

Investigating an Outbreak

Facilitator Name

Date



Objectives

When you have completed this session, you will be able to:

- Determine when to investigate an outbreak
- Verify and report an outbreak or public health event
- Develop clear investigation objectives
- Summarize cases by time, place and person
- Draw and interpret an epidemic curve
- Develop an explanation for the possible cause of an outbreak

Session Overview

- Overview of outbreak investigations
- Steps of an outbreak investigation
- Basic data analysis

Overview of Outbreak Investigations

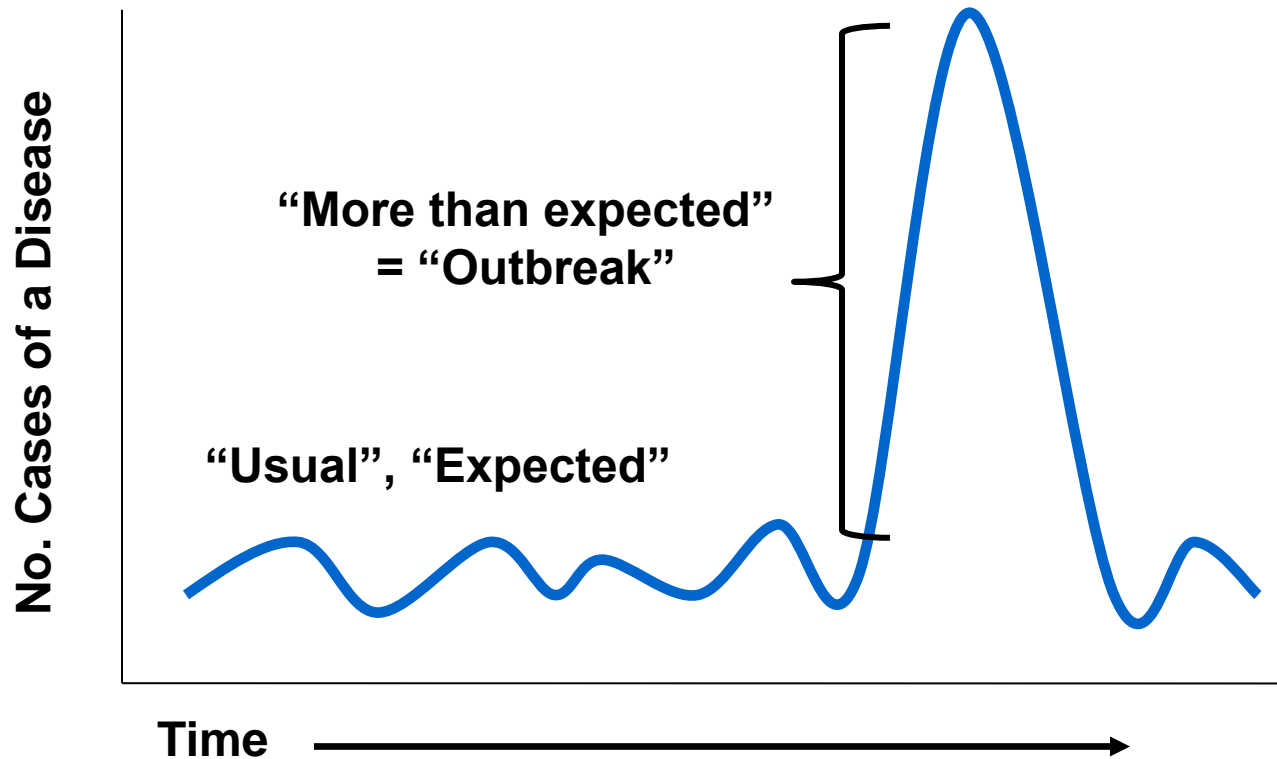


Outbreaks in the News

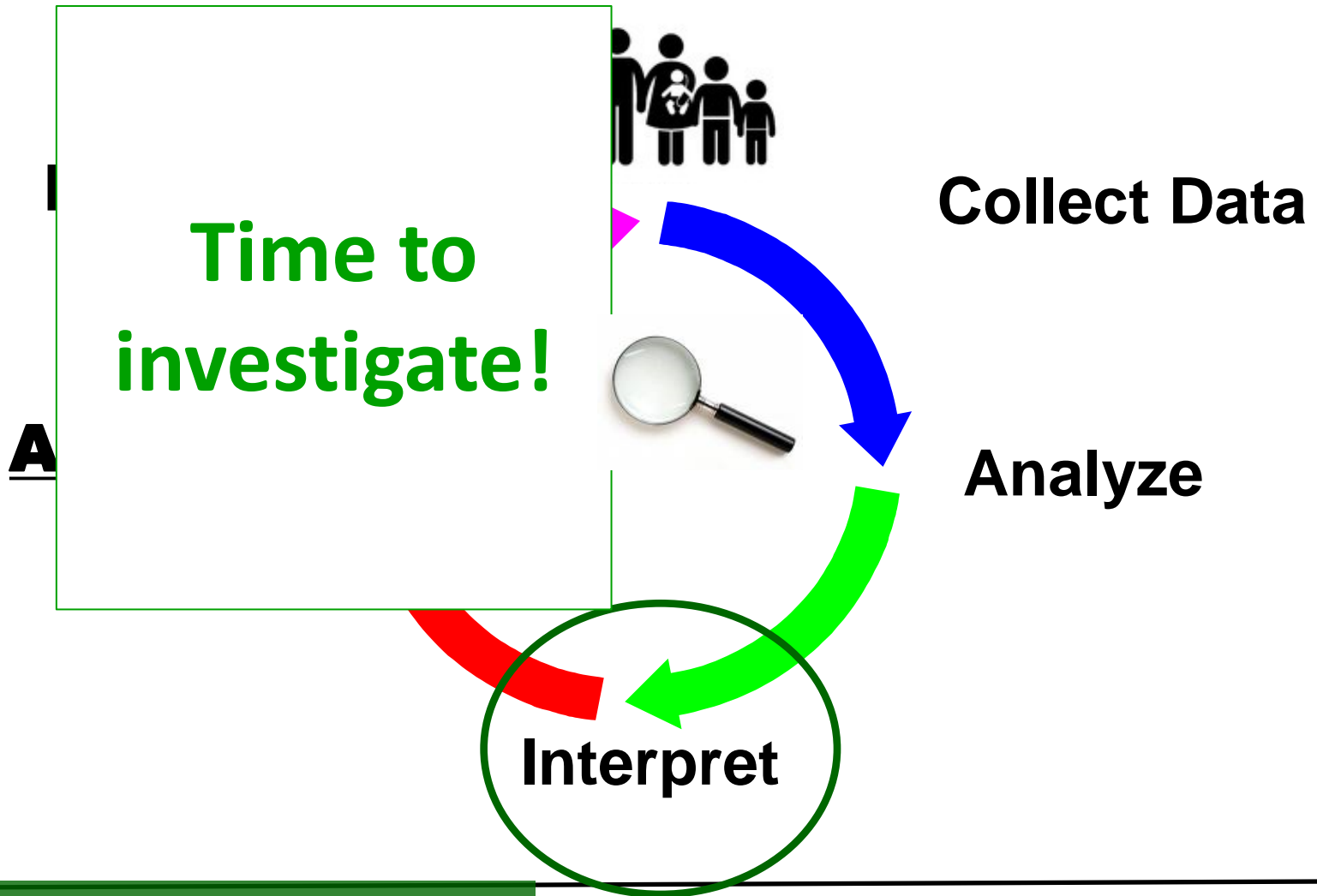
- Ebola: World Goes on Red Alert
- Nicaraguans Affected by Diarrhea Outbreak
- Dover in Grip of Sweeping Epidemic of Influenza
- Meningitis Outbreak Ruled Out in an Alajuela Jail
- Mideast virus MERS merits caution, not alarm, WHO says
- Anthrax Outbreak Alert in Ganado

What is an outbreak?

The occurrence of more cases of a disease than expected for a particular place and time



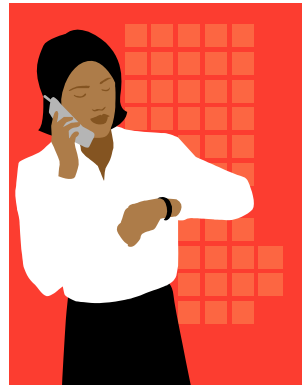
Do Outbreaks Connect to Surveillance?



Identifying a Potential Outbreak



- Review of surveillance data
- Clinician or laboratory reports of unusual diagnoses
- Reports from the public
- Media



Why Investigate?

- **To prevent and control the disease**
- To characterize a public health problem
- To conduct research and answer scientific questions
- For political/legal reasons
- To train health department staff in methods


Should you investigate?

Yes or No?

Depends on:

- Severity of illness
- Potential for spread
- Availability of prevention and control measures
- Political considerations
- Public relations
- Resource availability

Exceptions to the Rule



If the source is suspected and still
a threat to public health...

**Take immediate
control measures!**



Exercise 1: Would you investigate?

On your own:

1. Review the scenarios in your workbook.
2. For each scenario determine if you would probably investigate.
3. After 10 minutes, we will discuss as a group.



Would you investigate?

Probably

Probably Not

1. ___ If the illness is life-threatening such as rabies
2. ___ If signs/symptoms or confirmed diagnoses suggest patients might not have the same illness
3. ___ If cases all report that they ate food from a specific food establishment



Would you investigate?

Probably

Probably Not

4. ___ If there is outside pressure from politicians or the media
5. ___ If there are confirmed clusters/large numbers of a similar illness
6. ___ If ill persons are not able to provide adequate information for investigation



Would you investigate?

Probably

Probably Not

7. ___ If the illness seems to be associated with a commercially distributed product
8. ___ If a complainant refuses to provide his/her name but otherwise provides detailed information
9. ___ If there are repeated complaints made by the same individual(s) for which prior investigations revealed no significant findings

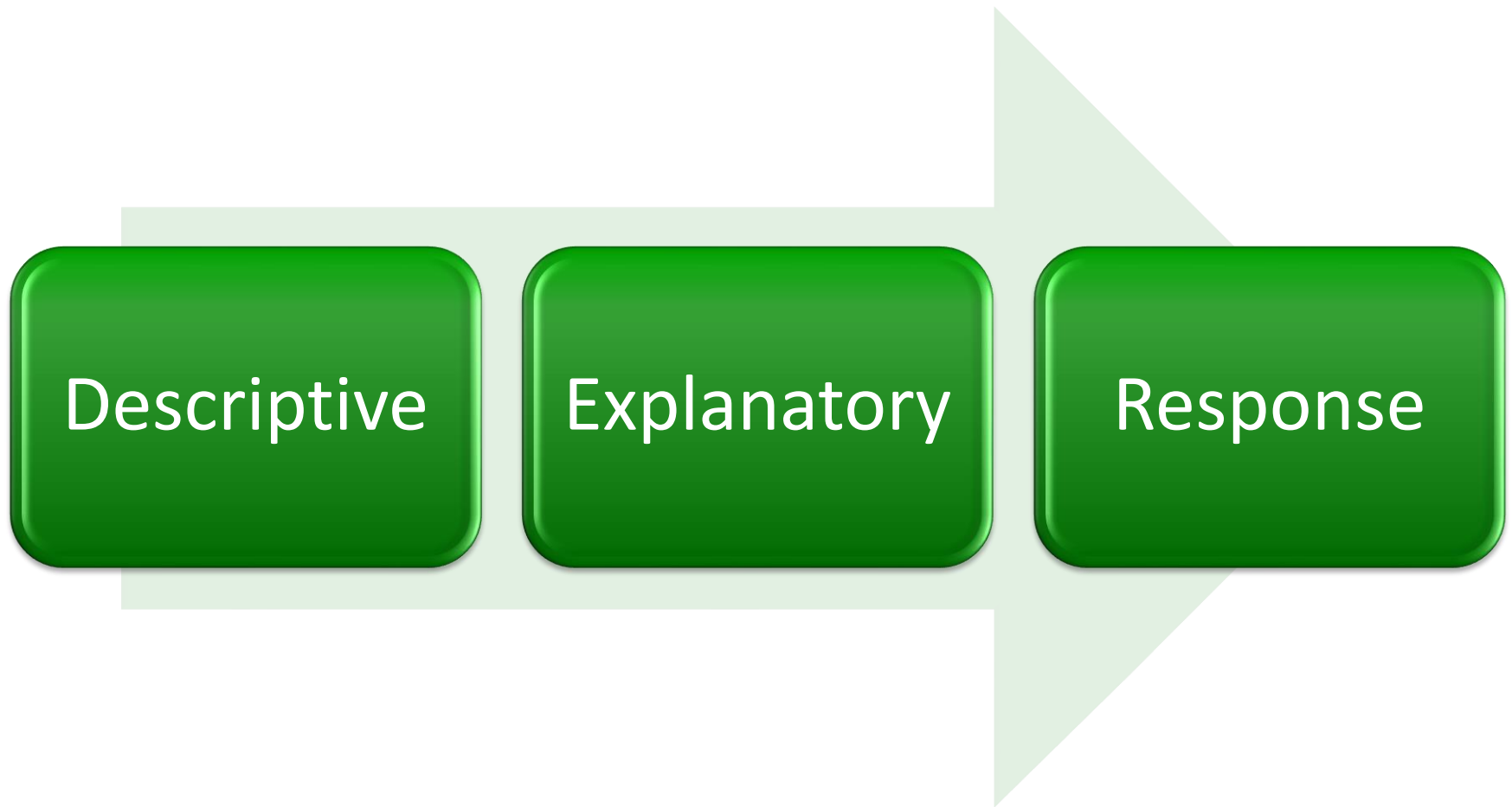
What are the objectives of your investigation?

- Identify the
 - agent
 - source, and/or
 - mode of transmission
- Characterize the extent of the outbreak, e.g., who has been affected, who is at risk
- Identify exposures or risk factors that increase risk of disease
- Develop and implement control and prevention measures

Steps of an Outbreak Investigation



General Phases of an Outbreak Investigation



Descriptive

Descriptive Phase

1. Prepare for fieldwork
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Construct a case definition
5. Identify cases and collect information
6. Perform descriptive epidemiology

7. Develop hypotheses
8. Evaluate hypotheses epidemiologically
9. Reconcile epidemiology with laboratory and environmental findings
10. Conduct additional studies as necessary

Response

Response Phase

11. Implement and evaluate prevention and control measures
12. Initiate or maintain surveillance
13. Communicate findings

- 1. Prepare for fieldwork**
2. Establish the existence of an outbreak
3. Verify the diagnosis
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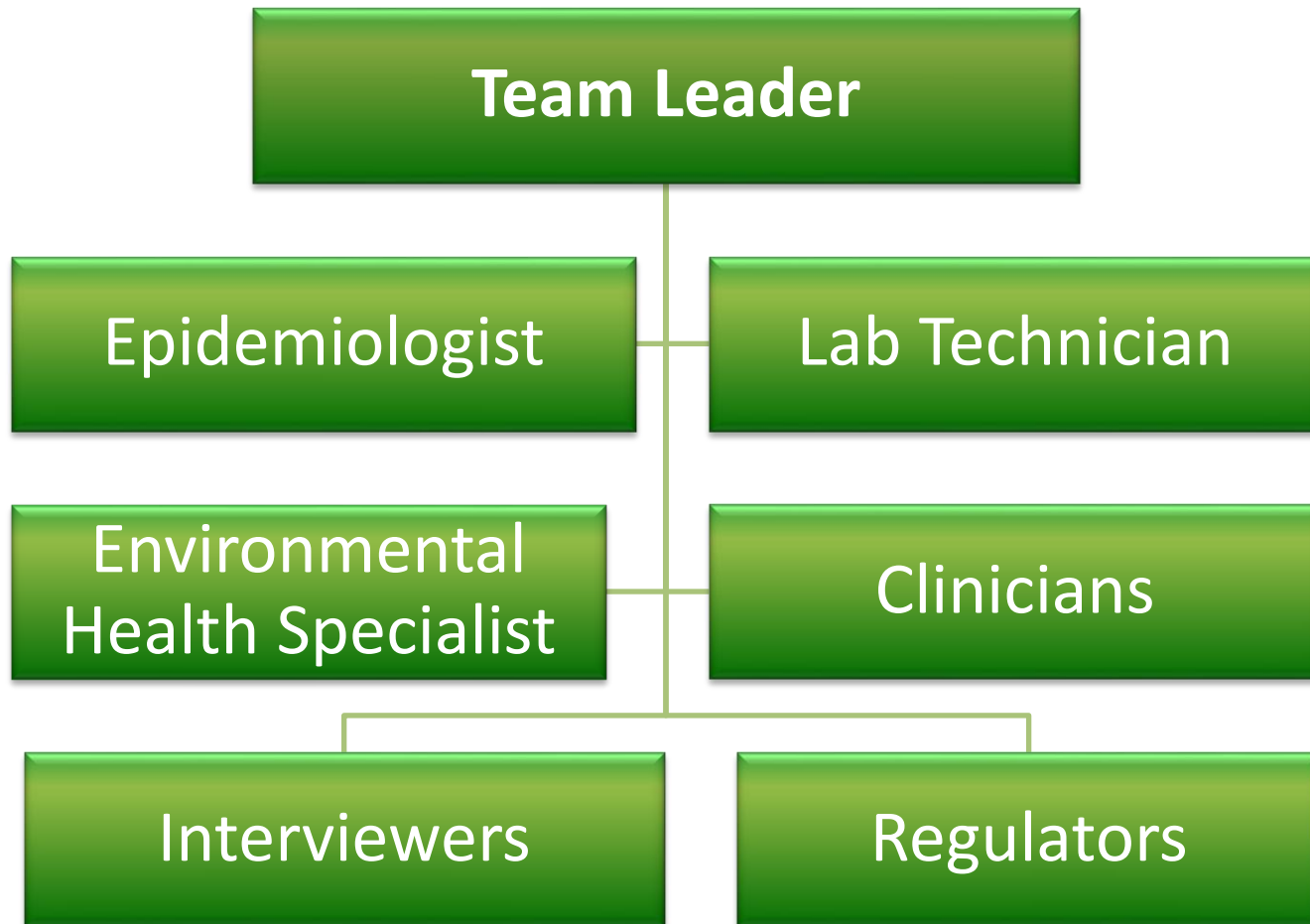
Tasks to Prepare For Fieldwork



- Form a team
- Learn about the disease
- Make necessary administrative, personnel, and logistical arrangements
- Coordinate with partner agencies and local contacts

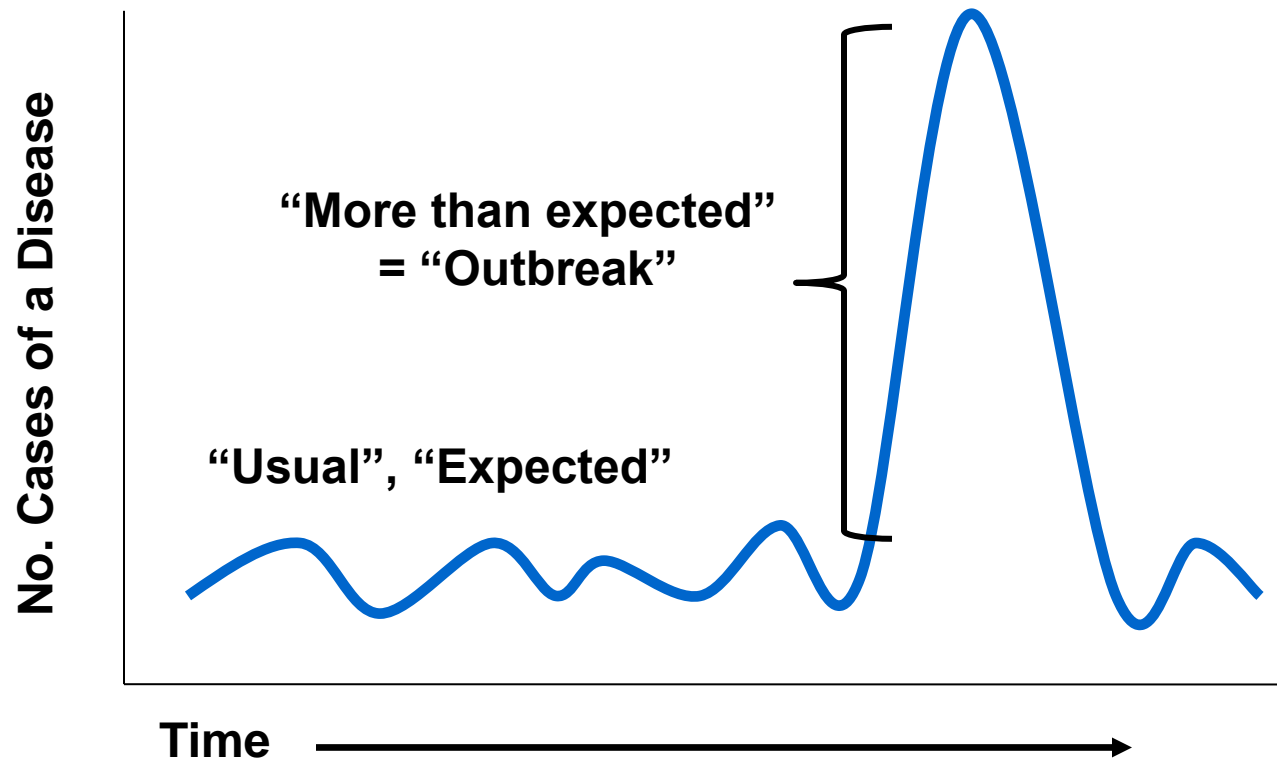
Form a Team

Descriptive



1. Prepare for fieldwork
- 2. Establish the existence of an outbreak**
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6. Perform descriptive epidemiology

The occurrence of more cases of a disease than expected for a particular place and time



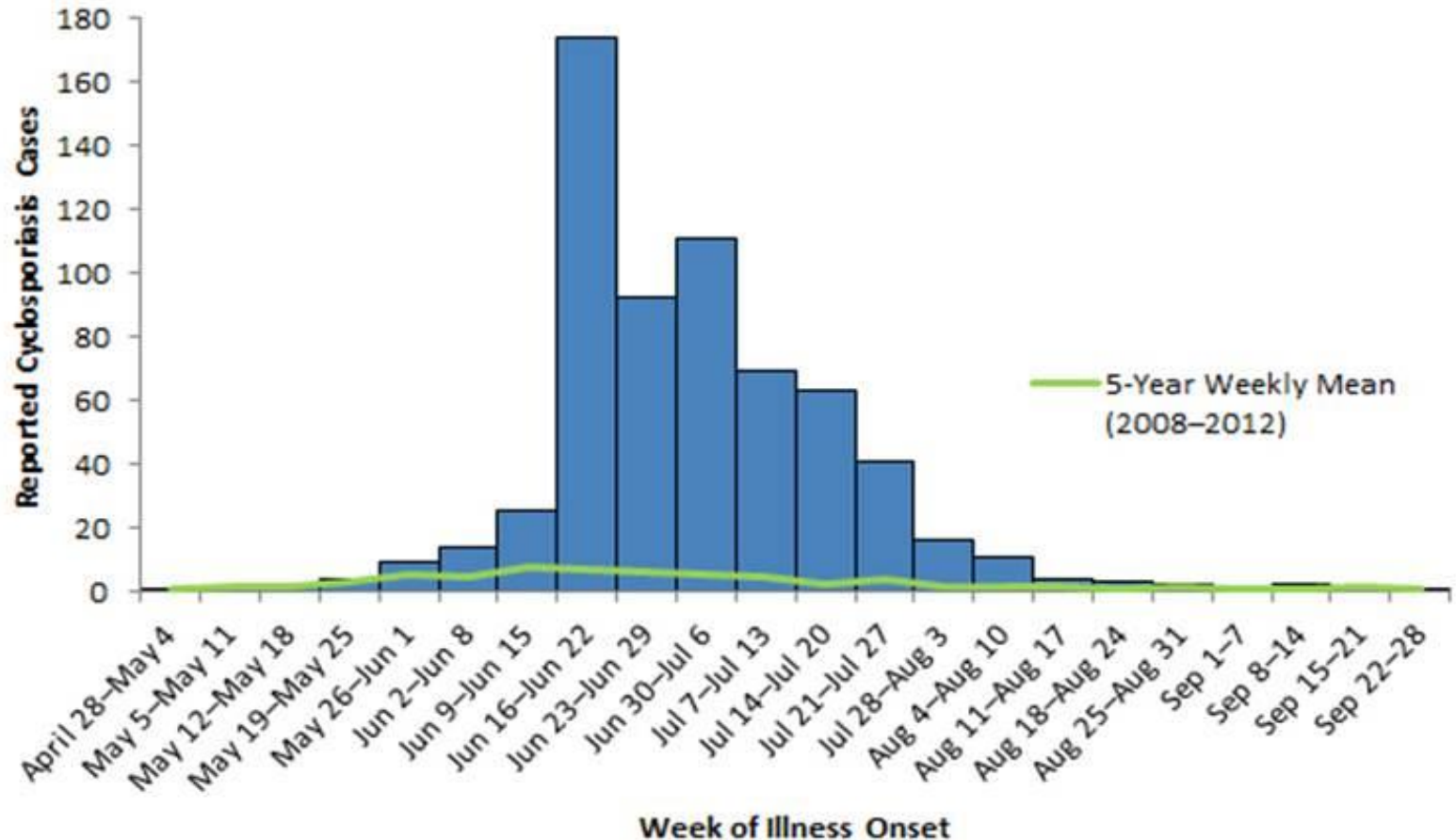
Descriptive

Case Reports Will Help Establish the Existence of an Outbreak

- Review the reports or data
- Confirm that cases are the same disease
- Confirm that the number of cases exceeds the normal
- Apparent increases in cases may not be real



Confirmed Cyclosporiasis Cases by Week of Illness Onset



1. Prepare for fieldwork
2. Establish the existence of an outbreak
3. **Verify the diagnosis**
4. Construct a case definition
5. Identify cases and collect information
6. Perform descriptive epidemiology

Descriptive

Evaluate the Clues to Verify the Diagnosis



- Signs and symptoms
- Laboratory findings
- Disease onset
- Duration of symptoms
- Suspected exposure
- Suspected virus, bacteria, or toxin

- Most definitive method for verifying diagnosis
- Pathogen identification helps identify the incubation period
- Don't wait for laboratory diagnosis to proceed



1. Prepare for fieldwork
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. **Construct a case definition**
5. Identify cases and collect information
6. Perform descriptive epidemiology

Descriptive

- Suspected case:
 - Any person residing in Ajegunle with at least one episode of severe diarrhea between January 1 and April 30, 2011
- Confirmed case:
 - Suspect case with rectal swab positive for *Vibrio cholerae* O1

Descriptive

- Clinical criteria
 - Characteristic symptoms and clinical signs
 - Laboratory data
- Epidemiologic criteria (especially for outbreaks)
 - Time
 - Place
 - Person (epidemiologic link, otherwise uncommon)
- Should **not** include the hypothesis (suspected exposure) being tested

Descriptive

- Suspected case:
 - Resident of Ajegunle with ≥ 1 episode of severe diarrhea
 - 1 Jan – 30 Apr, 2011
- Confirmed case:
 - Suspect case with rectal swab positive for *Vibrio cholerae* O1

Example: Outbreak Case Definition for Cholera

Case definition elements

Clinical

– Symptoms

– Lab

Epi

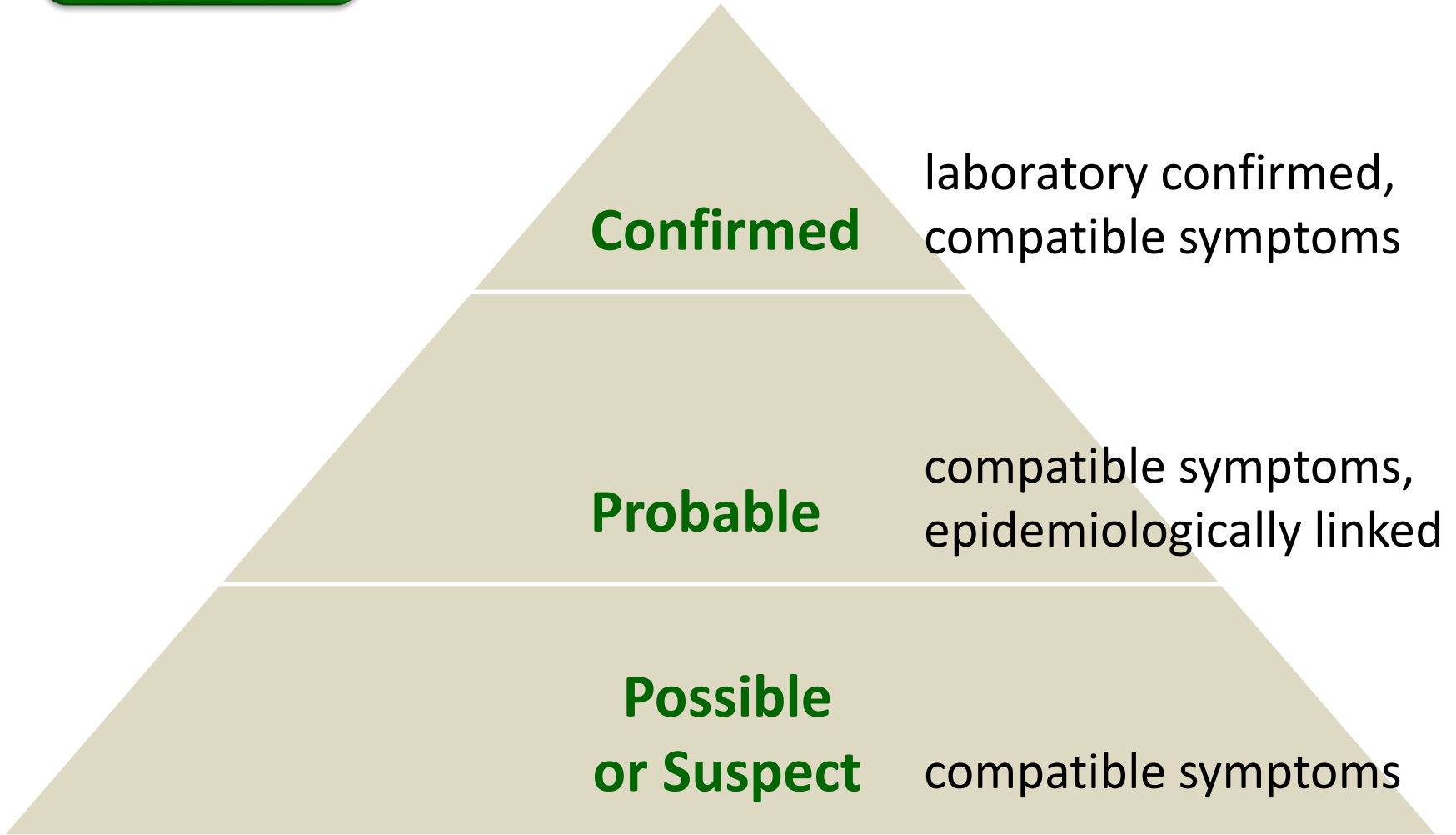
– Time

– Place

– Person

Descriptive

Case Classification Levels



1. Prepare for fieldwork
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Construct a case definition
5. **Identify cases and collect information**
6. Perform descriptive epidemiology

Find Cases Systematically, Develop Line List

Descriptive

Case #	Date of Symptom Onset	Signs/Symptoms			Labs	Demographics	
		Diarrhea	Vomiting	Fever >37°C	Positive stool culture	Age	Gender
1	22/10/14	Y	Y	Not done	Y	19	M
2	25/10/14	N	Y	N	N	17	M
3	22/10/14	N	Y	N	Y	23	F
4	27/10/14	Y	?	?	Pending	18	?
5	23/10/14	N	Y	N	Y	21	M
6	21/10/14	Y	Y	Y	Not submitted	18	F

You have been tasked with finding cases of malaria in a small rural community.



- **How would you find cases?**
- **What information would you collect?**



Exercise 2: Is It an Outbreak?

In your group:

1. Read the scenario in your workbook.
2. What are the first steps you would take?
3. Review surveillance data
4. Create working case definitions for suspect, probable and confirmed cases.

1. Prepare for fieldwork
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Construct a case definition
5. Identify cases and collect information
6. **Perform descriptive epidemiology**

- Describe and orient data

- Person
- Place
- Time



- **Time (*epidemic curve*)**
 - Ideally: when were they infected?
 - More practically: when did they become ill?
- **Place (*spot map, shaded map*)**
 - Ideally: where were they infected?
 - More commonly: where do they live, work?
- **Person (*tables*)**
 - Who was infected?
 - Numerators and denominators
 - What do the cases have in common?

- Use “epidemic curve” in outbreak investigations
- Histogram (no space between adjacent columns)
- X-axis = date of onset of illness
 - Hour(s), day(s), week, month
- Y-axis = number of cases
- Can display columns or “stack of boxes” (personal preference)

Dates of Onset of Disease X, District Y, September 2014

Descriptive

Dates of Onset (n=57)

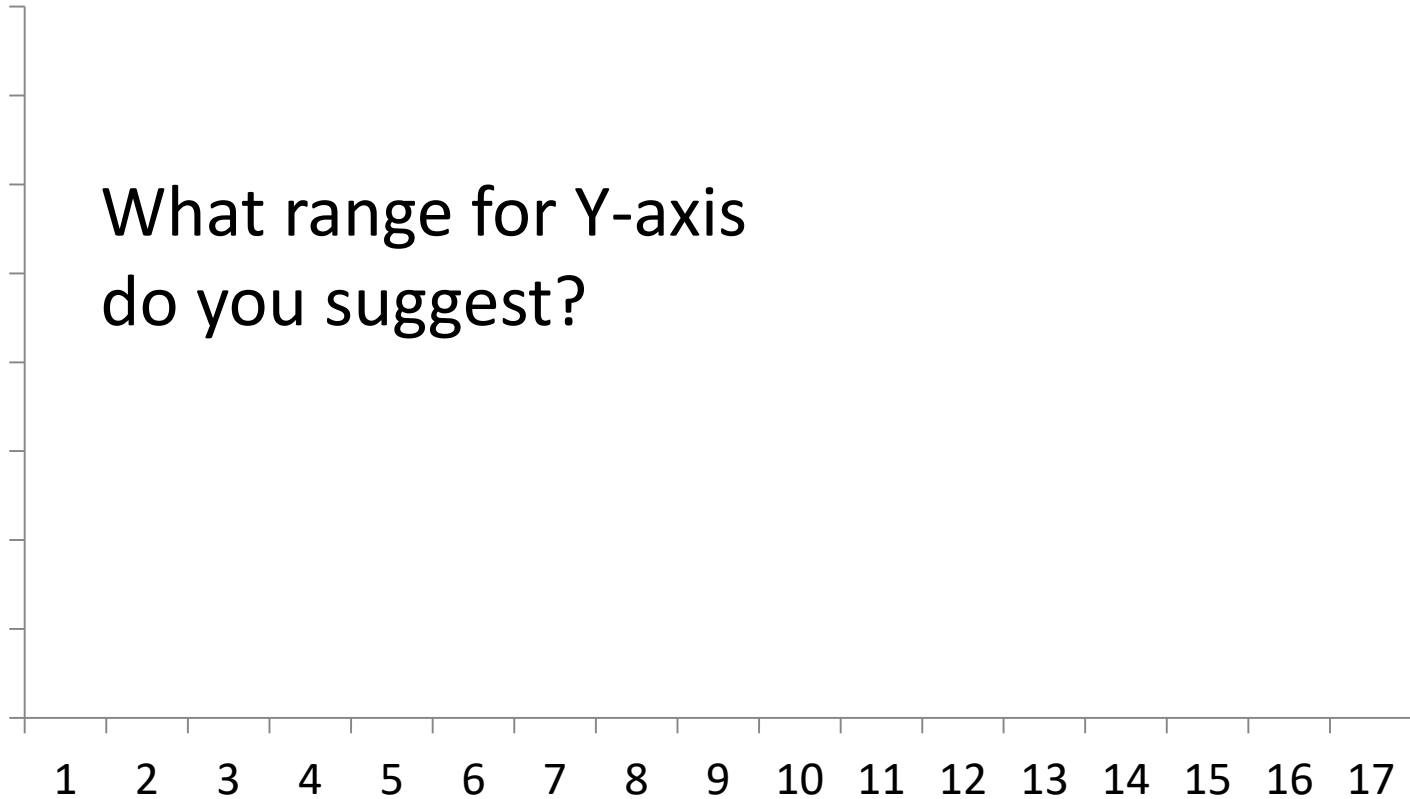
01/09	06/09	07/09	08/09	09/09	11/09
03/09	06/09	07/09	08/09	09/09	11/09
04/09	06/09	07/09	08/09	09/09	12/09
04/09	06/09	07/09	08/09	09/09	12/09
04/09	06/09	07/09	08/09	09/09	14/09
06/09	07/09	07/09	08/09	09/09	15/09
06/09	07/09	07/09	08/09	09/09	17/09
06/09	07/09	07/09	08/09	10/09	
06/09	07/09	07/09	08/09	10/09	
06/09	07/09	08/09	08/09	10/09	

Sept.	No. Cases
1	1
2	0
3	1
4	3
5	3
6	10
7	14
8	11
9	7
10	3
11	2
12	2
13	0
14	1
15	1
16	0
17	1

What range for X-axis do you suggest?

Descriptive

X-Axis

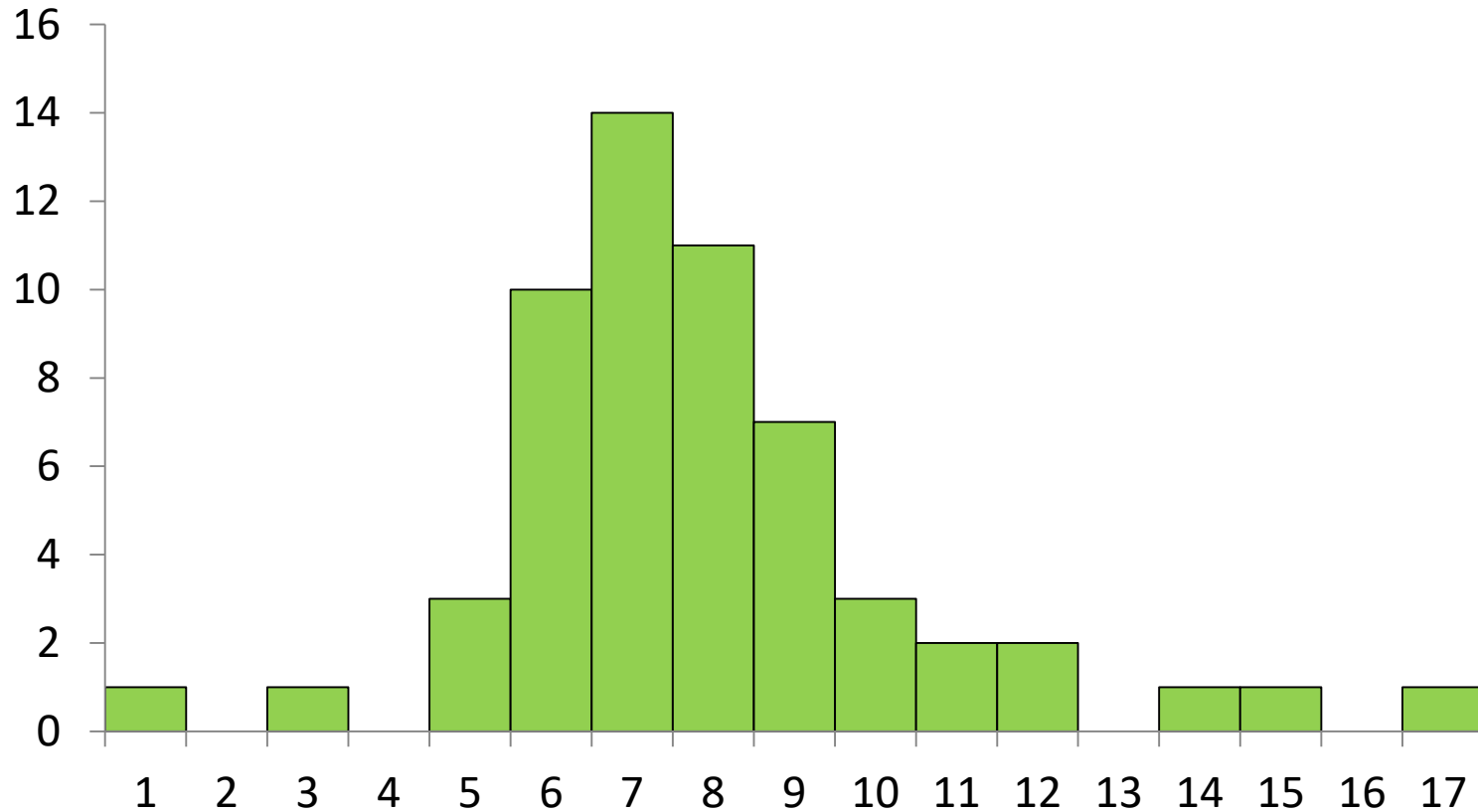


Descriptive

Y-Axis



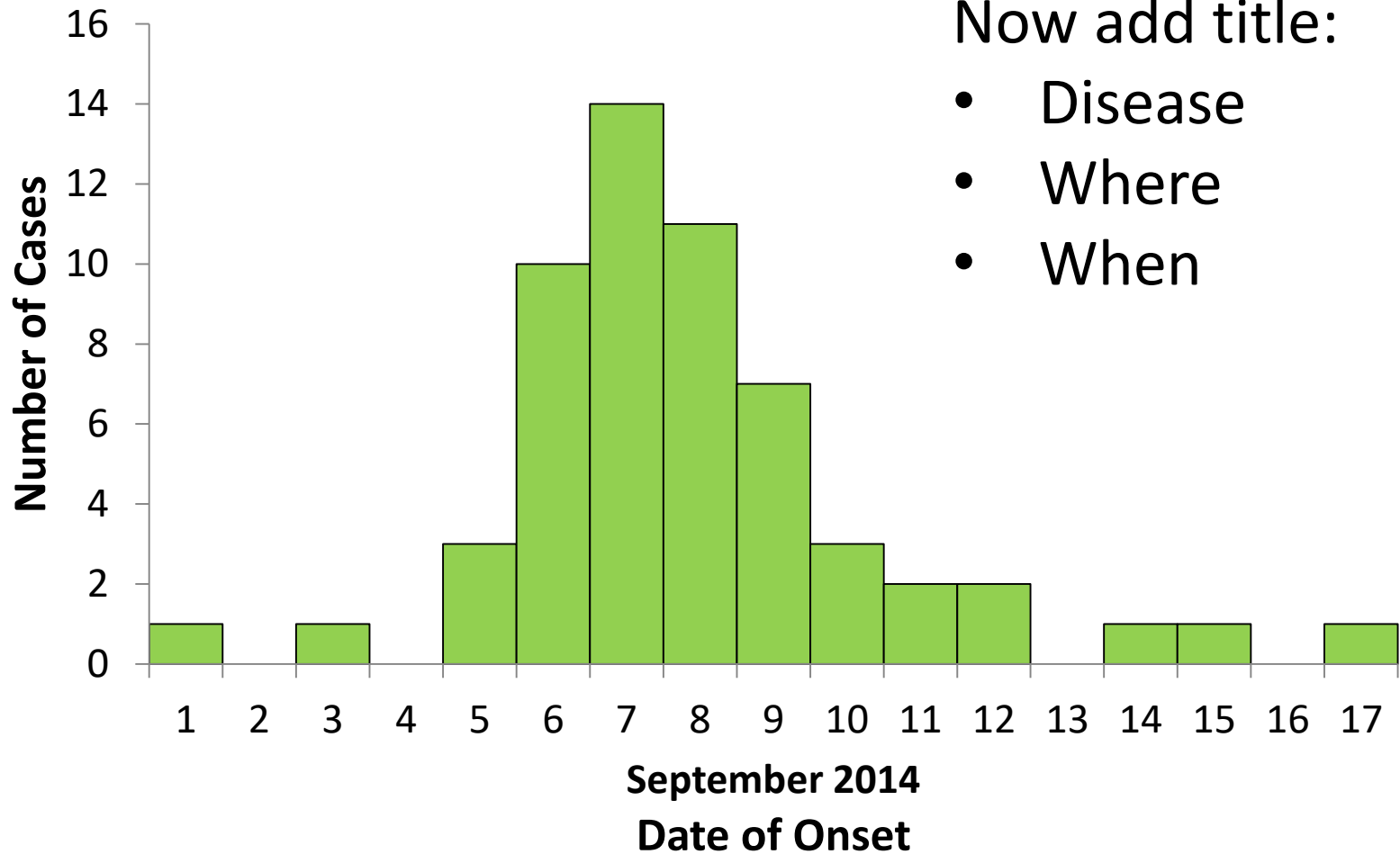
Descriptive



Now add the axis labels

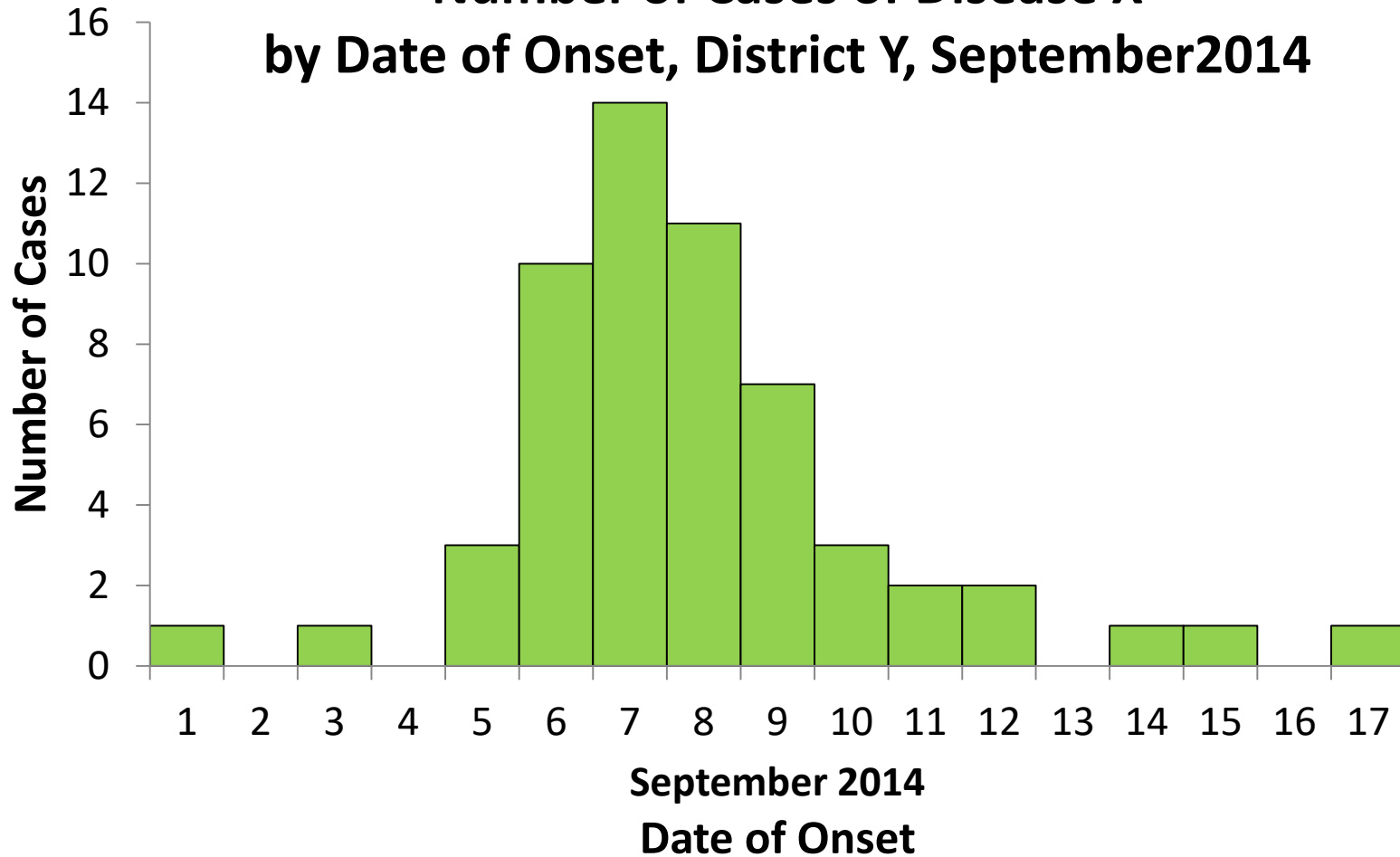
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With axis labels



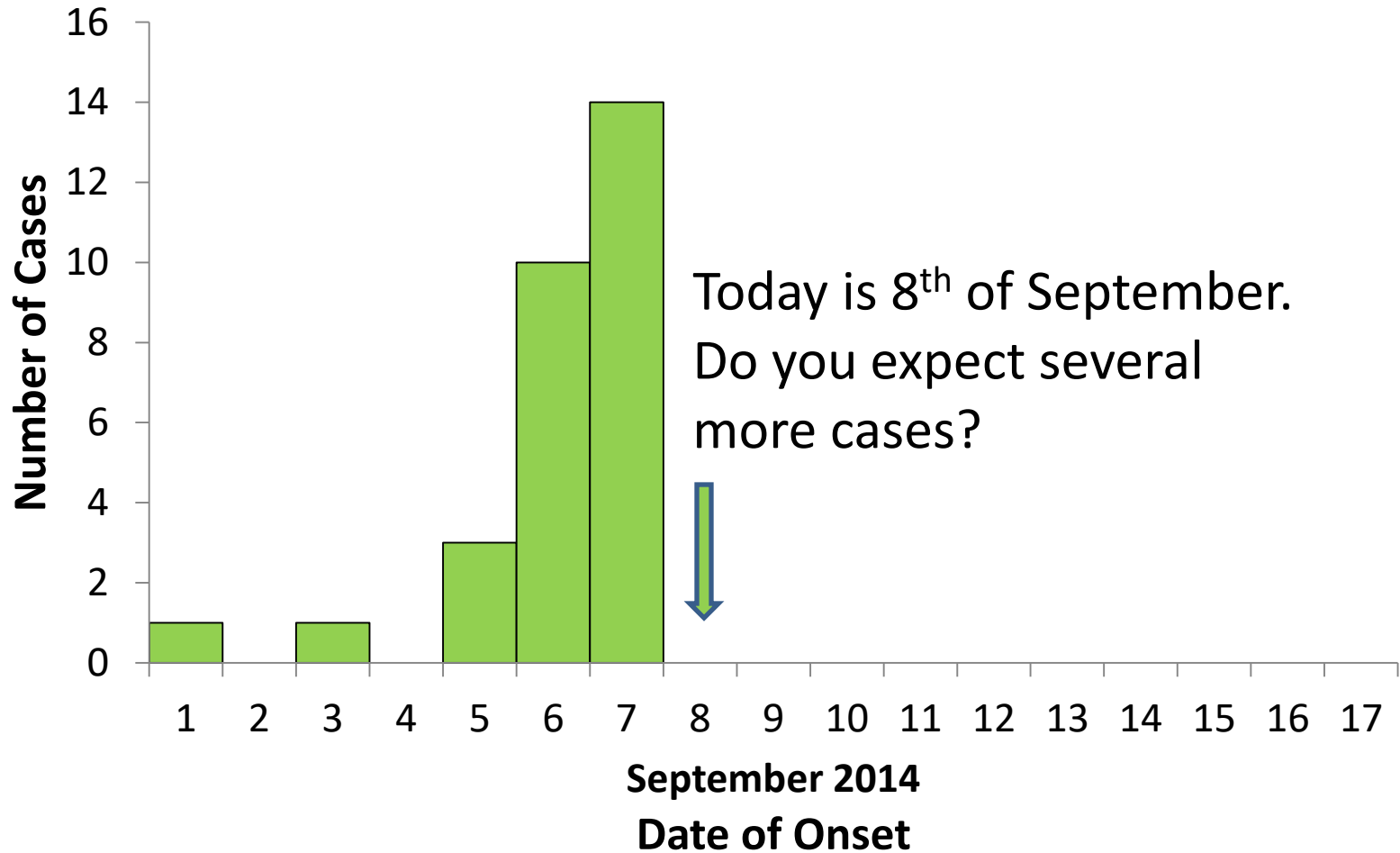
Descriptive

**Number of Cases of Disease X
by Date of Onset, District Y, September 2014**



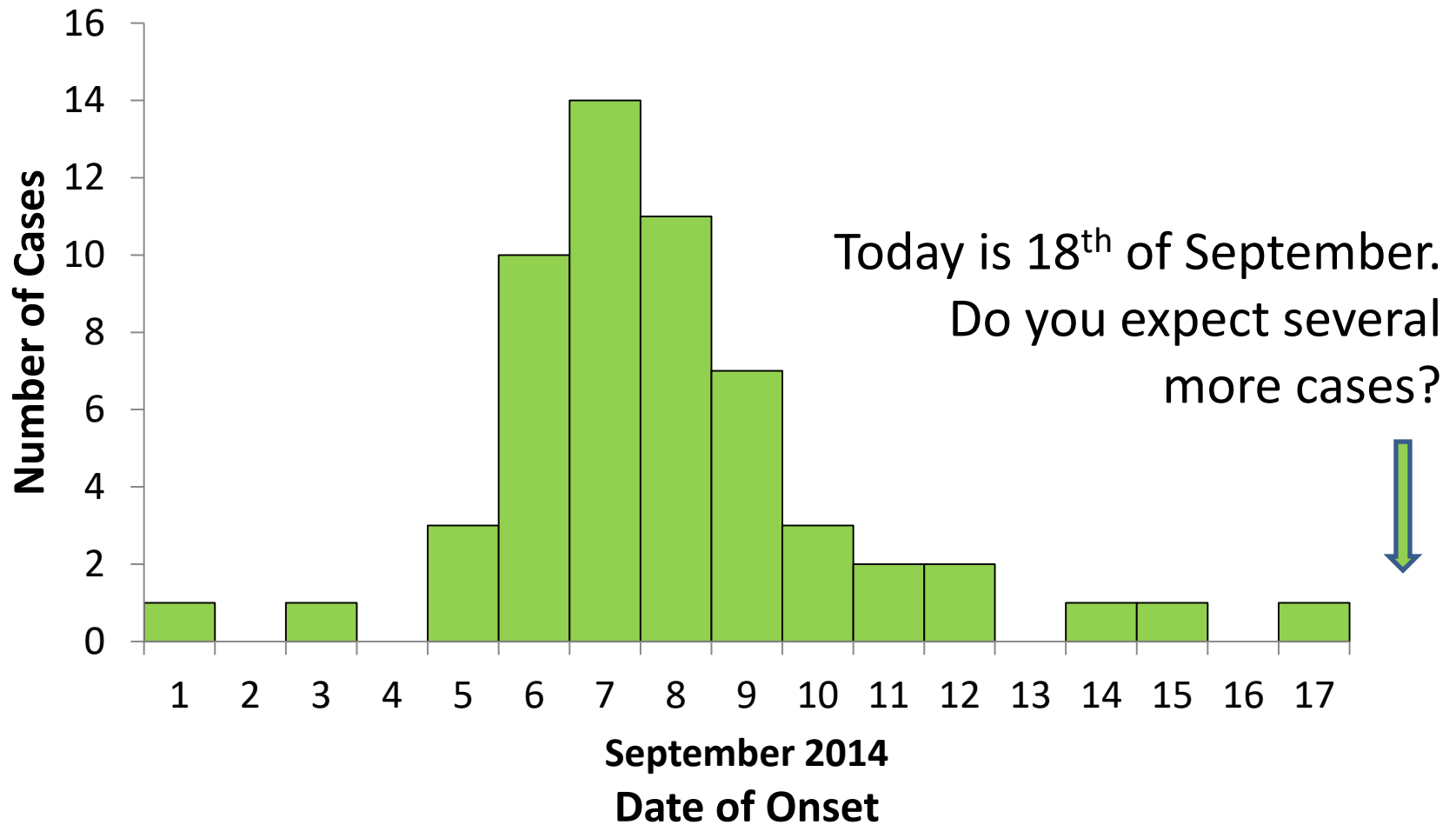
Descriptive

Interpreting Epidemic Curves



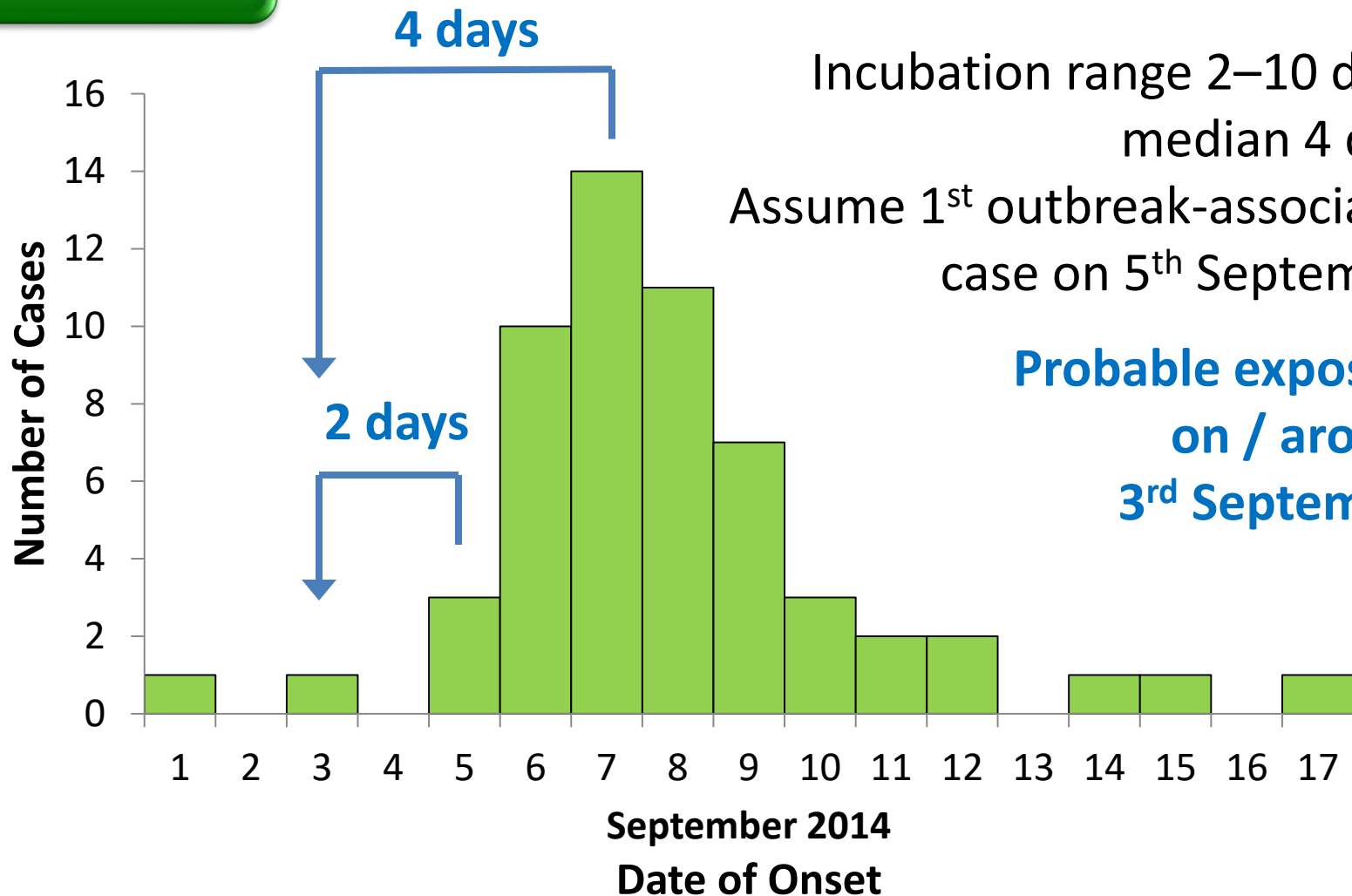
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Interpreting Epidemic Curves



Descriptive

Interpreting Epidemic Curves

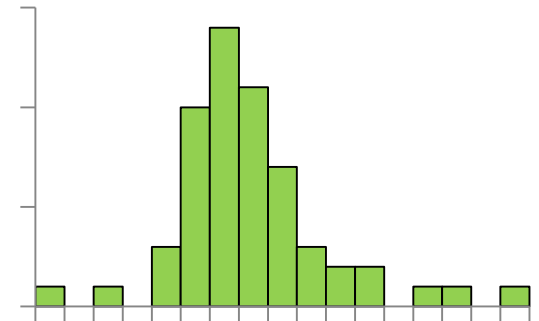


Incubation range 2–10 days,
median 4 days

Assume 1st outbreak-associated
case on 5th September

**Probable exposure
on / around
3rd September**

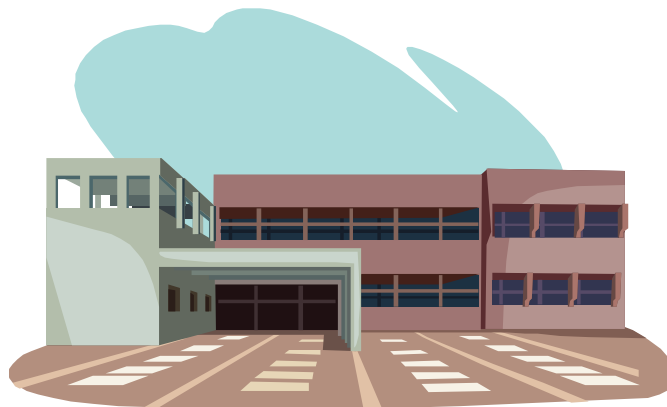
- Show the magnitude of the outbreak
- Show the time course of the outbreak
- Can help determine the incubation period or exposure period
- Can show the pattern of spread
- Highlight outliers



Describe and Orient the Data by Place

Descriptive

- Description



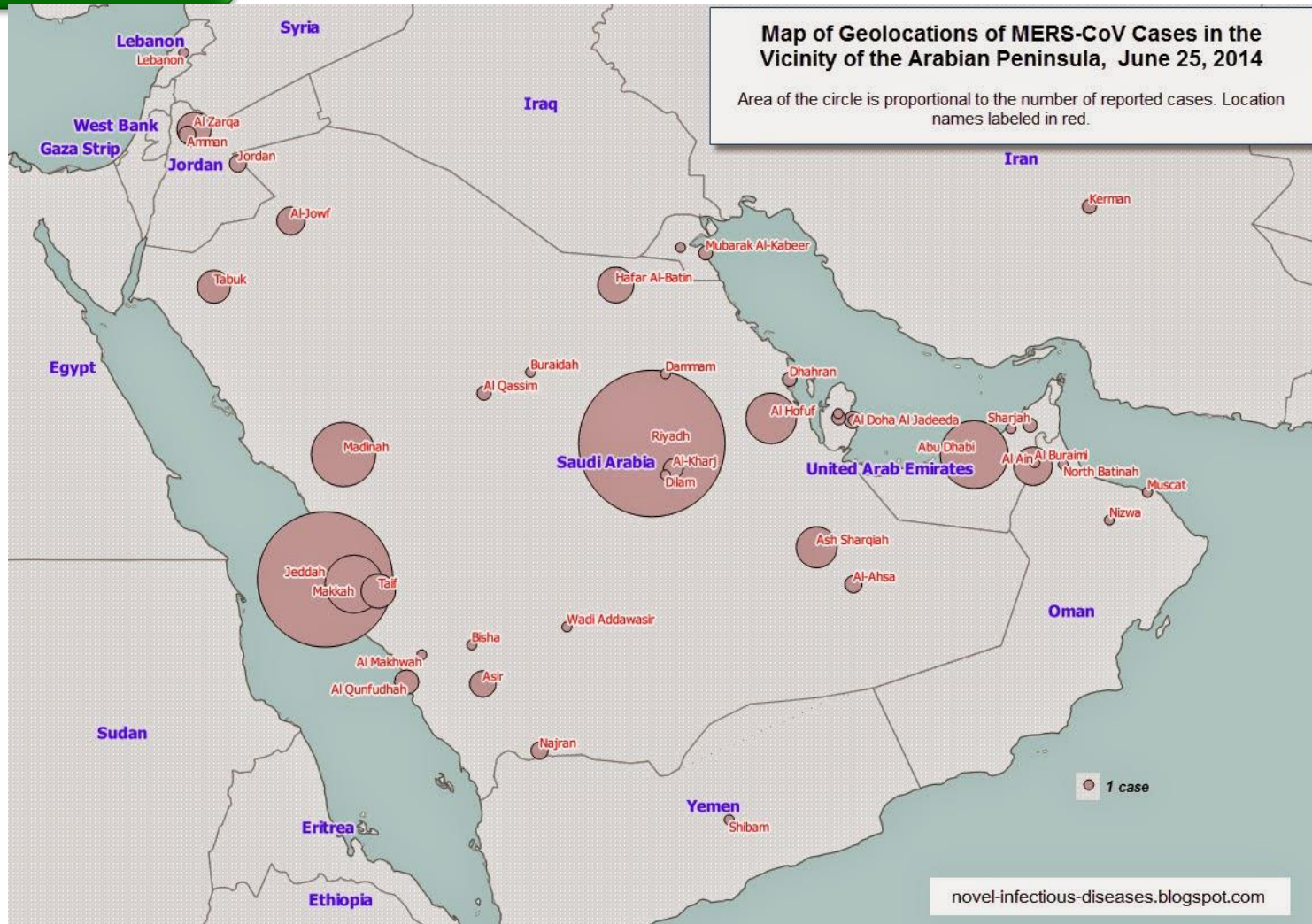
- Maps

- Spot
- Area



Descriptive

Spot Map: MERS-CoV detections in KSA



Summarize data by person

Age and Sex Distribution, Ebola Cases, Zaire, 1976

Age (yrs)	Male	Female	Total
< 1	10	14	24
1 - 14	18	25	43
15 - 29	33	60	93
30 - 49	57	52	109
50+	23	26	49
Total	141	177	318

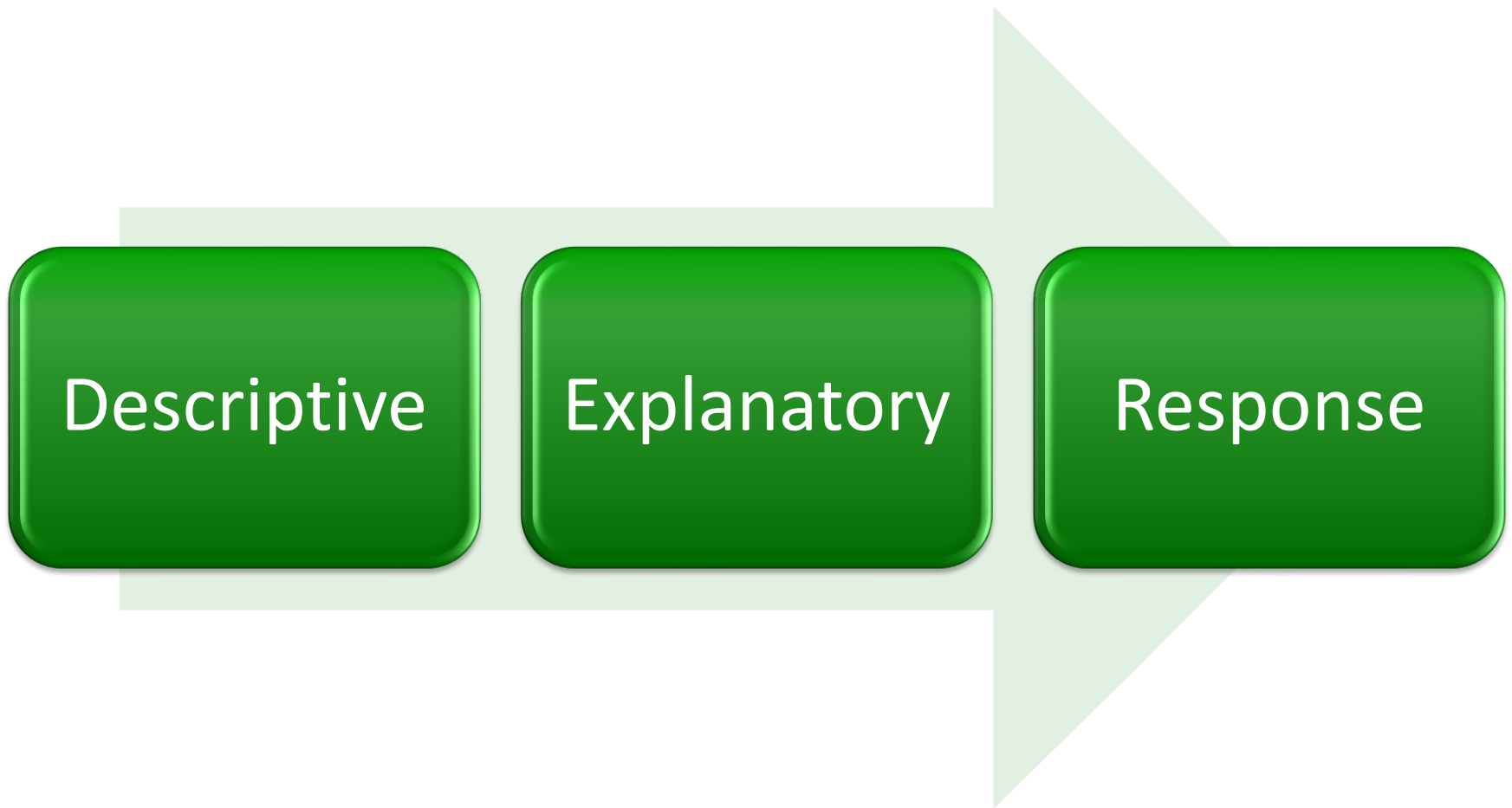
Perform Descriptive Epidemiology



Work in teams of two:

1. Create a line list of current cases
2. Analyze the data using various statistical methods
3. Create an epidemic curve
4. Interpret the epidemic curve

General Phases of an Outbreak Investigation



- 7. Develop hypotheses**
8. Evaluate hypotheses epidemiologically
9. Reconcile epidemiology with laboratory and environmental findings
10. Conduct additional studies as necessary

What is a hypothesis?

- Hypothesis (in context of outbreak) = educated guess about an association between an exposure and outcome, and/or about mode of spread
- How to develop a hypothesis
 - Subject matter knowledge – known sources, vehicles, transmission modes
 - Review descriptive epidemiology – what would account for most?
 - Outliers (unique exposure opportunities)
 - Talk to case-patients – what do they think?
 - What do local health officials think?

Develop a Hypothesis

Scenario: Several cases of meningitis (presumed meningococcal) among newborns in Hospital X

Subject matter knowledge [from WHO Fact Sheet]: Meningococcal meningitis is transmitted from person-to-person through droplets of respiratory or throat secretions from carriers. Close and prolonged contact (e.g., kissing, sneezing or coughing, or living in close quarters with an infected person) facilitates the spread of the disease

What is your hypothesis? (Specify outcome and possible exposure)

- Outcome is meningitis
- In this hospital, newborns stayed with their mothers in the maternity ward
- Exposure is person (presumably carrier) in maternity ward
 - Physician, nurse, technician?
 - Mother?
 - Visitor?





Exercise 4: Hypothesis Generation

Work in teams of two.

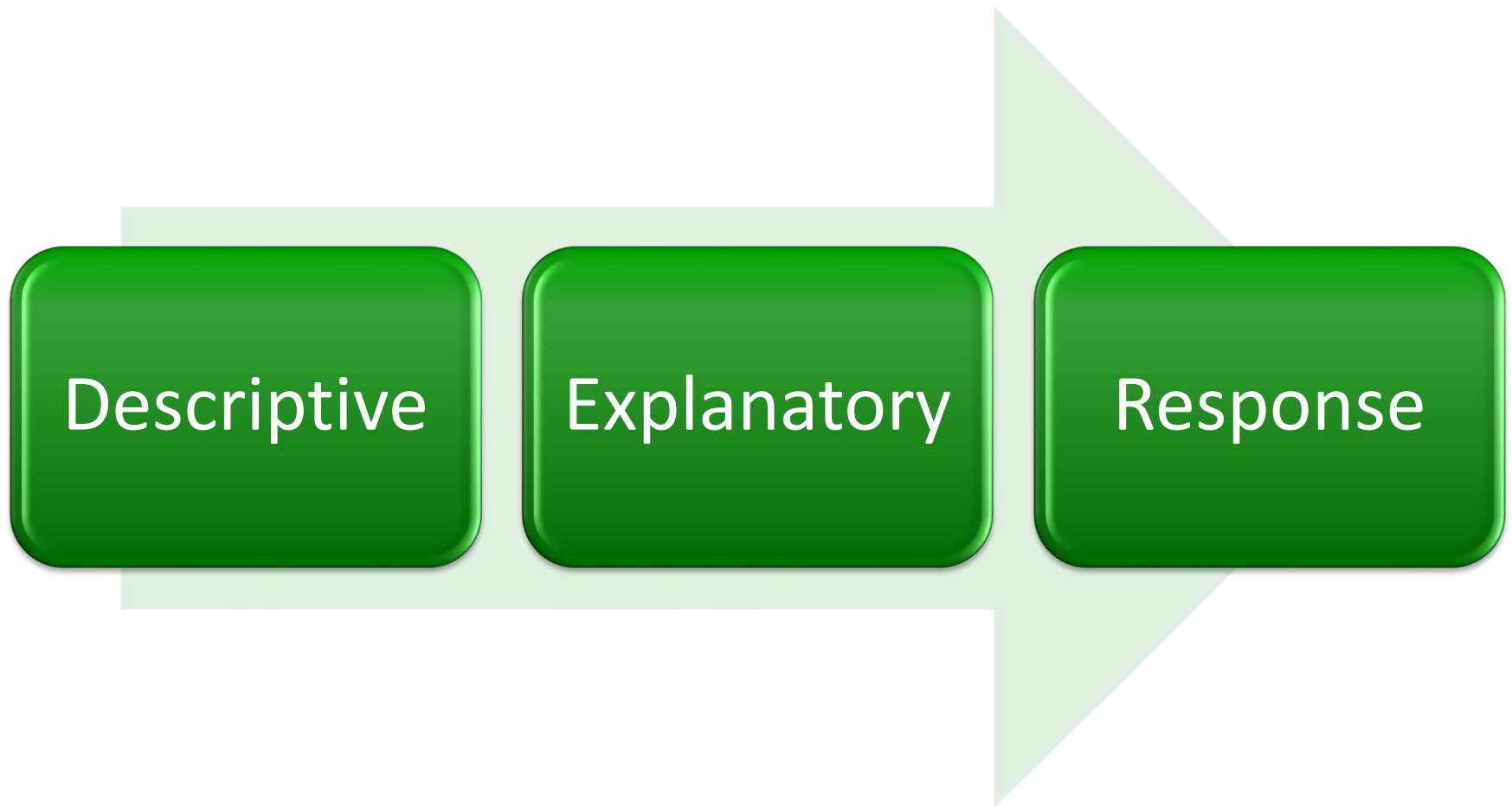
1. Based on your information, select **one** hypothesis to test further.
2. Review the January 19 update. Does it support your hypothesis?
3. Review the January 20 update. Does it support your hypothesis?

7. Develop hypotheses
- 8. Evaluate hypotheses epidemiologically**
9. Reconcile epidemiology with laboratory and environmental findings
10. Conduct additional studies as necessary

- Comparing hypotheses with established facts
 - Laboratory evidence
 - Clinical evidence
 - Environmental evidence
 - Epidemiologic evidence
- Use analytic epidemiology

7. Develop hypotheses
8. Evaluate hypotheses epidemiologically
- 9. Reconcile epidemiology with laboratory and environmental findings**
- 10. Conduct additional studies as necessary**

General Phases of an Outbreak Investigation



- 11. Implement and evaluate prevention and control measures**
12. Initiate or maintain surveillance
13. Communicate findings

Response

Implementing Control Measures

- Prevent further exposure and future outbreaks by eliminating or treating the source
- Initiate as soon as possible

Response

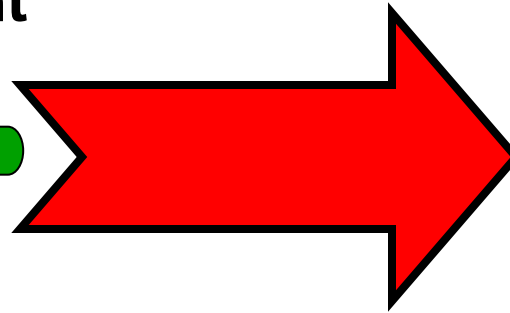
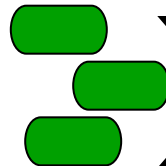
Chain of Transmission

Reservoir



Route of Transmission

Agent



Susceptible Host
(via portal of entry)



- Immediate control measures
- Long-term control measures



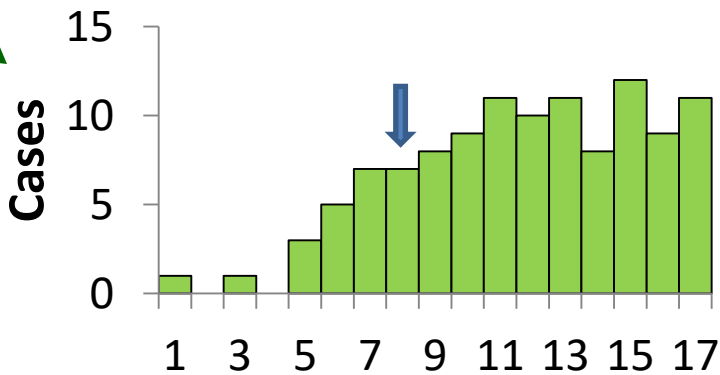
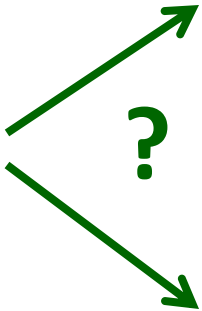
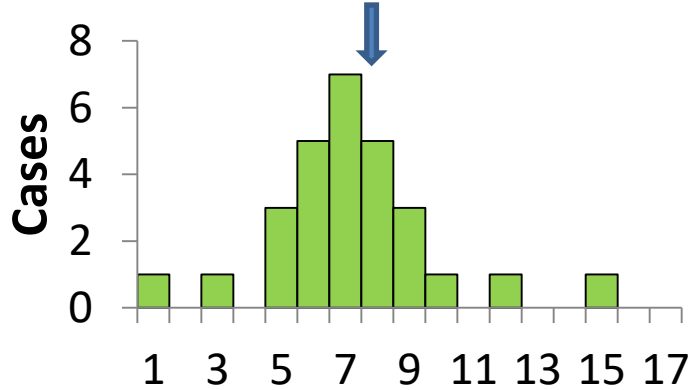
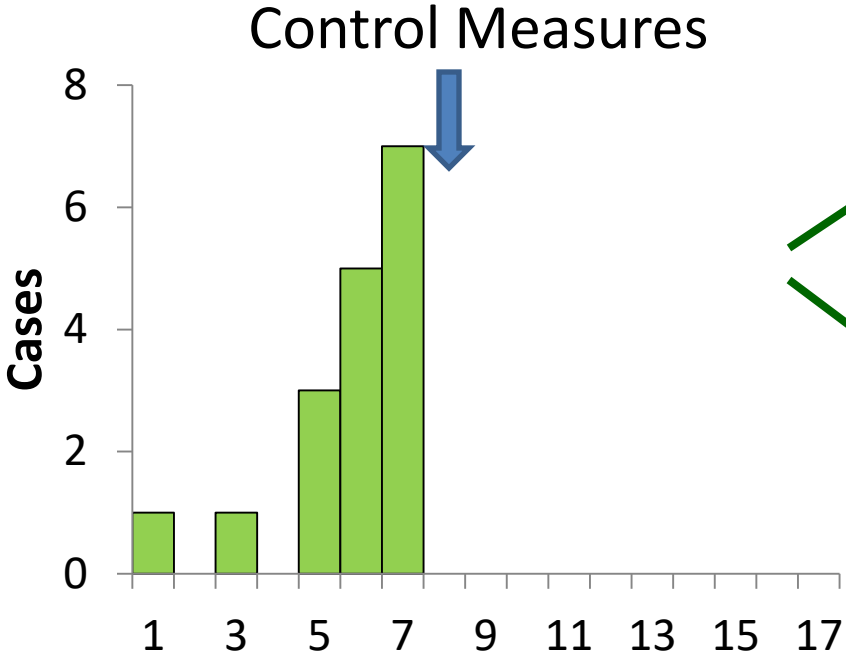
Short-term or Long-term Control Measures?

1. Recommending different food safety procedures in a restaurant
2. Sending ill children home from a school where there is an outbreak
3. Containing a chemical spill and evacuating the area
4. Establishing screening programs for local emergency departments
5. Making engineering modifications to existing water systems

11. Implement and evaluate prevention and control measures
- 12. Initiate or maintain surveillance**
13. Communicate findings

Surveillance – Are the Control Measures Working?

Response



11. Implement and evaluate prevention and control measures
12. Initiate or maintain surveillance
- 13. Communicate findings**

- During the investigation
 - Among team members
 - To the public
 - To health professionals
 - To public health officials/policy makers
- At the end of the investigation
 - Oral briefing
 - Written report



Example: Hantavirus Outbreak in Panama

Response

- Severe cardiopulmonary illness
- Rodent-borne
- 1999 – 2000
- Los Santos province
- 12 patients; 3 died



Report led to Prevention

- Local risk-reduction measures
- Nationwide public awareness and risk-reduction campaign
- Additional suspected cases evaluated in other provinces
- Treatment guidelines established
- Additional studies to identify the rodent reservoir

- Recommends actions needed
- Shares new insights
- Serves as a record of performance
- Supports research and evaluation activities
- Serves as a document for potential legal issues



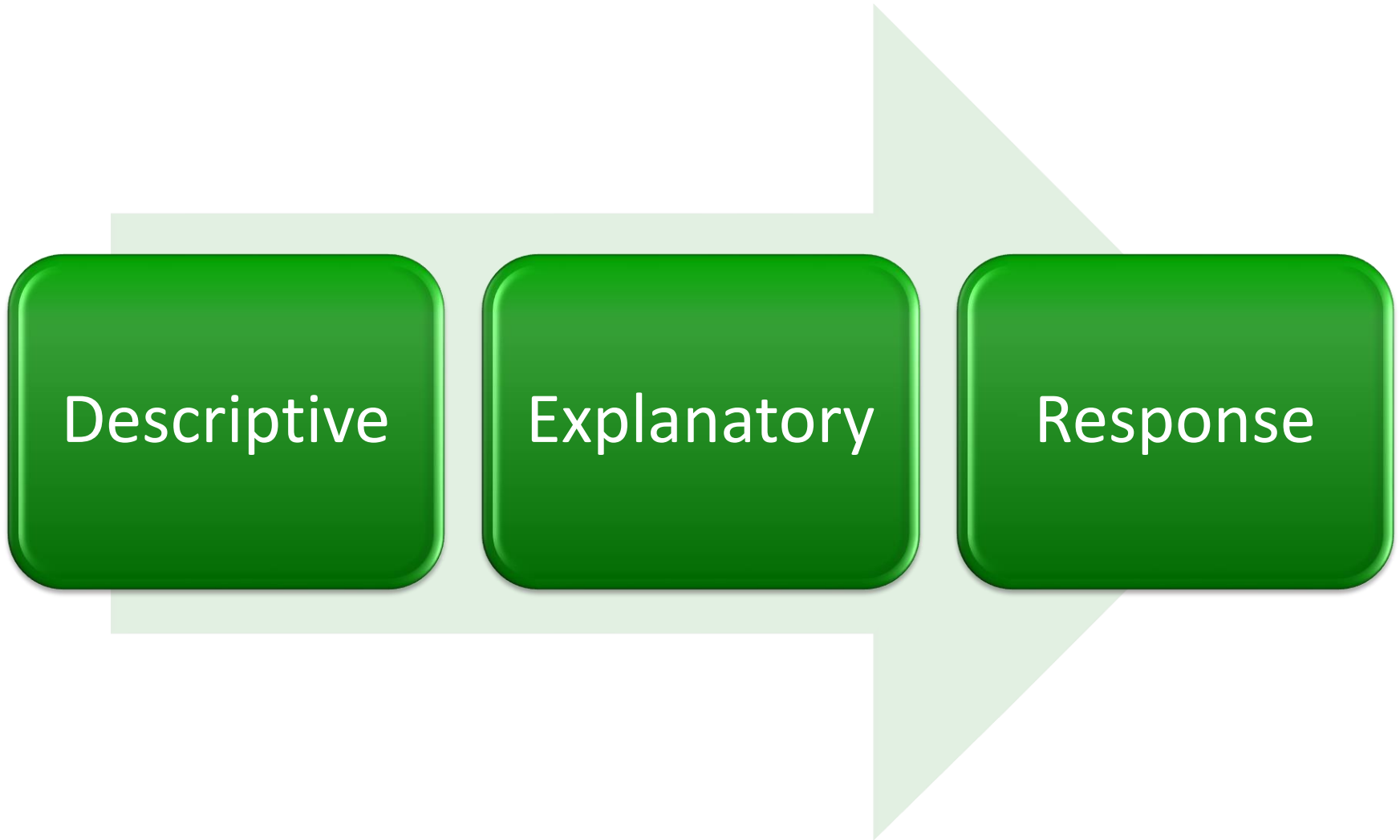
1. Summary
2. Introduction and Background
3. Outbreak Description
4. Methods and Results
5. Discussion
6. Lessons Learned
7. Recommendations
8. Acknowledgements



**~ 2 - 3
pages**

+ Supporting Documentation

General Phases of an Outbreak Investigation



Points to Remember

1. Alert thresholds will help you know when to investigate an outbreak
2. Document all of the rumors, reports and verified information about an outbreak
3. Assemble an outbreak investigation team and consider all of the logistics that will need to be taken care of so that they can do their jobs
4. Analyze the investigation results and decide if there is immediate action needed
5. Prepare an outbreak report to submit to the National Level

- Outbreak investigations should result in **actionable recommendations**
 - Immediate control measures
 - Long-term prevention and control



Exercise 5: Make Recommendations

1. What are your recommendations for prevention and control of this cholera outbreak?
2. Select one group member to present your group's responses to exercises 4 and 5.