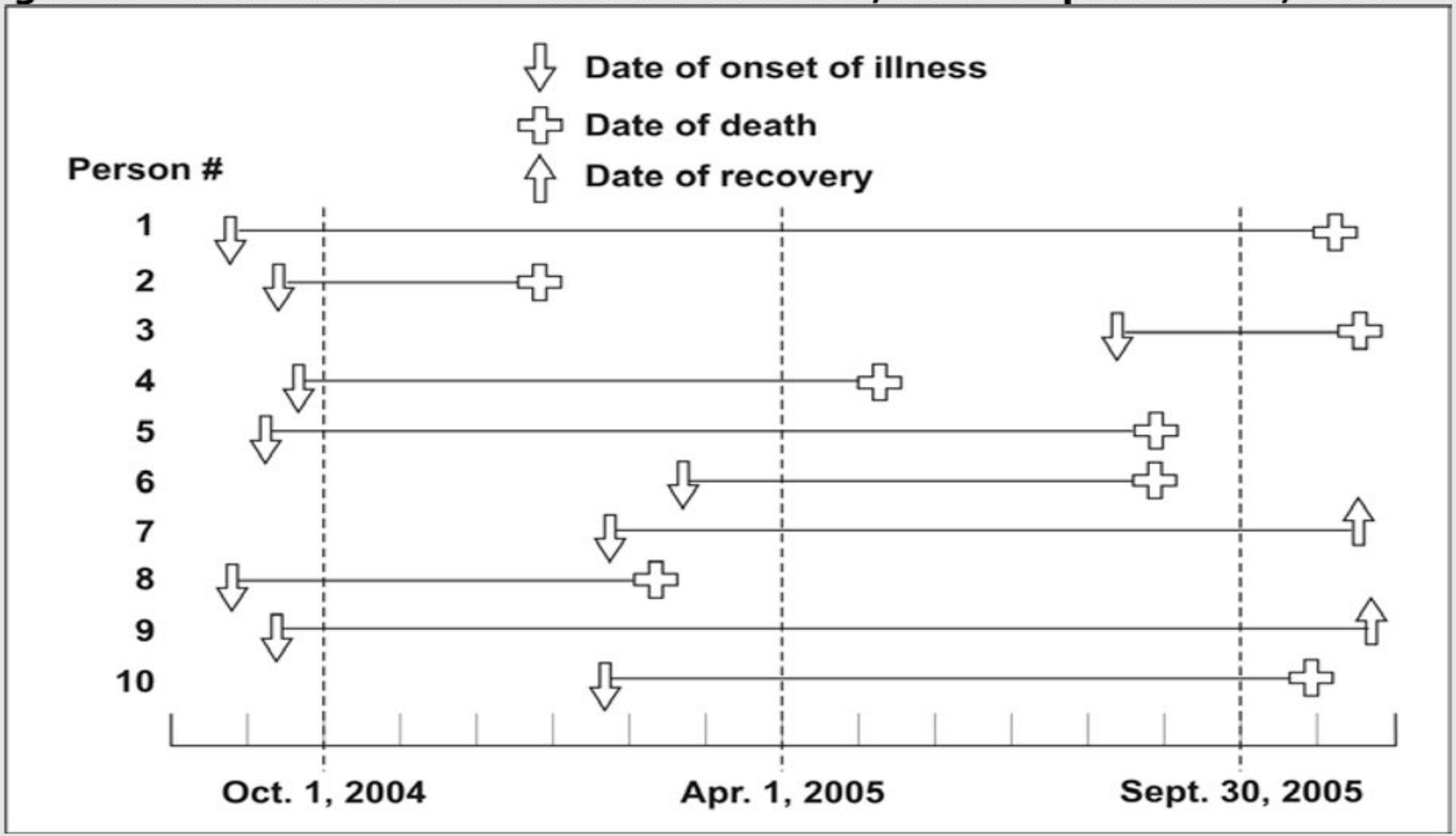
Title & Summary Clearance Process

What is the difference between prevalence vs. incidence?

Incidence vs Prevalence

- incidence a measure of the frequency with which new cases of illness, injury, or other health condition occurs among a population during a specified period.
- incidence rate a measure of the frequency with which new cases of illness, injury, or other health condition occur, expressed explicitly per a time frame. Incidence rate is calculated as the number of new cases over a specified period divided either by the average population (usually mid-period) or by the cumulative person-time the population was at risk.
- prevalence the number or proportion of cases or events or attributes among a given population.
- prevalence rate the proportion of a population that has a particular disease, injury, other health condition, or attribute at a specified point in time (point prevalence) or during a specified period (period prevalence).

Figure 3.1 New Cases of Illness from October 1, 2004–September 30, 2005



Example A: *Calculate the incidence rate from October 1, 2004, to September 30, 2005, using the midpoint population (population alive on April 1, 2005) as the denominator. Express the rate per 100 population.*

Incidence rate numerator	= number of new cases between October 1 and September 30 = 4 (the other 6 all had onsets before October 1, and are not included)
Incidence rate denominator	= April 1 population = 18 (persons 2 and 8 died before April 1)
Incidence rate	= (4 / 18) x 100 = 22 new cases per 100 population

Example B: *Calculate the point prevalence on April 1, 2005. Point prevalence is the number of persons ill on the date divided by the population on that date. On April 1, seven persons (persons 1, 4, 5, 7, 9, and 10) were ill.*

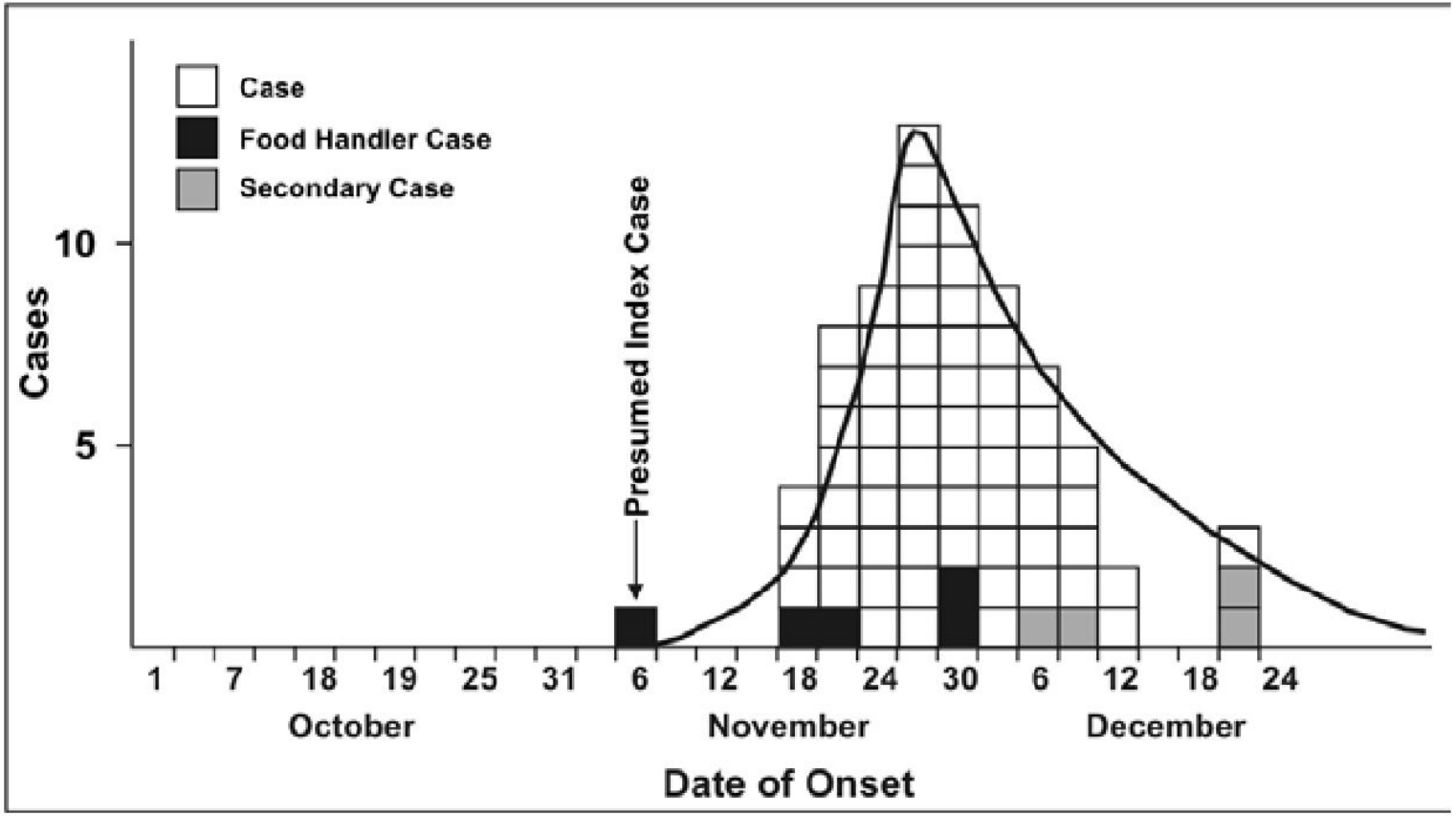
Point prevalence	= (7 / 18) x 100 = 38.89%

Example C: *Calculate the period prevalence from October 1, 2004, to September 30, 2005. The numerator of period prevalence includes anyone who was ill any time during the period. In Figure 3.1, the first 10 persons were all ill at some time during the period.*

Period prevalence	= (10 / 20) x 100 = 50.0%

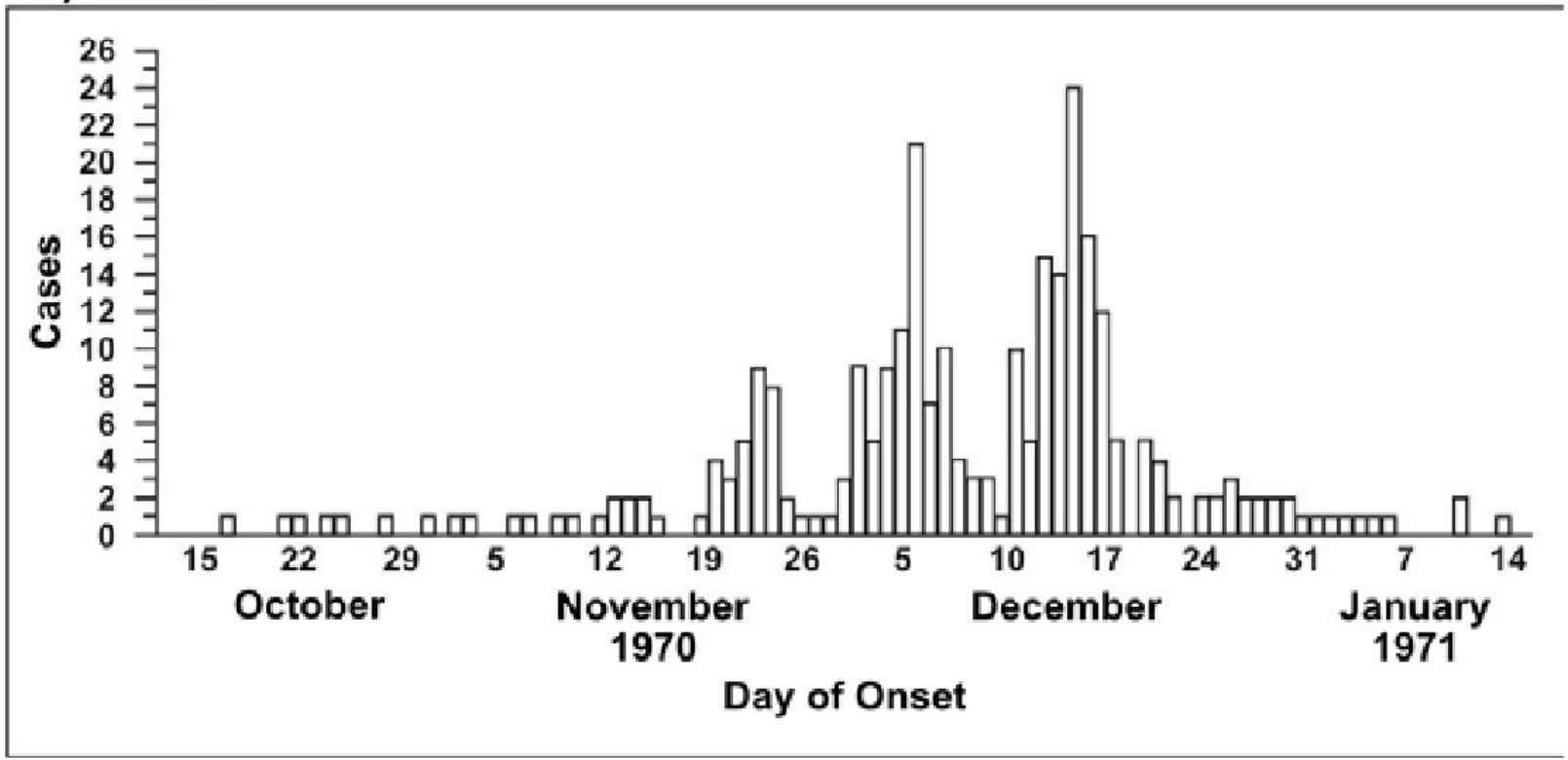
How can you determine an incubation period from an epi curve?

Figure 1.21 Hepatitis A Cases by Date of Onset, November–December, 1978



Source: Centers for Disease Control and Prevention. Unpublished data; 1979.

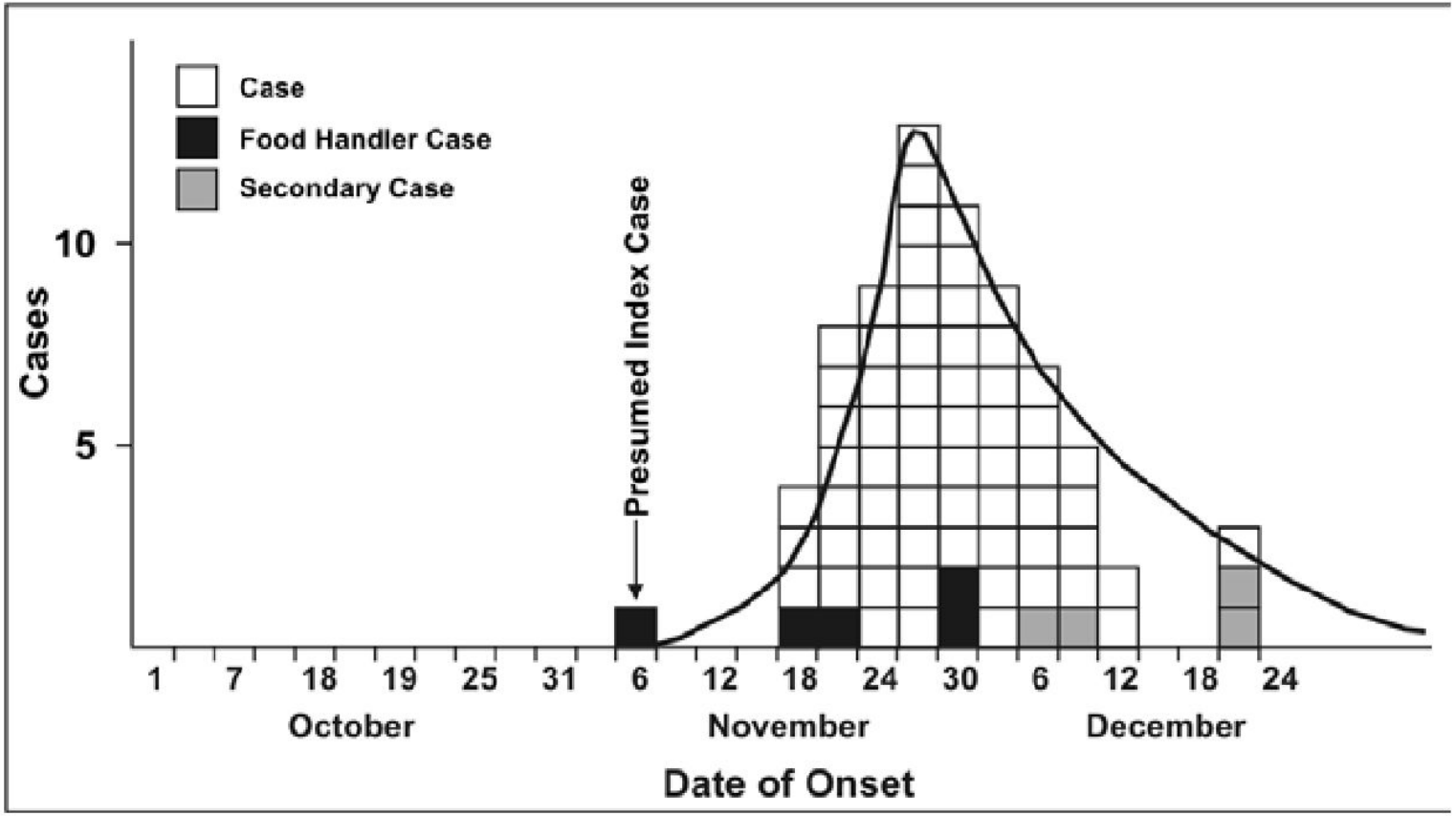
Figure 1.23 Measles Cases by Date of Onset, October 15, 1970–January 16, 1971



Source: Centers for Disease Control and Prevention. Measles outbreak—Aberdeen, S.D.

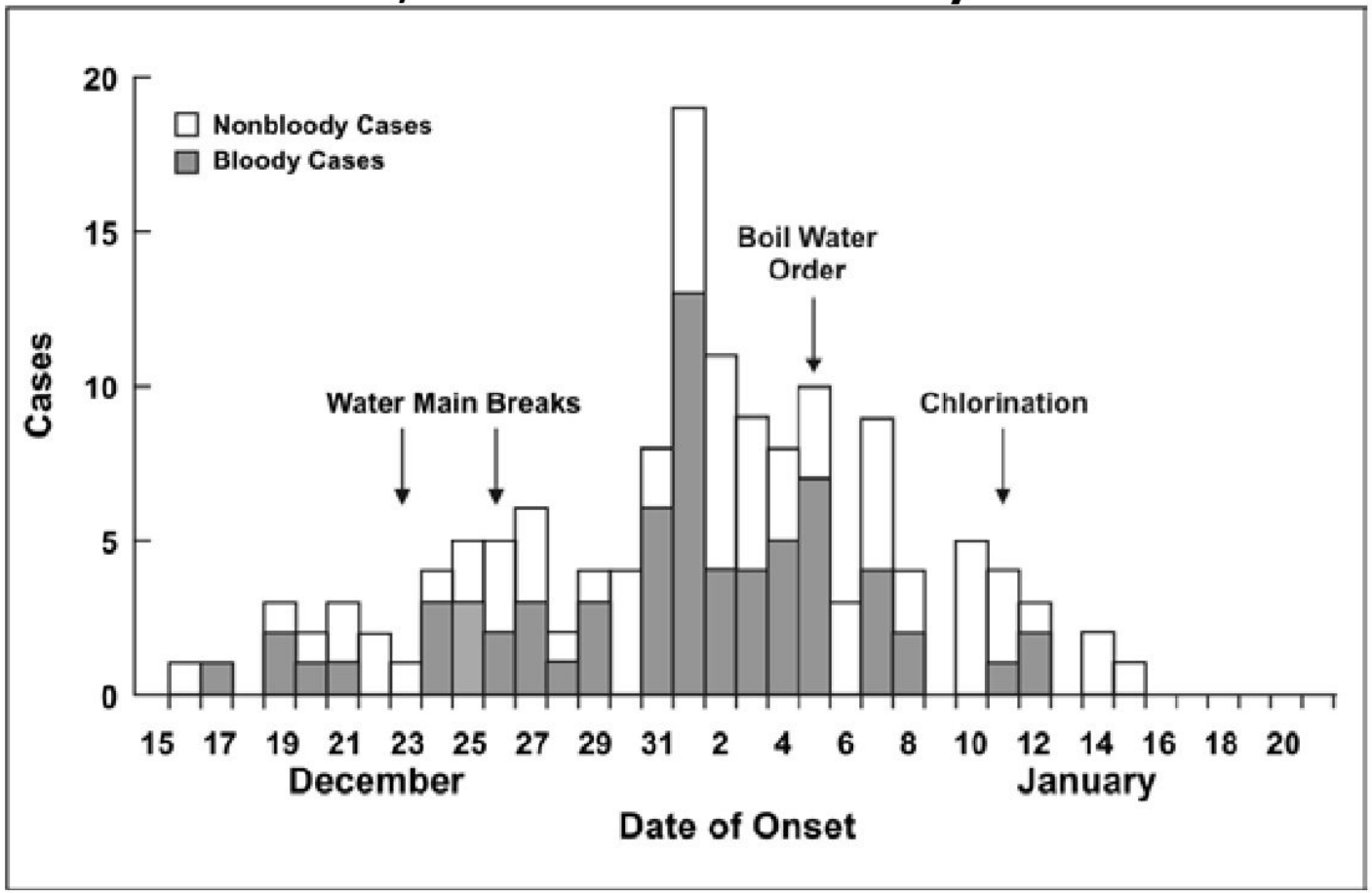
How can you tell the difference between point-source, continuous and propagated epi-curves if the epi-curve has a singular peak?

Figure 1.21 Hepatitis A Cases by Date of Onset, November–December, 1978



Source: Centers for Disease Control and Prevention. Unpublished data; 1979.

Figure 1.22 Diarrheal Illness in City Residents by Date of Onset and Character of Stool, December 1989–January 1990



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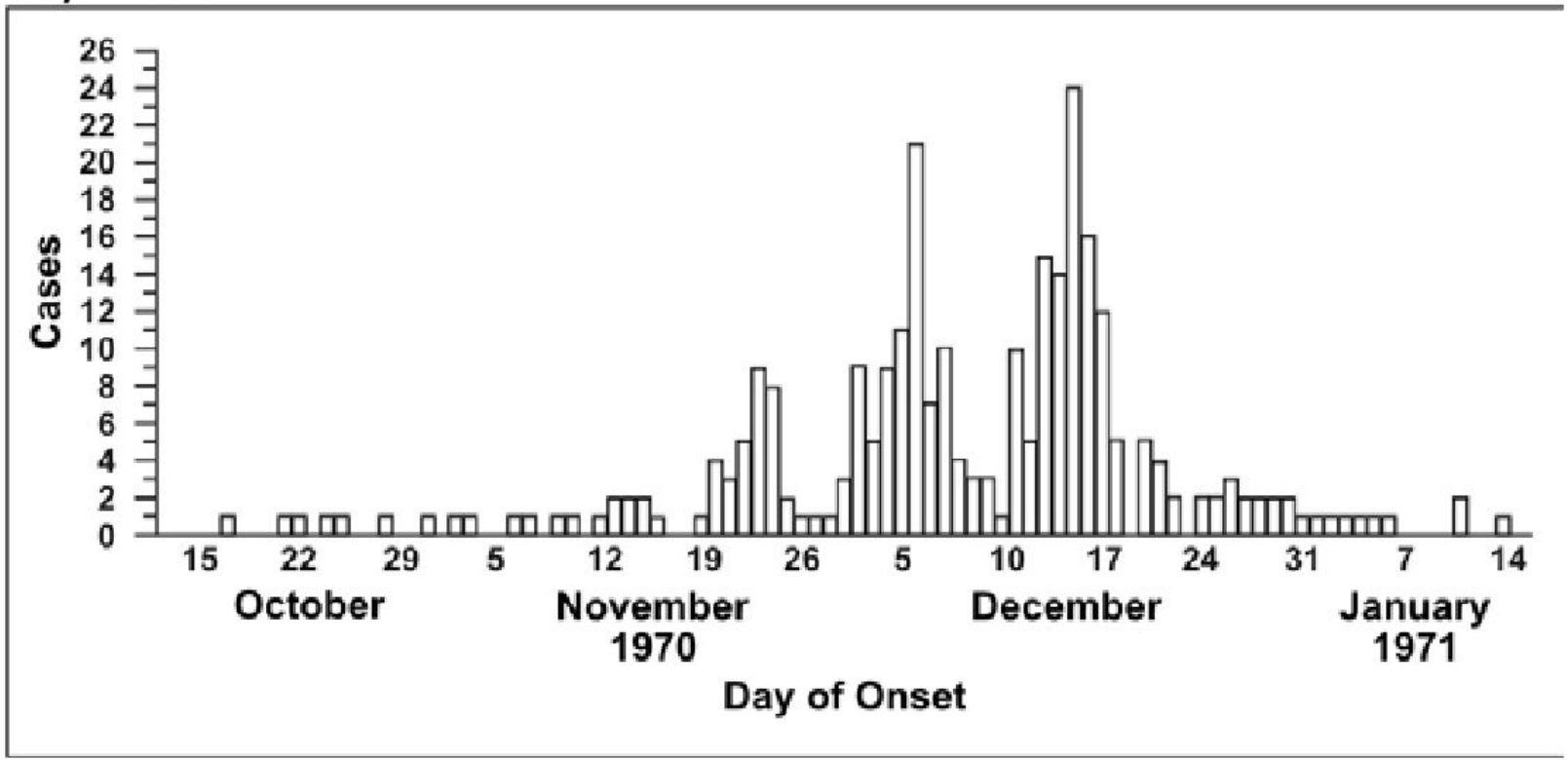
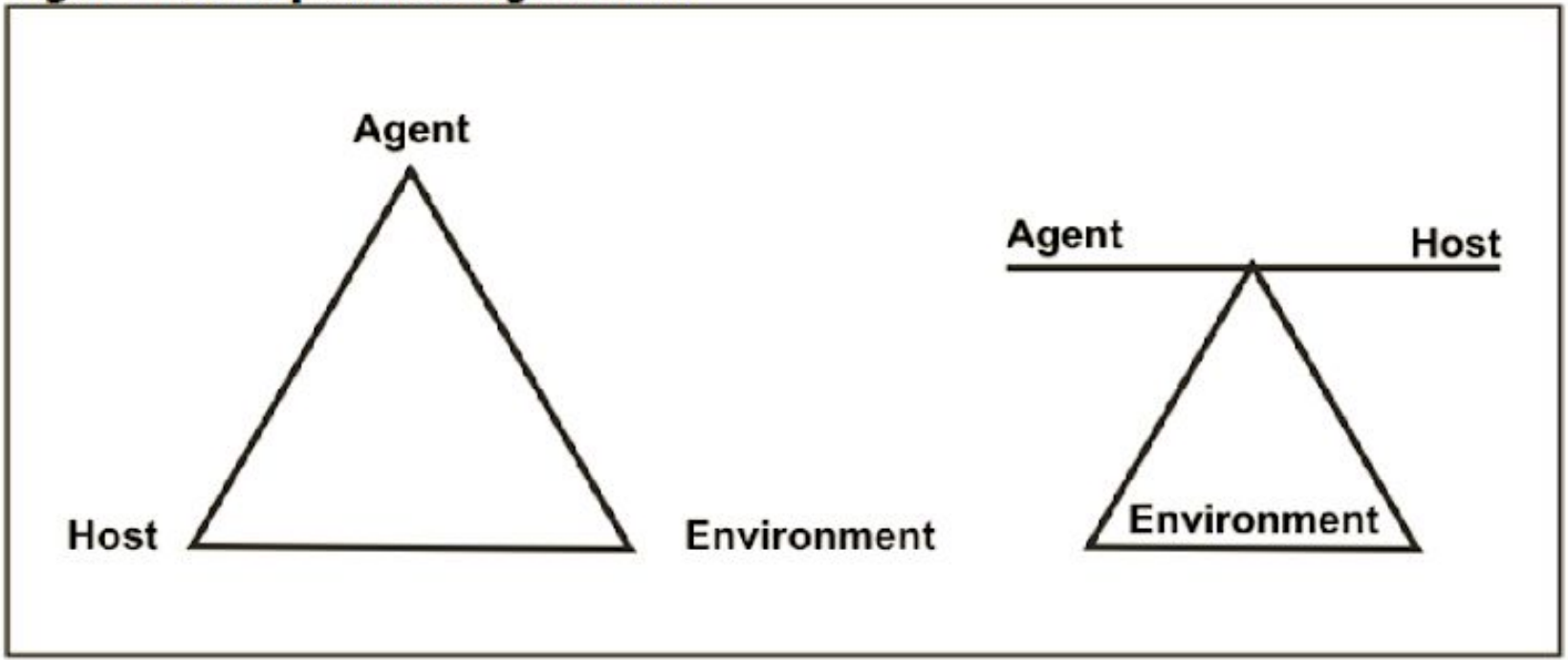


Source: Centers for Disease Control and Prevention. Measles outbreak—Aberdeen, S.D.

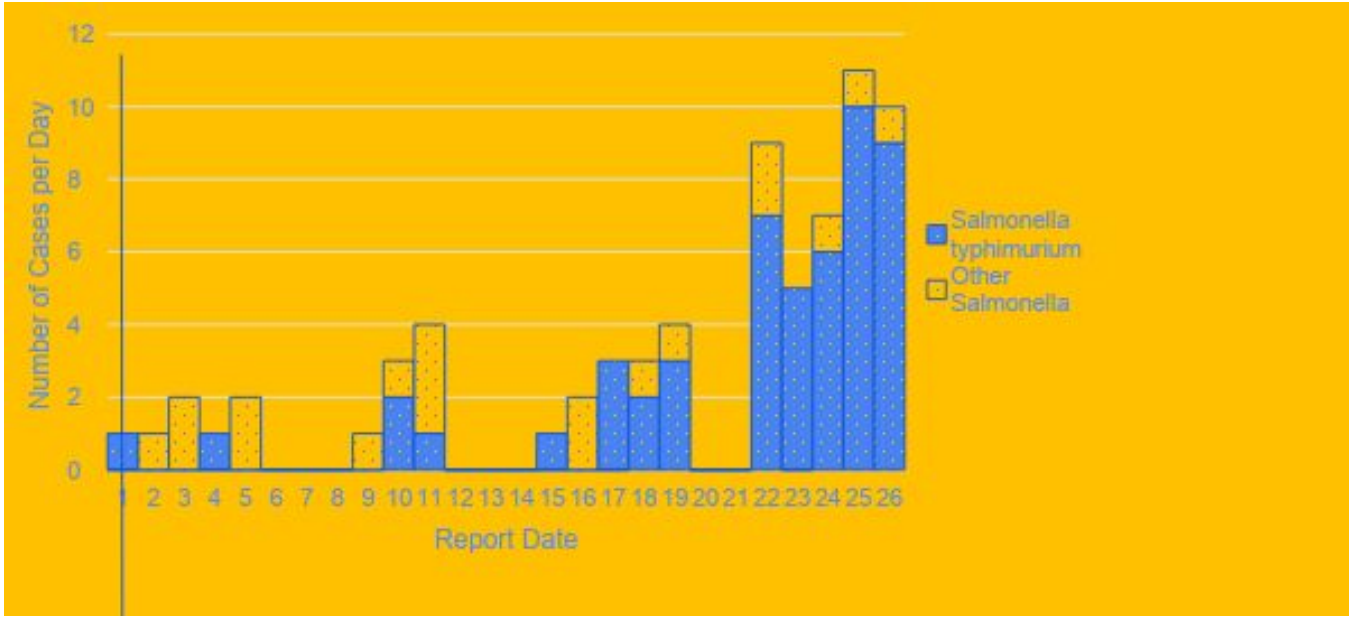
Why are there two epidemiology triads listed? Agent/host/environment vs. time/place/person

Figure 1.16 Epidemiologic Triad



Descriptive Epidemiology - Time

Figure 1. Number of *Salmonella* serotype *typhimurium* and other *Salmonella* non-*typhimurium* infections reported to county health department by report day, July 15–August 10, 1984a.



Descriptive Epidemiology - Person

Number and percentage of Salmonella serotype typhimurium (ST) cases reported during from August 1– to August 10, 1984, and percentage of salmonellosis cases reported in the United States. in 1983, by age group

Age (yrs)	Number of ST Cases	Percent of ST Cases	Percent of U.S. Salmonellosis Cases [1]
<1	3	6.5%	21.5%
1–4	15	32.6%	18.5%
5–9	9	19.6%	7.3%
10–19	7	15.2%	11.6%
20–29	5	10.9%	14.3%
30–39	4	8.7%	7.8%
40–49	1	2.2%	4.7%
50+	2	4.3%	14.2%
Total	46		

Descriptive Epidemiology - Place

Figure 3: Residence location for each of 15 salmonellosis patients reported from supermarket outbreak during June 1984. (Each dot represents a single case).

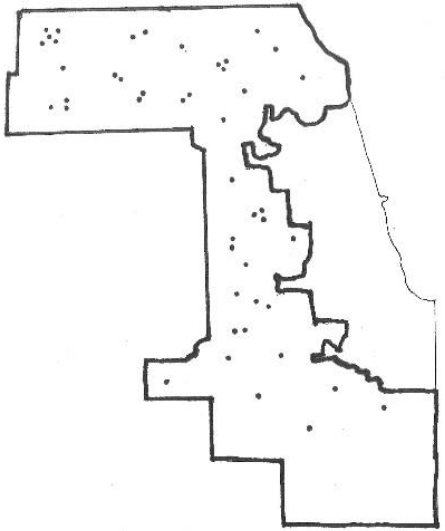


Figure 2. Residence location for each patient with *Salmonella* serotype *typhimurium* infection reported to county health department during August 1–August 10, 1984. (Each dot represents a single case.)

When do you use attack rate vs. relative risk?

Attack rate vs Relative Risk (Risk ratio)

Attack rate - a form of incidence that measures the proportion of persons in a population who experience an acute health event during a limited period (e.g., during an outbreak), calculated as the number of new cases of a health problem during an outbreak divided by the size of the population at the beginning of the period, usually expressed as a percentage or per 1,000 or 100,000 population – Used descriptively by itself

Risk ratio - measure of association that quantifies the association between an exposure and a health outcome from an epidemiologic study, calculated as the ratio of incidence proportions of two groups. - Can also be used to describe differences in risk between two groups.

What is the difference between carrier vs. host?

Carrier vs Host

Carrier - person or animal that harbors the infectious agent for a disease and can transmit it to others, but does not demonstrate signs of the disease. A carrier can be asymptomatic (never indicate signs of the disease) or can display signs of the disease only during the incubation period, convalescence, or postconvalescence. The period of being a carrier can be short (a transient carrier) or long (a chronic carrier).

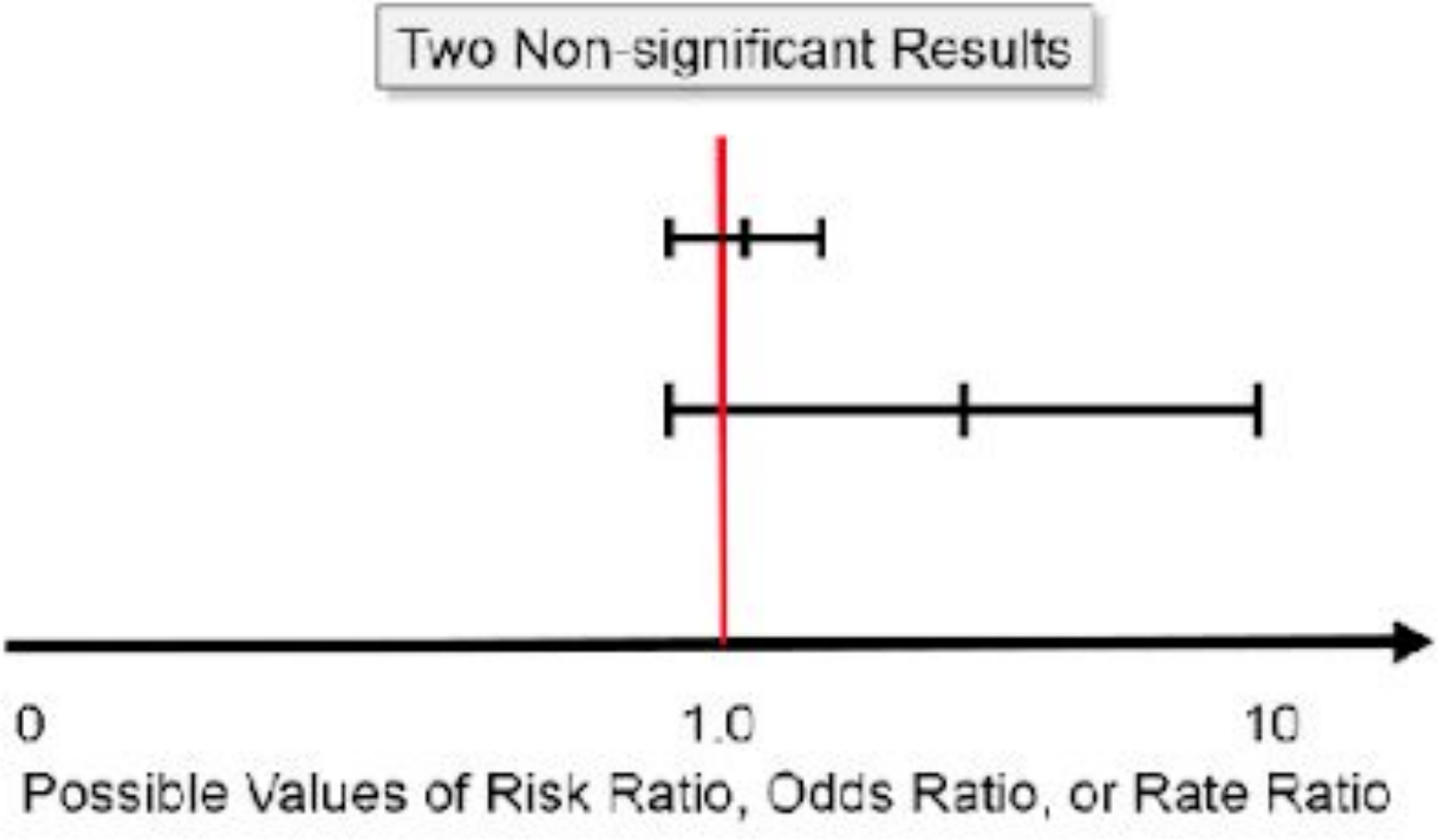
Host - person or other living organism that is susceptible to or harbors an infectious agent under natural conditions

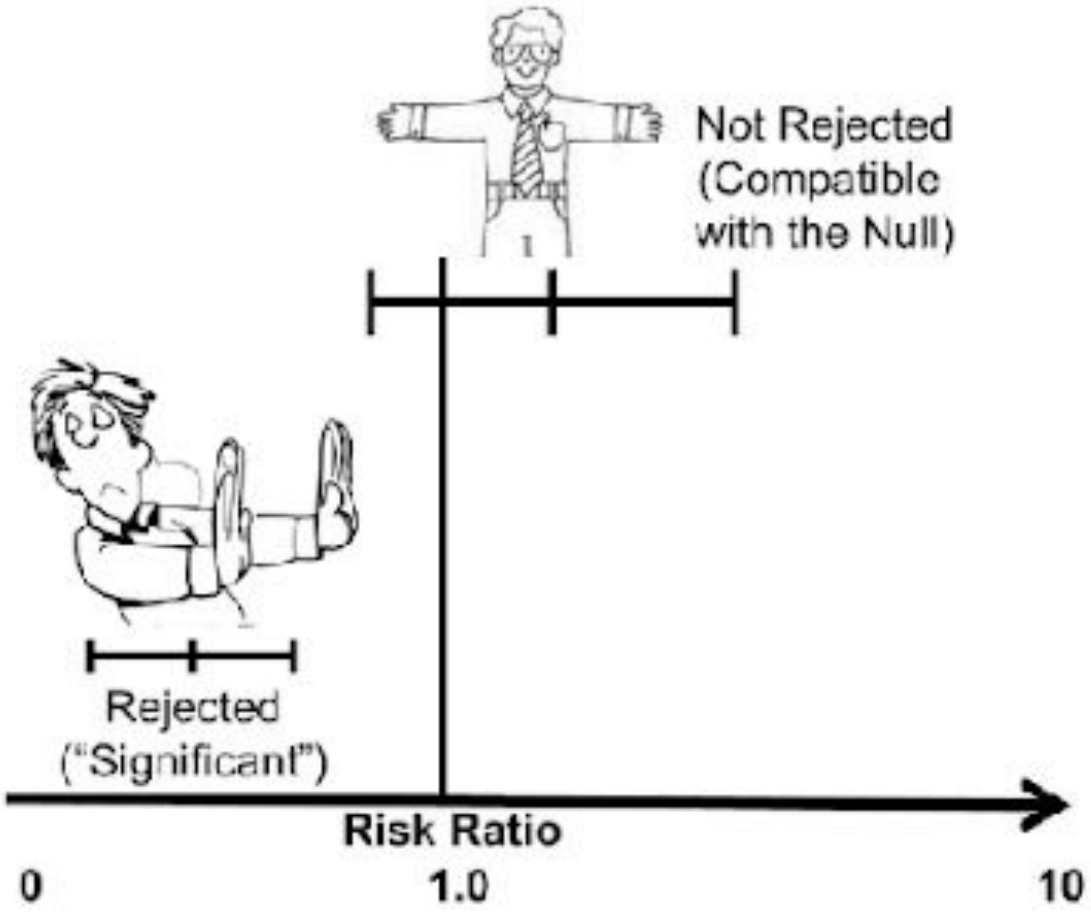
Famous Carrier vs Famous Host

What is the difference between the reported p-values and the confidence intervals? Don’t they tell you the same thing?

P-values vs Confidence Intervals

- p-value is the likelihood of obtaining a comparable difference by chance under the same circumstances
- Confidence intervals – the likely range of the actual value


Two Non-significant Results
0
1.0
10
Possible Values of Risk Ratio, Odds Ratio, or Rate Ratio


Not Rejected
(Compatible
with the Null)
Rejected
("Significant")
Risk Ratio
0
1.0
10

How can you tell the difference between a case-control and a cohort study?

Case-control vs Cohort studies

Case-control study - an observational analytic study that enrolls one group of persons with a certain disease, chronic condition, or type of injury (case-patients) and a group of persons without the health problem (control subjects) and compares differences in exposures, behaviors, and other characteristics to identify and quantify associations, test hypotheses, and identify causes.

Cohort study - an observational analytic study in which enrollment is based on status of exposure to a certain factor or membership in a certain group. Populations are followed, and disease, death, or other health-related outcomes are documented and compared. Cohort studies can be either prospective or retrospective

Classical Experiment

- Hypothesis : Exposure to X causes disease Y.
- Randomize experimental animals or study subjects into two groups .
- One group (test group) gets the exposure.
- Second (control group) is not exposed – gets placebo.
- Follow both groups through time and observe for illness.
- Compare illness rates in the two groups

$$\text{Illness Rate} = \frac{\#\text{ ill subjects in exposed (unexposed) group}}{\text{total \# subjects in exposed (unexposed) group}}$$

Cohort Study

- Hypothesis : Exposure to X causes disease Y
- Follows classical experiment except subjects determine their exposure status
- Requires that study population be identifiable
- Start with exposed and unexposed groups & follow through time
- Both exposure and disease onset may be in the past
- Collect information about exposure and disease states through interviews or observation
- Compare illness rate or risk for exposed and unexposed

Two by Two Table

	Sick	Well	Total
Exposed	A	B	A+B
Not Exposed	C	D	C+D
	A+C	B+D	A+B+C+D

Relative Risk (RR) = Attack Rate in Exposed/Attack Rate in Not Exposed

$$RR= (A/(A+B))/(C/(C+D))$$

Line-listing from an Investigation of an Outbreak of Gastroenteritis, Arafat, Saudi Arabia, 1979

Table 6.8
Selected characteristics of Kuwaiti medical mission members who ate lunch at Arafat, Saudi Arabia, October 31, 1979

			Onset of Illness		Foods			Signs and Symptoms*					
Id #	Age	Sex	Date	Hour	Rice	Meat	TS*	D	C	BS	N	V	F
31	36	M	Oct. 31	5 p.m.	X	X	X	D	C	BS			
77	28	M	Oct. 31	5 p.m.	X	X		D	C				
81	33	M	Oct. 31	10 p.m.	X	X	X	D	C				
86	29	M	Oct. 31	10 p.m.	X	X	X	D	C				
15	38	M	Oct. 31	10 p.m.		X		D		BS	N		
17	48	M	Oct. 31	10 p.m.	X	X		D	C				
18	35	M	Oct. 31	10 p.m.	X	X	X	D	C				
35	30	M	Oct. 31	11 p.m.	X	X	X	D	C				
88	27	M	Oct. 31	11 p.m.	X	X	X	D	C				
76	29	M	Oct. 31	11 p.m.	X	X	X	D	C	BS			
71	50	M	Oct. 31	12 MN	X	X	X	D					
1	39	F	Nov. 1	1 a.m.	X	X	X	D	C			V	
27	36	M	Nov. 1	1 a.m.	X	X	X	D	C		N		
28	44	M	Nov. 1	1 a.m.	X	X	X	D	C				
29	48	M	Nov. 1	1 a.m.	X	X	X	D	C	BS			

Line-listing from an Investigation of an Outbreak of Gastroenteritis, Arafat, Saudi Arabia, 1979

	# persons who ATE specified food				# who DID NOT EAT specified food			
	Ill	Well	Total	Attack Rate	Ill	Well	Total	Attack Rate
Rice	62	31	93	66.7%	2	0	2	100.0%
Meat	63	25	88	71.6 %	1	6	7	14.3%
T.S.	50	26	76	65.8%	14	5	19	73.7%

	AR Exposed	AR Unexp	RR
Rice	66.7	100	0.66
Meat	71.6	14.3	5.01
T.S.	65.8	73.7	0.89

Cohort Study

- Hypothesis : Persons with disease Y have a greater odds of exposure to X than persons without disease Y
- Start with a group of case-patients (case definition)
- Select a group of control subjects (similar to cases except they do not have disease Y)
- Collect information about exposure and disease states through interviews or records
- Compare odds of exposure among case patients with that among control subjects

Two by Two Table

	Sick	Well	Total
Exposed	A	B	A+B
Not Exposed	C	D	C+D
	A+C	B+D	A+B+C+D

Odds of exposure among case patients = A:C
Odds of exposure among control subjects=B:D

OR=(A:C)/(B:D) =
(AD)/(BC)

Chain A or Chain B among persons infected with Salmonella serotype typhimurium with that among persons infected with other enteric pathogens.

	Persons infected with Salmonella serotype typhimurium		Persons infected with other enteric pathogens		Odds Ratio (95% confidence intervals)
	Exposed	Not exposed	Exposed	Not exposed	
Raw eggs	4	45	9	34	0.3 (0.09–1.18)
Tomatoes	43	6	38	5	0.9 (0.2–3.3)
Milk	45	4	31	12	4.4 (1.3–14.8)
2% Milk	45	4	25	18	8.1 (2.5–26.6)
Shopped supermarket Chain A	46	3	29	14	7.4 (2.0–28.0)
Shopped supermarket Chain B	26	23	23	20	1.0 (0.4–2.2)

I know that you are supposed to use risk ratios for cohort studies and odds ratios for case-control studies but we saw an article in a journal where the authors said it was a cohort study yet they used odds ratios. Why is that?

We've seen two different lists of the steps of an outbreak investigation. Each has a different number of steps. Which is correct?

Steps of an Outbreak Investigation

Table 6.2 Epidemiologic Steps of an Outbreak Investigation

1. Prepare for field work
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Construct a working case definition
5. Find cases systematically and record information
6. Perform descriptive epidemiology
7. Develop hypotheses
8. Evaluate hypotheses epidemiologically
9. As necessary, reconsider, refine, and re-evaluate hypotheses
10. Compare and reconcile with laboratory and/or environmental studies
11. Implement control and prevention measures
12. Initiate or maintain surveillance
13. Communicate findings

10 Steps of an Outbreak Investigation

1. Identify investigation team and resources
2. Establish existence of an outbreak
3. Verify the diagnosis
4. Construct case definition
5. Find cases systematically and develop line listing
6. Perform descriptive epidemiology/develop hypotheses
7. Evaluate hypotheses/perform additional studies as necessary
8. Implement control measures
9. Communicate findings
10. Maintain surveillance

What is the difference between direct droplet spread and indirect airborne transmission?

T. D. Brock

What is the difference between confounding and bias?

Confounding vs Bias

Confounding - the distortion of the association between an exposure and a health outcome by a third variable that is related to both exposure and outcome (i.e., diabetes, hypertension and heart disease)

A “naturally” occurring situation that can often be addressed in the study design and analysis phases by matching or stratified analysis

Bias - a systematic deviation of results or inferences from the truth or processes leading to such systematic deviation; any systematic tendency in the collection, analysis, interpretation, publication, or review of data that can lead to conclusions that are systematically different from the truth.

Introduced during the study design stage – difficult to address.

When do you use a chi square test and when do you use Fishers exact?

Title & Summary Clearance Process

Additional questions, concerns, or thoughts?

For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov