Outbreak Investigation

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Tuesday 27th September 2011

OBJECTIVES OF THE LECTURE

- Importance of investigating reported outbreaks
- Steps in the investigation of an outbreak
- Describe epidemic curves

Outbreak

Epidemic

Cluster

Jargon Busted!

An **outbreak** or an **epidemic** is the occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time.

A **cluster** is an aggregation of cases in a given area over a particular period without regard to whether the number of cases is more than expected

To investigate or Not To?

"Outbreak investigations, an important and challenging component of epidemiology and public health, can help identify the source of ongoing outbreaks and prevent additional cases. Even when an outbreak is over, a thorough epidemiologic and environmental investigation often can increase our knowledge of a given disease and prevent future outbreaks. Finally, outbreak investigations provide epidemiologic training and foster cooperation between the clinical and public health communities."

Outbreak Investigations—A Perspective
Arthur L. Reingold
University of California, Berkeley
Emerging Infectious Diseases, Vol. 4 , No. 1

Why to investigate?

- Control & Prevention
- 
  Research Opportunities
- 
  Training
- Public/Legal/Political Concerns

Control Vs. Further Investigations

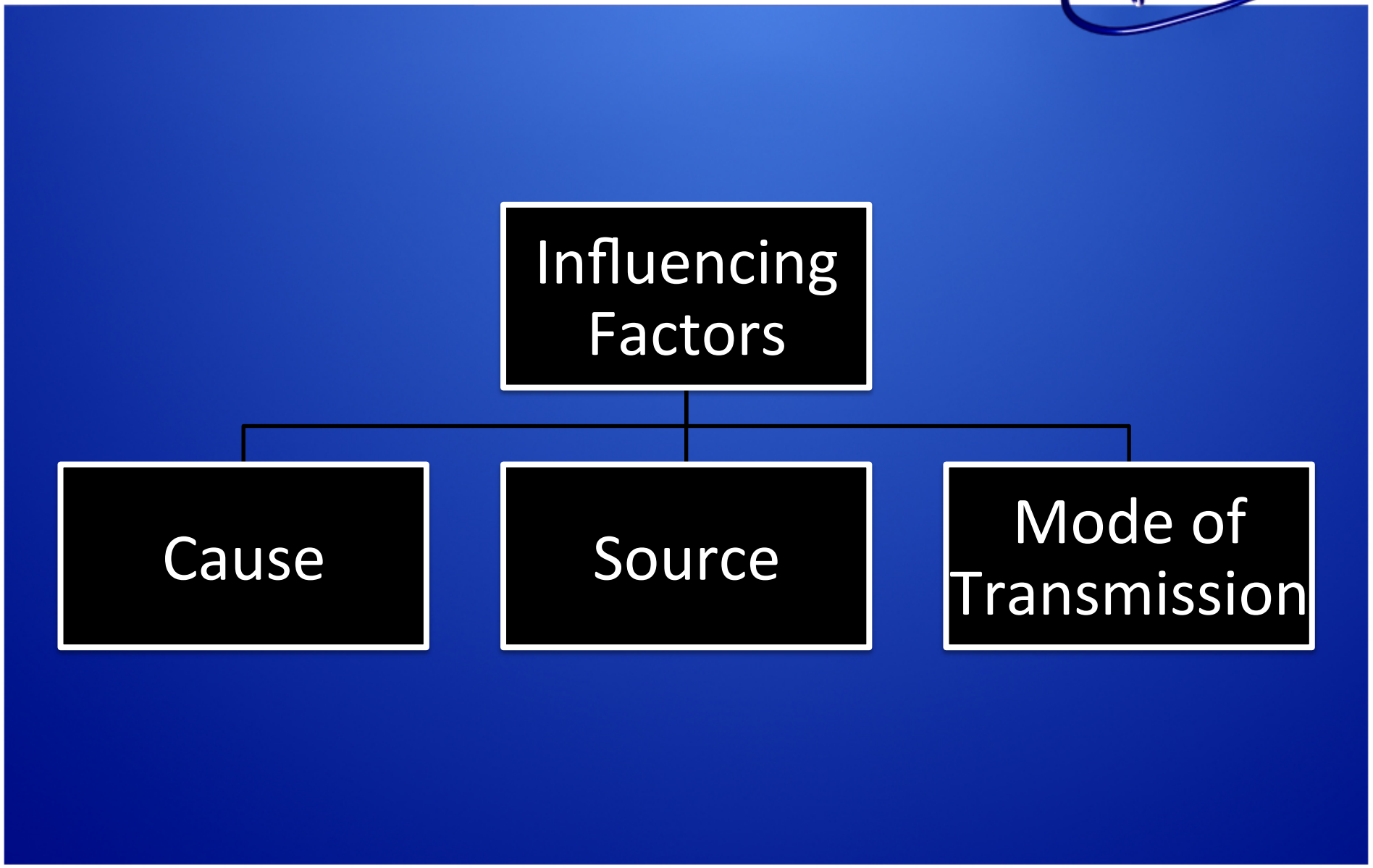


Table 6.1 Relative Priority of Investigative and Control Efforts During an Outbreak, Based on Knowledge of the Source, Mode of Transmission, and Causative Agent

		Source/Mode of Transmission (How people are getting exposed to the agent)	
		Known	Unknown
Causative Agent	Known	Investigation + Control +++	Investigation +++ Control +
	Unknown	Investigation +++ Control +++	Investigation +++ Control +

+++ = highest priority
+ = lowest priority

Source: Goodman RA, Buehler JW, Koplan JP. The epidemiologic field investigation: science and judgment in public health practice. Am J Epidemiol 1990;132:9–16.

- ✓ Definitions
- ✓ Importance of investigating an outbreak i.e. why to investigate?
- ✓ Deciding on relative priority between control and further investigations

Once a decision is made to investigate an outbreak

- ***The epidemiologic investigation.***
- **The environmental investigation.**
- **The interaction with the public, the press, and, in many instances, the legal system.**

Table 6.2
Steps of an outbreak investigation

1. Prepare for field work
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Define and identify cases
   a. establish a case definition
   b. identify and count cases
5. Perform descriptive epidemiology
6. Develop hypotheses
7. Evaluate hypotheses
8. As necessary, reconsider/refine hypotheses and execute additional studies
   a. additional epidemiologic studies
   b. other types of studies – laboratory, environmental
9. Implement control and prevention measures
10. Communicate findings

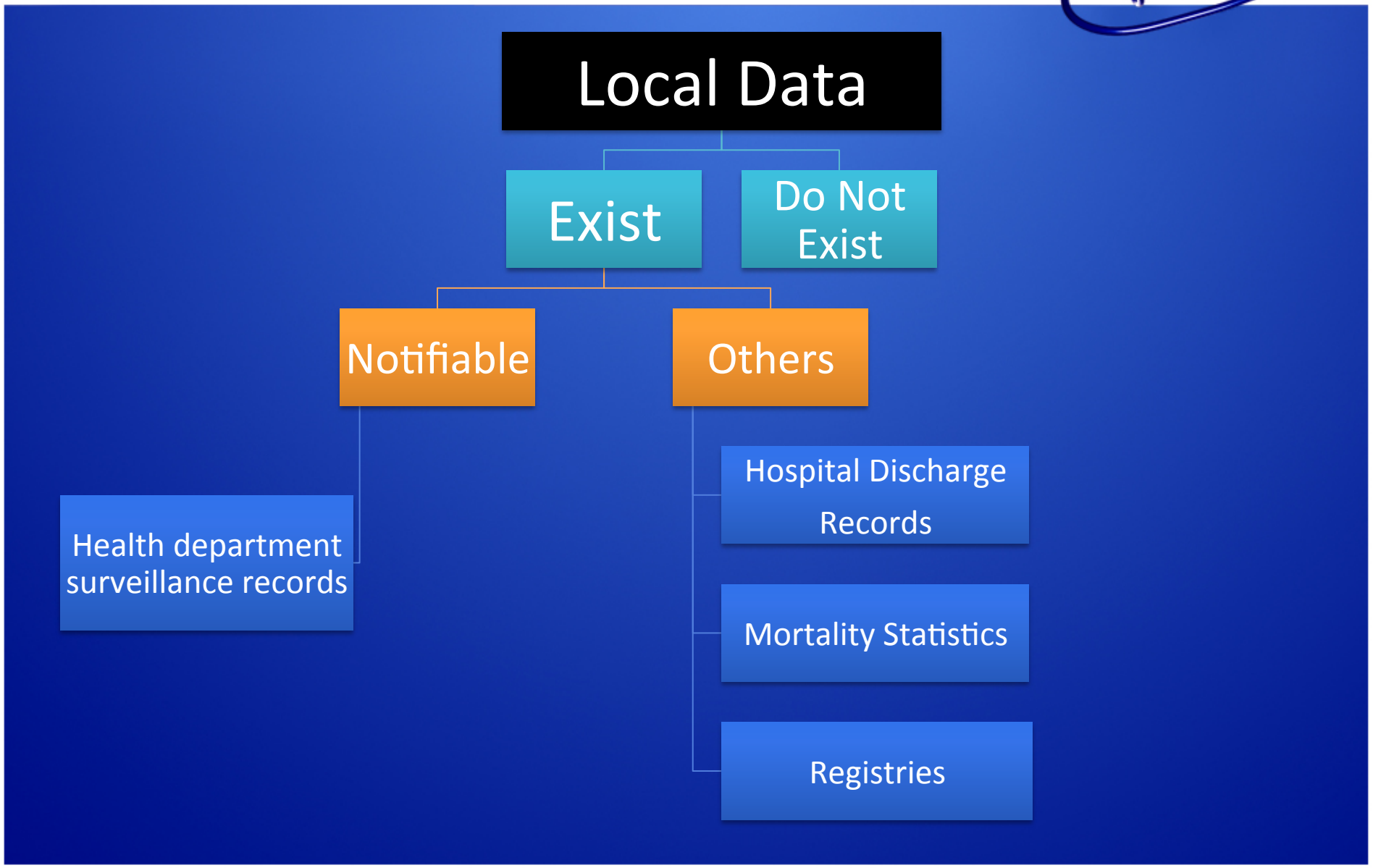
Step 1: Prepare the Fieldwork

Investigation	Administration	Consultation

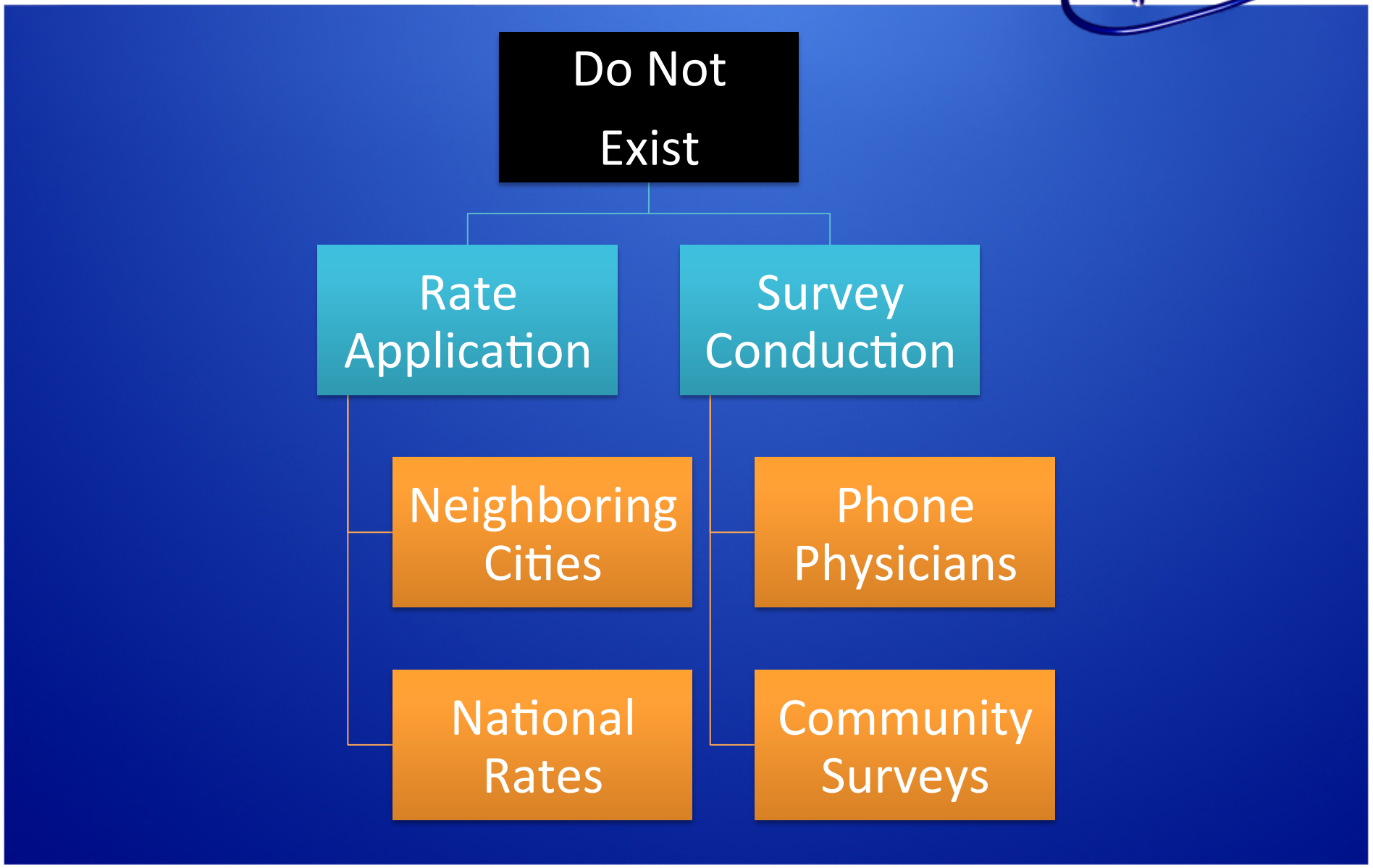
Step 2: Establishing the Existence of an Outbreak

Is this an epidemic or cluster of cases? (observed number exceed the expected number)

Sources to Answer Step 2



Sources to Answer Step 2



Sources to Answer Step 2

- For a notifiable disease: use health department surveillance records.
- For other diseases and conditions: find existing data locally—hospital discharge records, mortality statistics, cancer or birth defect registries.
- If local data are not available: apply rates from neighboring cities or national data, or, alternatively, conduct a telephone survey of physicians to determine whether they have seen more cases of the disease than usual.
- Finally, conduct a survey of the community to establish the background or historical level of disease.

Step 3: Verifying the Diagnosis

closely linked to verifying the existence of an outbreak

Step 3

Importance of Step 3:

- To ensure that the problem has been properly diagnosed
- To rule out laboratory error as the basis for the increase in diagnosed cases

Steps of Verification:

① Review the clinical findings and laboratory results.

② Visit several patients with the disease.

③ Summarize the clinical findings with frequency distributions

Why?

- Diseases can be misdiagnosed.
- Case may not be actual case, but rather suspected case.
- Information from non-cases must be excluded from the case information used to confirm the presence or absence of an epidemic.

Step 4 (a): Establishing a Case Definition

Definition	Components	Terminology

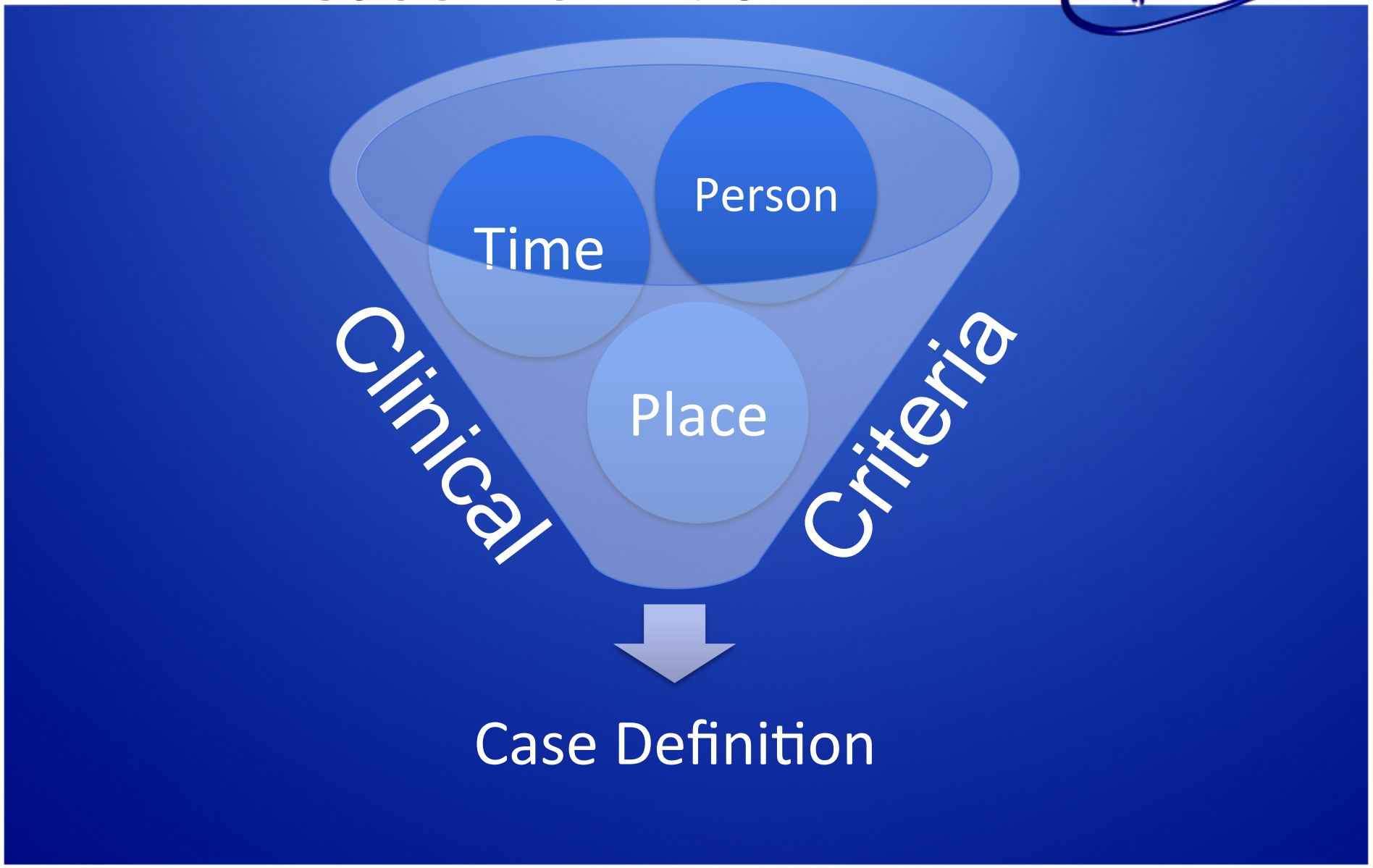
Step 4 (b): Identifying and Counting Cases

Sources for Identification	Information Collected	Line Listing (counting)

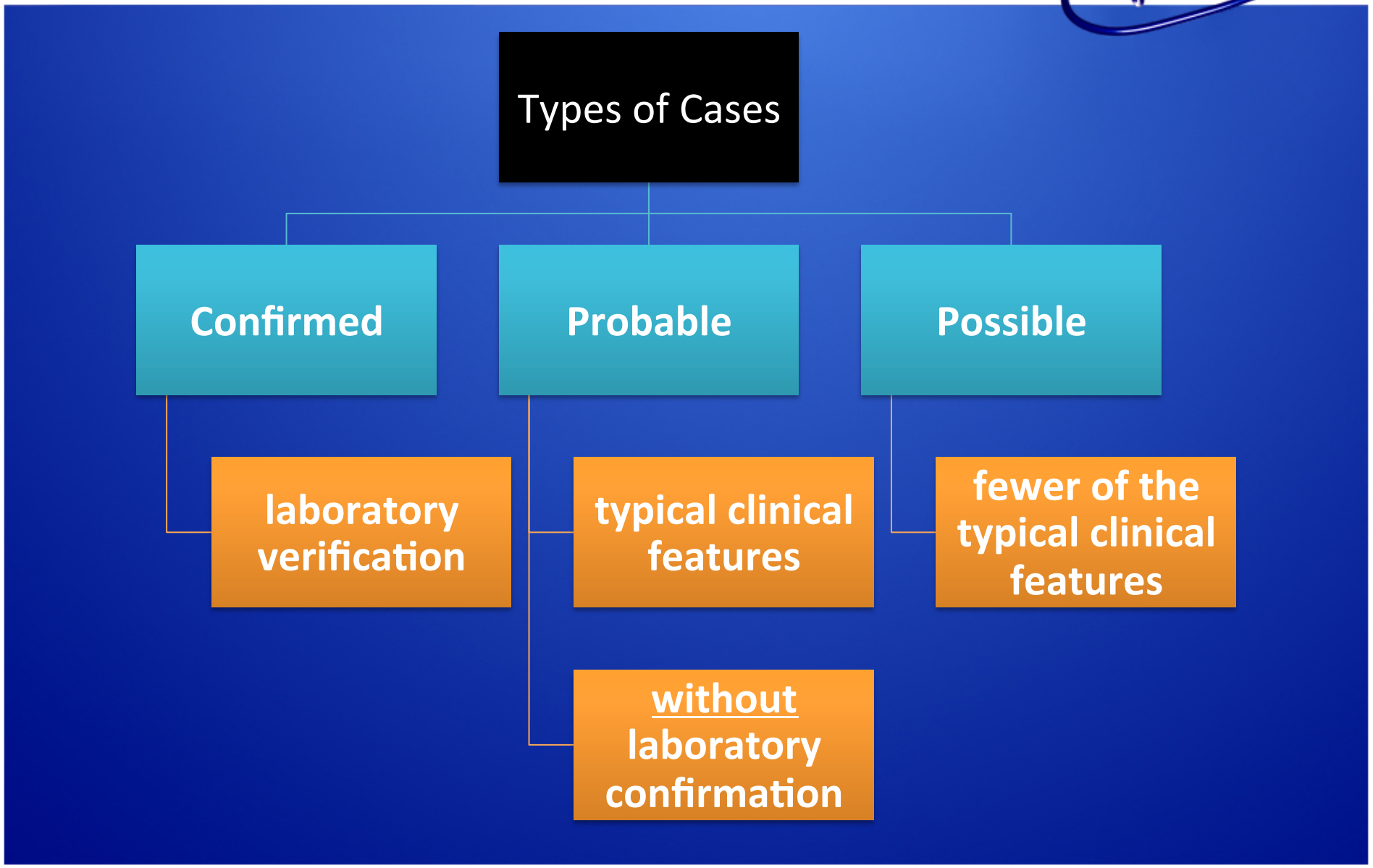
Step 4 (a): What is a Case Definition?

A standard set of criteria for deciding whether an individual should be classified as having the health condition of interest.

Step 4 (a): Components of a Case Definition



Step 4 (a): Terminology



Remember!

Early in an investigation, investigators often use a sensitive or "loose" case definition which includes confirmed, probable, and even possible cases. Later on, when hypotheses have come into sharper focus, the investigator may "tighten" the case definition by dropping the possible category.

Step 4 (b): Sources for Identifying Cases

sources

- Direct case finding at health care facilities
- Direct public alert through local media
- Ask case-patients if they know anyone else with the same condition
- Conduct a survey of the entire population

Step 4 (b): Information Collected

Every Case

- identifying information
- demographic information
- clinical information
- risk factor information
- reporter information

Step 4 (b): Line Listing (Counting Cases)

Line Listing of reported suspect cases, page 1

Case #	Initials	Date of Report	Date of Onset	Diagnostic								Lab		Age	Sex
				MD Dx	Signs and Symptoms							HA IgM	Other		
					N	V	A	F	DU	J					
1	JG	10/12	10/6	Hep A	+	+	+	+	+	+		+	SGOT↑	37	M
2	BC	10/12	10/5	Hep A	+	–	+	+	+	+		+	ALT↑	62	F
3	HP	10/13	10/4	Hep A	±	–	+	+	+	S*		+	SGOT↑	30	F
4	MC	10/15	10/4	Hep A	–	–	+	+	?	–		+	HBs Ag-	17	F
5	NG	10/15	10/9	NA	–	–	+	–	+	+		NA	NA	32	F
6	RD	10/15	10/8	Hep A	+	+	+	+	+	+		+		38	M
7	KR	10/16	10/13	Hep A	±	–	+	+	+	+		+	SGOT = 240	43	M
8	DM	10/16	10/12	Hep A	–	–	+	+	+	–		+		57	M
9	PA	10/18	10/7	Hep A	±	–	+	±	+	+		+		52	F
10	SS	10/11	10/11	R/o Hep A Hep	+	+	+		+	–			HBsAg	21	M

S*= scleral F = fever

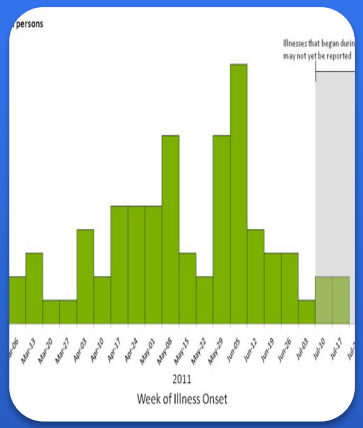
Step 5: Performing Descriptive Epidemiology

Time	Place	Person

Why we need to perform step 5

Become familiar with the data

- By inspecting and looking carefully at them



Trend of the disease

- portraying its trend over time
- its geographic extent (place)
- the populations (persons) affected by the disease

Why we need to perform step 5

Hypotheses Development

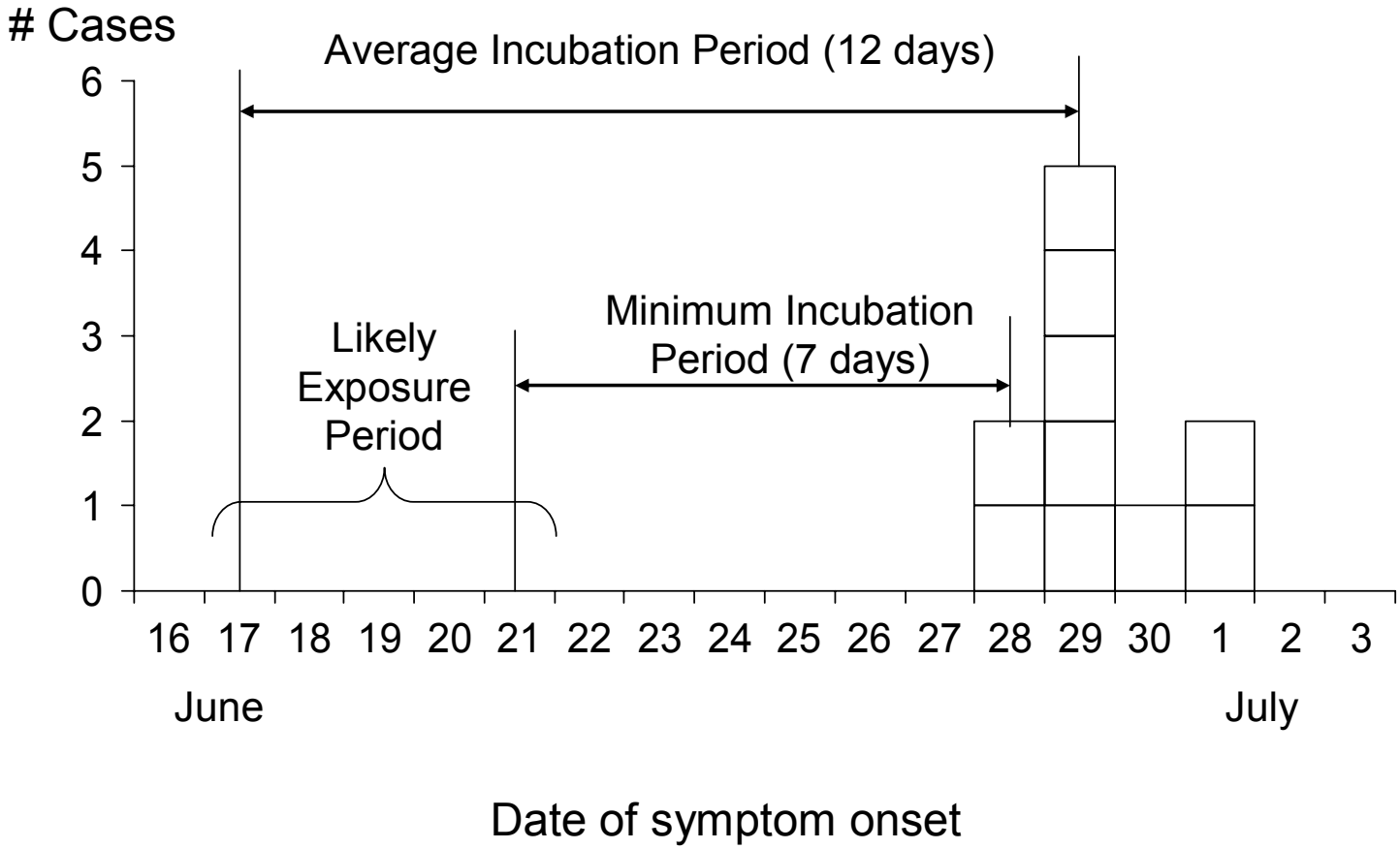
- Assess description of the outbreak in light of what is known about the disease (usual source, mode of transmission, risk factors and populations affected, etc.)

To identify the likely period of exposure from an epidemic curve

To identify the likely period of exposure from an epidemic curve

1. Look up the average and minimum incubation periods of the disease. This information can be found in ***Control of Communicable Diseases in Manual.***
2. Identify the ***peak of the outbreak*** or the ***median case*** and count back on the *x*-axis one average incubation period. Note the date
3. Start at ***the earliest case*** of the epidemic and count back the minimum incubation period, and note this date as well.

An outbreak of an acute respiratory disease



Time

- What is the exact period of the outbreak?
- What is the probable period of exposure?
- Is the outbreak likely common source or propagated?

Place

- What is the most significant geographic distribution of cases? Place of residence? Workplace?
- What are the attack rates?

Person

- What were the age and gender specific attack rates?
- What age and gender groups are at highest and lowest risk if illness?
- In what other ways do the characteristics of the cases differ significantly from those of the general population?

Interpreting an Epidemic Curve

Interpretation

- Source
- Pattern

Hypothesis

- how an epidemic spread throughout a population
- at what point you are in an epidemic
- the diagnosis of the disease by establishing the potential incubation period

Remember!

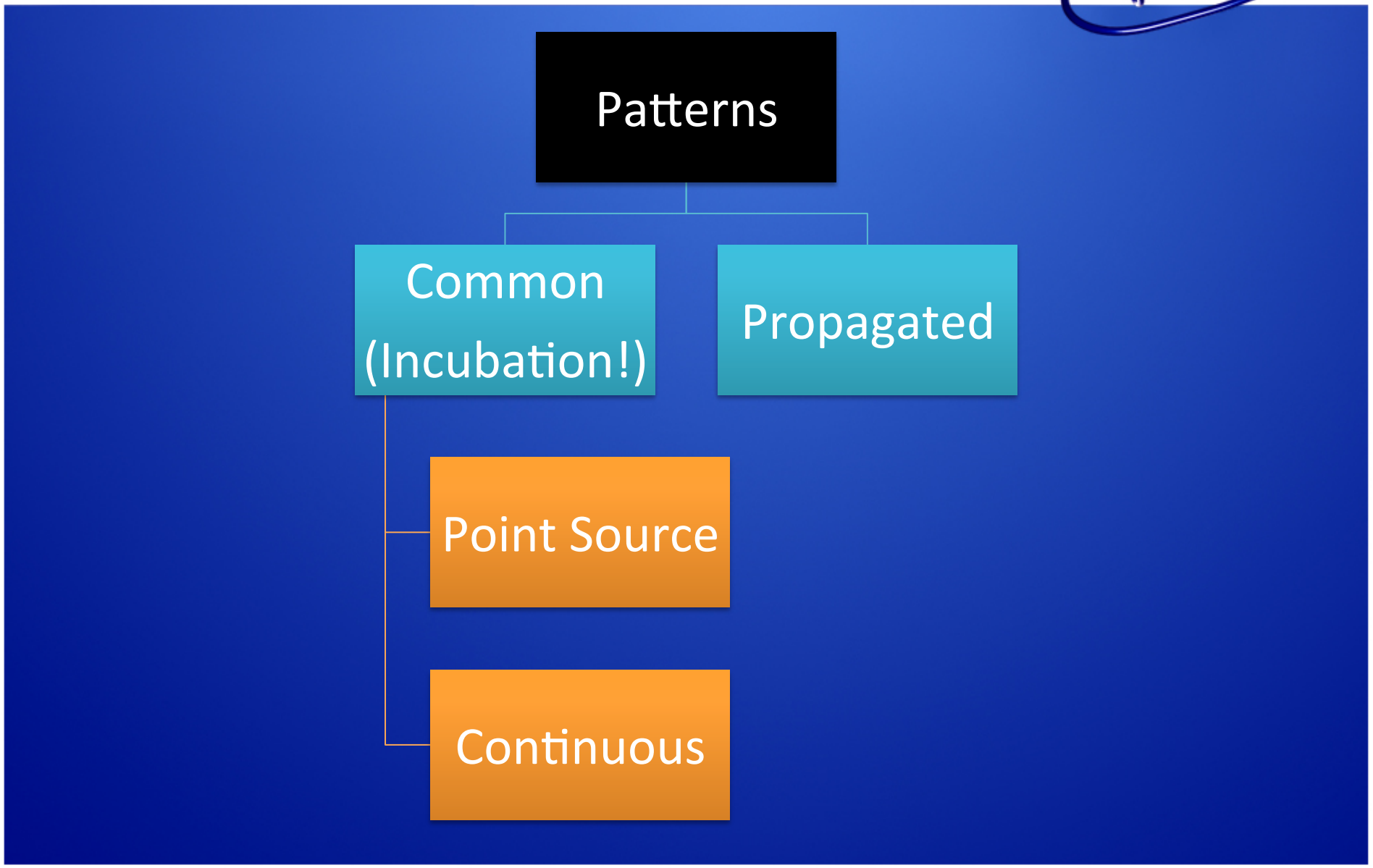
- **When analyzing an epidemic curve, it is important to consider the following factors to assist in interpreting an outbreak:**

  → The overall pattern of the epidemic

  → The time period when the persons were exposed

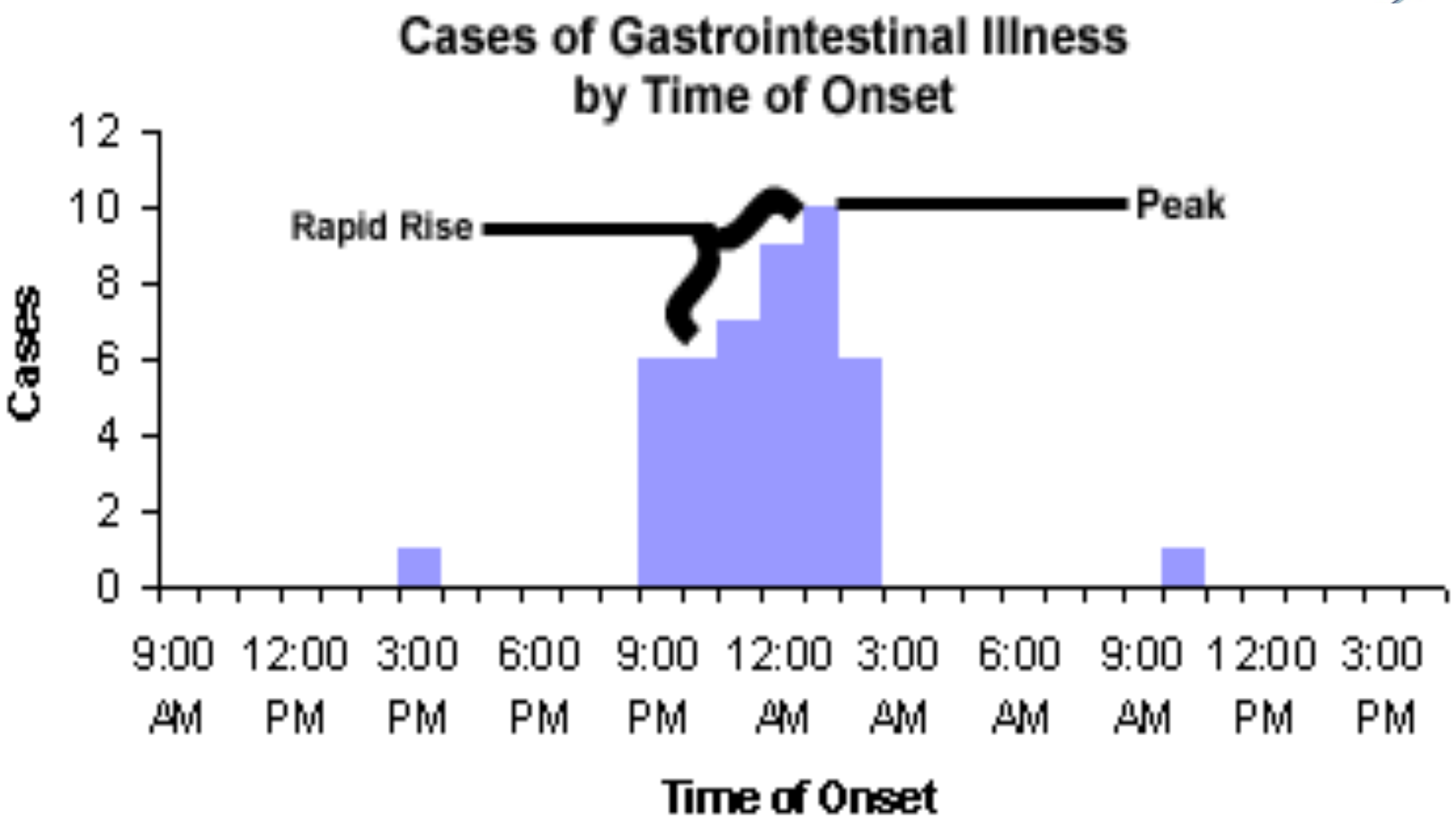
  → If there are any outliers

Epidemic Patterns



Point Common Source

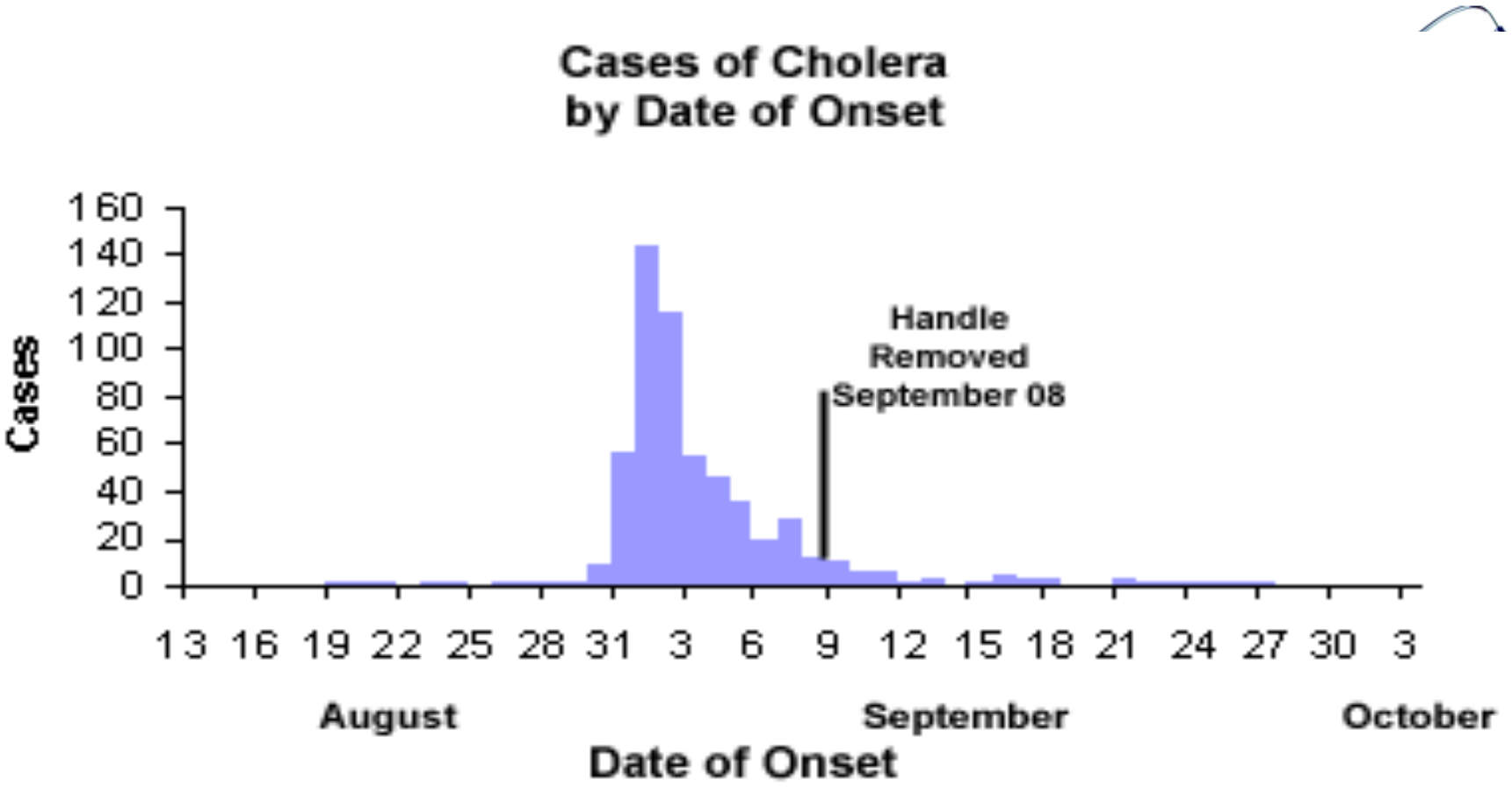
In a **point source epidemic**, persons are exposed to the same exposure over a limited, defined period of time, usually **within one incubation period**. The shape of this curve commonly rises rapidly and contains a **definite peak** at the top, followed by a gradual decline.



The graph above illustrates an outbreak of gastrointestinal illness from a single exposure. While there are outliers to this dataset, it is clear that there is an outbreak over a limited period of time, and the shape of the curve is characteristic of one source of exposure

Continuous Common Source

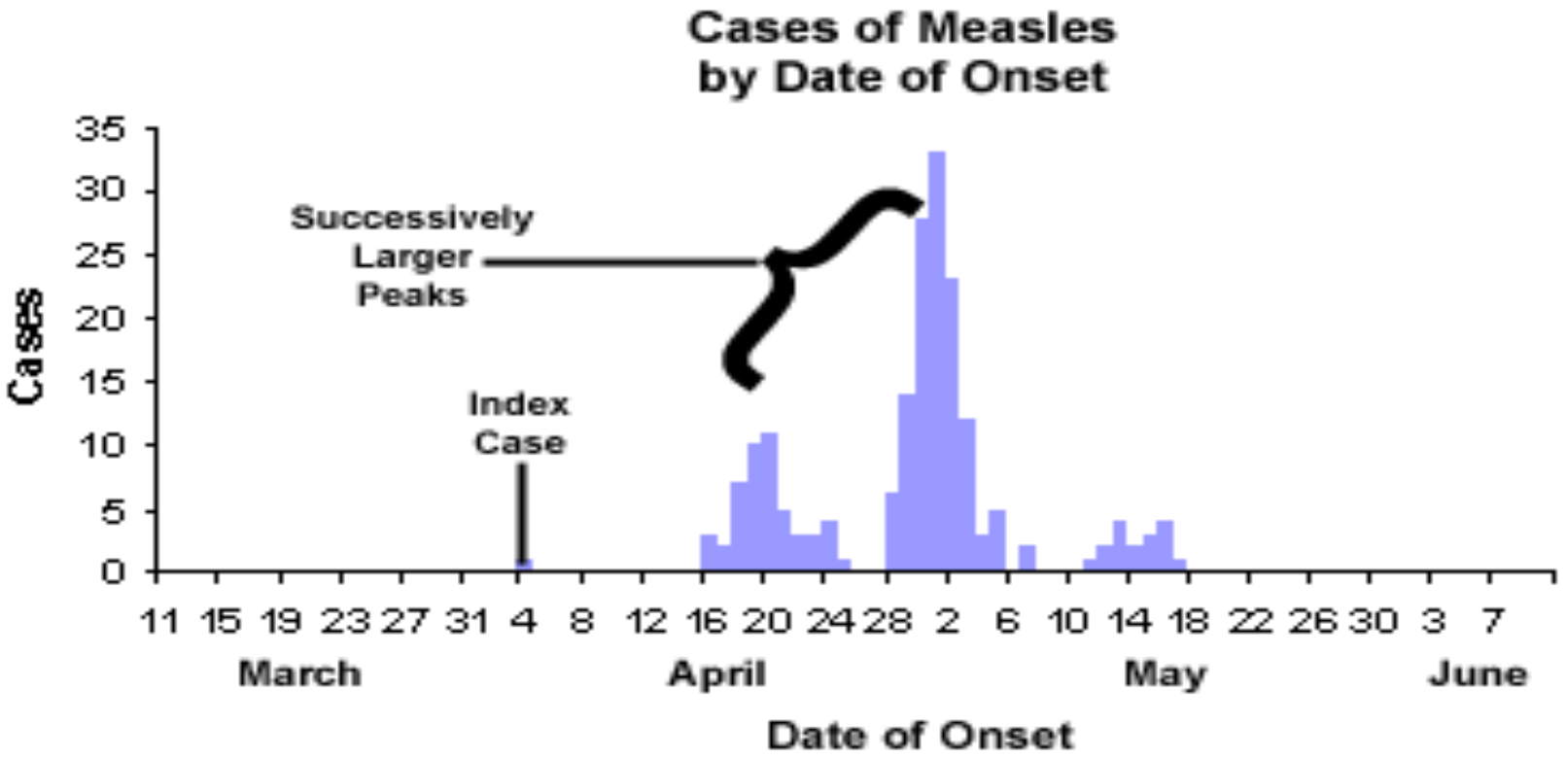
In a **continuous common source** epidemic, exposure to the source is **prolonged** over an extended period of time and may occur over **more than one incubation period.** The down slope of the curve may be **very sharp** if the common source is removed **or gradual** if the outbreak is allowed to exhaust itself.



The data above is from the well-known outbreak of cholera in London that was investigated by the "father of epidemiology," John Snow. Cholera spread from a water source for an extended period of time. Note that the typical incubation period for cholera is 1--3 days that the duration of this outbreak was more than 1 month.

Propagated (Progressive Source)

A **propagated (progressive source) epidemic** occurs when **a case of disease serves as a source of infection for subsequent cases** and those subsequent cases, in turn, serve as sources for later cases. The shape of the curve usually contains a **series of successively larger peaks**, reflective of the increasing number of cases caused by person-to-person contact, until the pool of susceptible is exhausted or control measures are implemented.



The graph above illustrates an outbreak of measles. The graph shows a single common source (the index case), and the cases appear to increase exponentially. Measles is caused by person-to-person contact. Its incubation period is typically 10 days but may be 7--18 days.

Common Source Questions

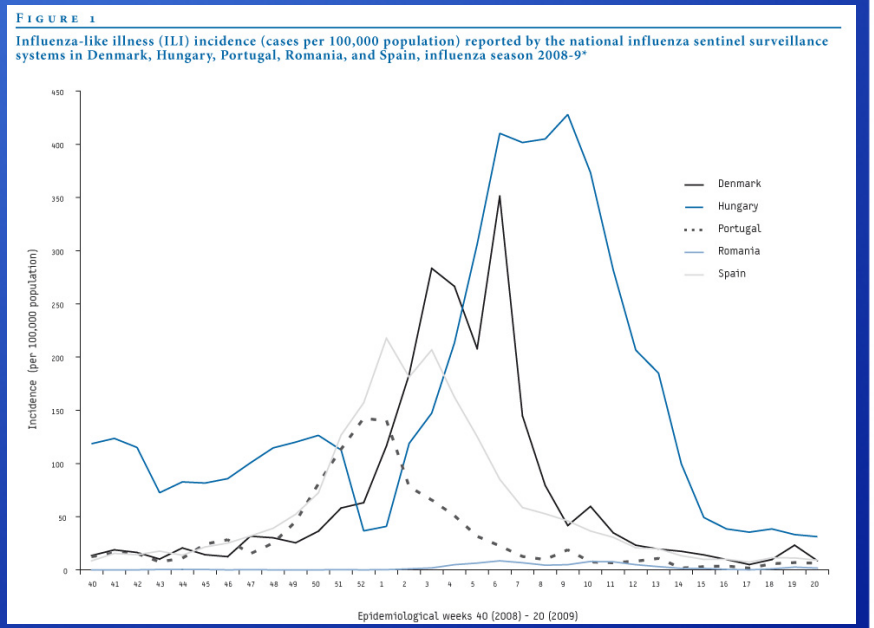
- Is the outbreak from a single source or common source?
- Is the disease spread from person to person?
- Is there continued exposure to a single source?

Propagated Source Questions:

- Is the outbreak from multiple sources or exposures?
- Is the outbreak airborne, behaviorally or chemically caused and does it involve multiple events?
- Are the sources of infection from inapparent sources?
- Is there a vector or animal reservoir involved?

Duration of an Epidemic

- ✓ The **number of susceptible persons** who are exposed to a source of infection and become infected.
- ✓ **Period of time** over which susceptible persons are **exposed** to the source.
- ✓ Minimum and maximum **incubation periods** for the disease.



So Far..

- ✓Steps 1 – 5
- ✓Case Definition
- ✓Line Listing
- ✓Epi Curve

Step 6: Developing Hypotheses

Source	Mode	Exposure	Other Factors

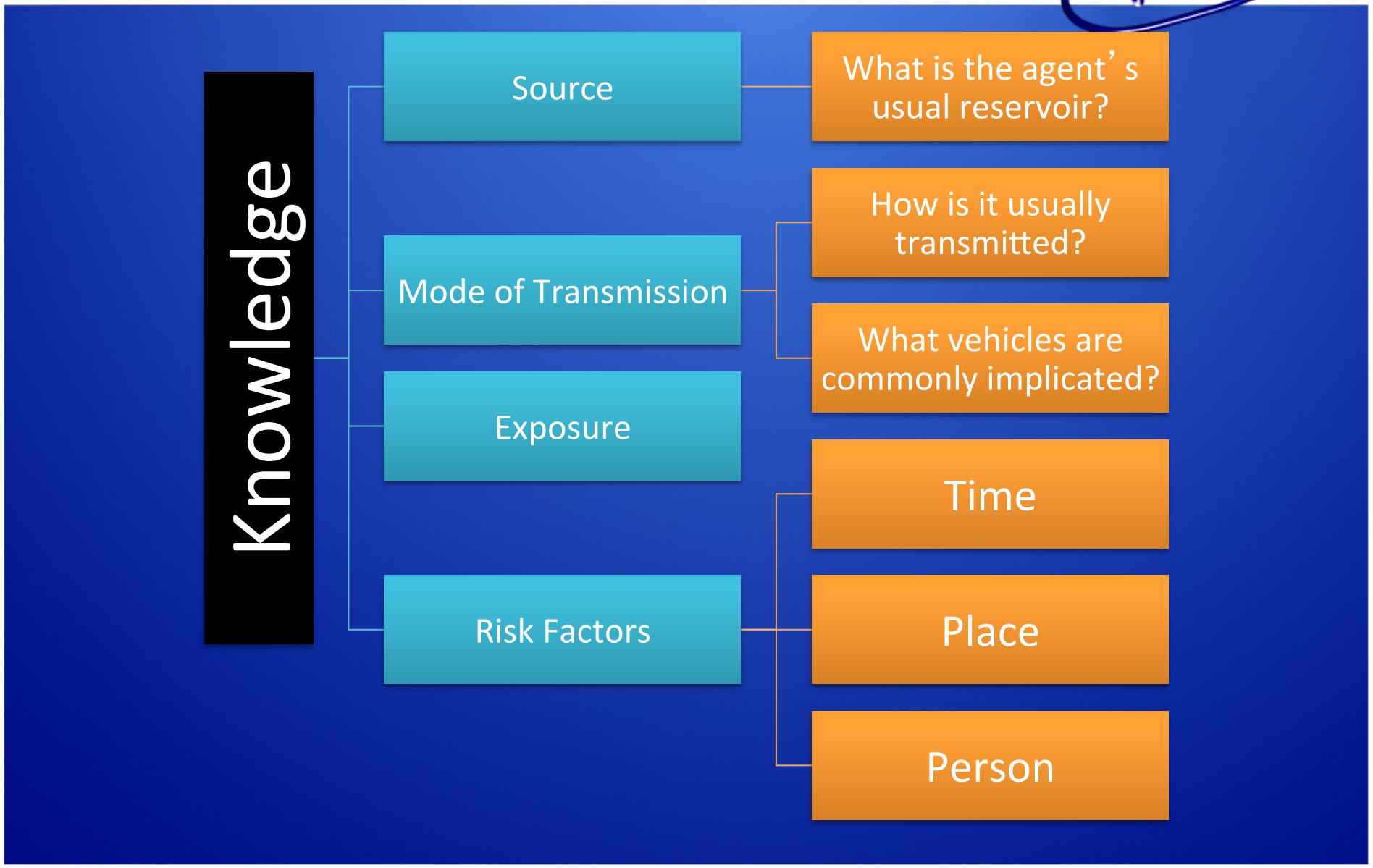
Step 7: Evaluating Hypotheses

Established Facts	Analytic Epidemiology

Step 8: Refining Hypotheses & Executing Additional Studies

Epidemiologic studies	Laboratory & environmental studies

Step 6: Hypotheses Development

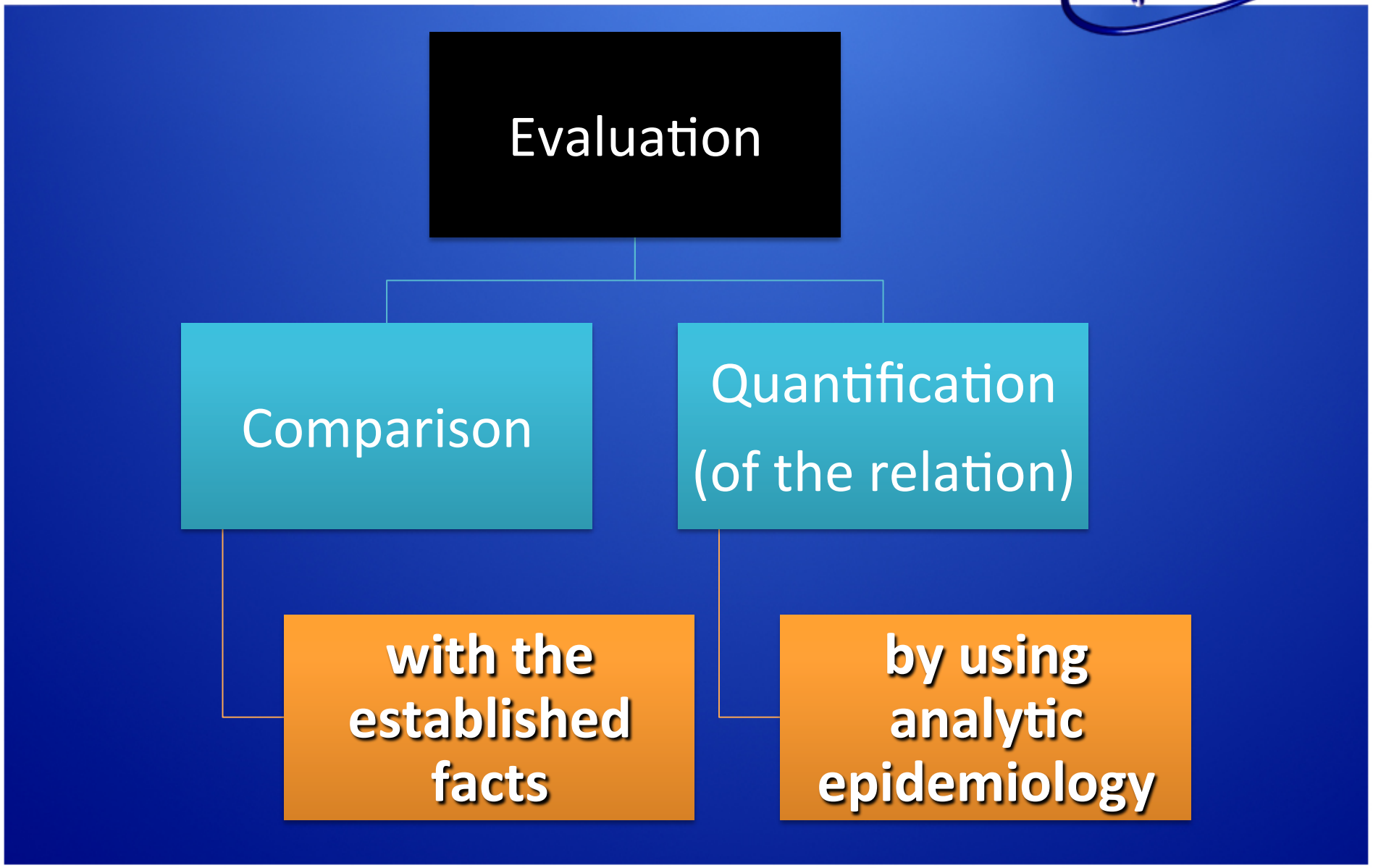


Step 6: Hypotheses Development

- Another useful way you can generate hypotheses is to talk to a few of the case-patients.

- In addition, investigators have sometimes found it useful to visit the homes of case-patients and look through their refrigerators and shelves for clues.

Step 7: Evaluating Hypotheses



Which One to Use?

Comparison

when the clinical, laboratory, environmental, and/or epidemiologic evidence so obviously supports the hypotheses that formal hypothesis testing is unnecessarily

Quantification

When the circumstances are not as straightforward. In those instances, you should use analytic epidemiology to test your hypotheses. The key feature of analytic epidemiology is a ***comparison*** group

Analytic Epidemiology

Retrospective Cohort Study

- Study of choice for an outbreak in a small, well-defined population (e.g. Wedding)
- Exposure/Outcome of each member of the cohort
- Calculate Attack Rates and Relative Risk (Risk Ratio)

Case – Control Study

- The population is not well defined (e.g. A city)
- The investigator asks both case-patients and a comparison group of persons without disease ("controls") about their exposures
- Calculate Odds Ratio

Retrospective cohort

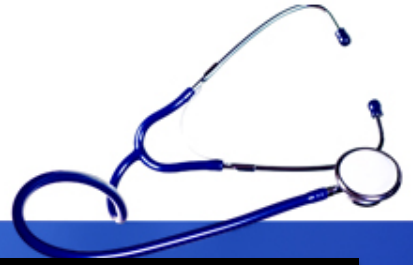
Food	ate			Did not eat			
	Ill	well	AR	Ill	well	AR	RR
meat	29	17	63	17	12	59	
spinach	26	17	60	20	12	62	
potato	23	14	62	23	14	62	
salad	13	11	54	28	19	60	
Ice cream	43	11	80	3	18	14	

Case control

Exposure		Case	Control	Total
Ate at restaurant A	Yes	30	36	66
	No	10	70	80
Total		40	106	146

Step 8: Refining Hypotheses & Executing Additional Studies

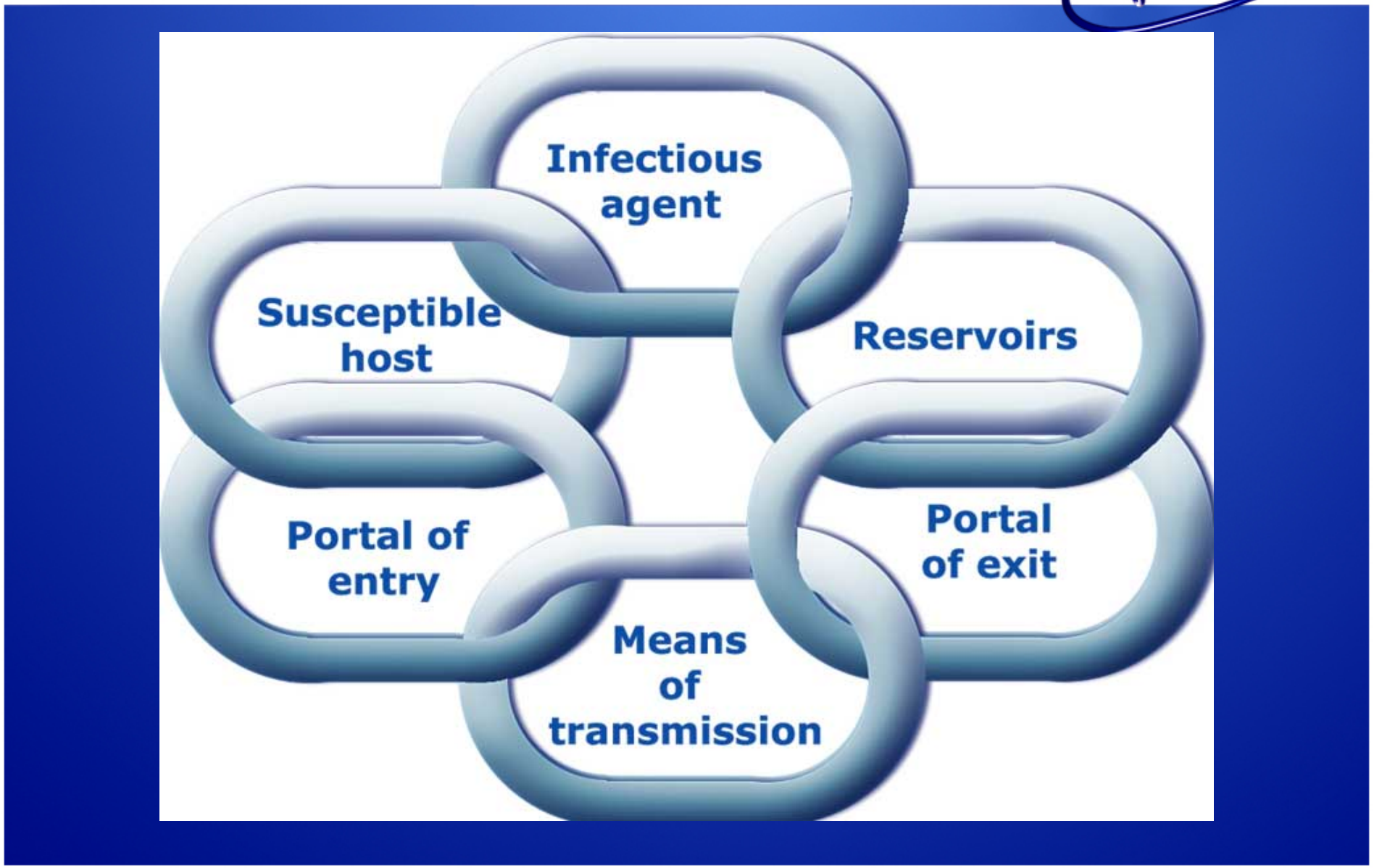
- **Epidemiologic studies**
- **Laboratory and environmental studies**

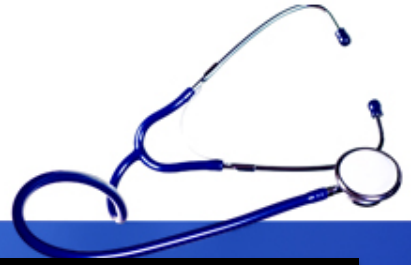


Step 9: Implementing Control and Prevention Measures

Chain of Infection

Step 9: Implementing Control and Prevention Measures





Step 10: Communicating the Findings

Oral Report	Written Report

References

- CDC. Principles of Epidemiology in Public Health Practice. Third Edition.
- Bonita R. et al. (2006). Basic Epidemiology. WHO.
- Ray M. Merril and Thomas C. Timmreck (2006). Introduction to Epidemiology. Jones & Bartlett Pub; 4th Edition.
- http://www.google.com/imghp

Outbreak Investigation Exercise: Sunday 1/10/2011

Please visit the following link to download the package that you will use for your exercise:
http://www.cdc.gov/epicasestudies/computer_salmonella.html

Instructions for download:

- Visit the link provided and go to the box that says "Available for Download". Click on complete package.
- Complete steps for installation and save the package on your desktop. Note that you will need a windows operating system to download the material.
- After installation is complete click on the icon that is shaped like a globe and start your program.

Working through the exercise:

- Follow instructions given when starting program (enter 4 digit number then your name). Save this information for future use. This allows you to save whatever progress you made through the tutorial, so that you don't have to restart the whole thing after each shutdown of your computer.
- The first 12 pages of the tutorial contain objectives and instructions about how to go through it's pages.
- Make sure you give yourself a good 3-4 hours to fully benefit from the tutorial exercise. Note that this doesn't obligate you to work on it all in one setting, but rather you can work on it at your own pace and free time.
- Keep track of your scores. At the end of the exercise you will be given a full score sheet that shows your final grade. Please save this page (as a screen snap shot) and print it out. This will be the basis of your bonus points.

- Note that you do not have to answer everything correctly in order to get the bonus points. The purpose of this exercise is for you to go through the investigation, get new information and learn from your mistakes.
- Please display honesty in your work. Note that each grade sheet is marked by the person's name, so copying another colleague's grade sheet will be easily detected.
- If you have any questions please contact: rdabbagh@live.com

Good luck!

Thank You

Any inquires: nmalamro@ksu.edu.sa