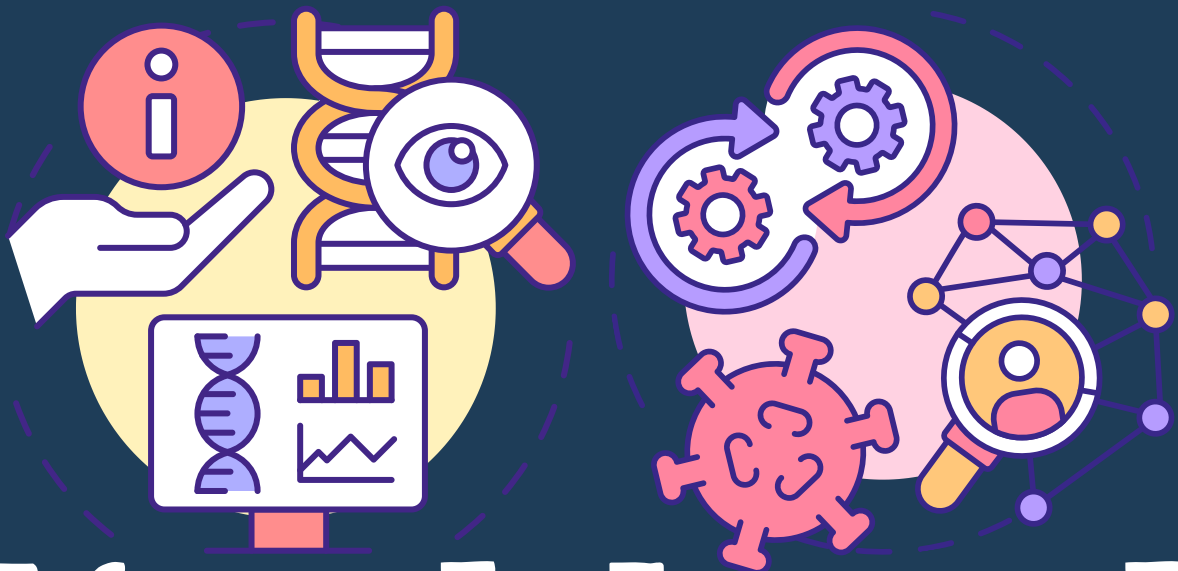


**FLEXED**  
**Virtual Community (VC)**

**Webinar 2**

**Future-Ready Epidemiology:  
A Conversation on Strengthening  
Outbreak Investigations**



# Workbook

# Welcome!

**Thank you for joining us for this  
NACCHO FLEXED Webinar on  
September 18th, 2025, part of the  
NACCHO FLEXED Virtual Community  
(VC) Learning Series.**

This workbook contains all the activities and interactive items from the workshop, plus the tools and graphics you need to help facilitate your understanding of the topics covered during our time together.

**We encourage you to use this workbook as a tool as you move forward with your mission to strengthen your LHD's outbreak investigations.**

# PHASES OF AN OUTBREAK INVESTIGATION\*

\*This is just one way of approaching an outbreak investigation! There are many more methods and possible steps, and those you use at your agency may differ slightly or significantly from those you see here. It's also crucial to understand that these activities listed below are not necessarily linear or chronological - depending on the issue, location, resources, and other variables, some of these "steps" will occur throughout the investigation, some will occur in a different order, and some will not occur at all.

Step 1. Prepare for Field Work

Step 2. Confirm the Diagnosis

Step 3. Determine the Existence of an Outbreak

Step 4. Identify and Count Cases

Step 5. Tabulate and Orient the Data in Terms of Time, Place, and Person

Step 6. Consider Whether Control Measures can be Implemented

Step 7. Develop and Test Hypotheses

Step 8: Plan One or More Systematic Studies

Step 9. Implement and Evaluate Control and Prevention Measures

Step 10: Communicate Findings

**What steps do you include in your outbreak investigations?  
Use the spaces on the next page to list and describe them!**

# PHASES OF AN OUTBREAK INVESTIGATION - YOUR TURN!

What steps do you include in your outbreak investigations?

Reflect on why you use the process you do, whether it has been effective, and what strengths and challenges it presents.

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# CASE STUDY

Help Nadia Martinez and the local county health department investigate a factor of unknown etiology in Riverside county!

## CASE STUDY GOAL

- The primary goal of this case study is to encourage the type of critical thinking required when investigating a factor of unknown etiology.
- In the absence of information and knowledge, it is these critical thinking skills that make us truly flexible and can help lead us to success despite the unknowns.

**The take home: It is not just knowledge, experience, and resources that make us flexible. It is the ability to arrive at answers despite an absence of those elements that make us truly flexible.**

## CASE STUDY GUIDANCE

- There are no wrong, right, or perfect answers here. Use your best critical thinking to reach your assumptions, hypotheses, decisions, and conclusions.
- The case study is presented in a linear, chronological way, but outbreak investigations do not follow a strict linear pattern and actions; activities and decisions may need to move quickly between and within different phases of an outbreak investigation process. Labels, phrases, and phases are always movable parts.

## LEARNING OBJECTIVES

By the end of this case study, participants will be able to:

- Analyze multiple factors influencing outbreak investigations
- Apply systems thinking to complex public health challenges

## **CASE BACKGROUND: SAY HELLO TO NADIA MARTINEZ AGAIN!**

Nadia Martinez, the surveillance director at Riverside County Health Department successfully implemented the surveillance systems you helped her design in Case Study #1. Now, 18 months later, she faces her biggest challenge yet, and she's asked you to join forces with her once again to provide consultation and guidance as she moves forward.



# CASE STUDY

## PART 1- DAY 1: INITIAL ALERT

**SETTING:** Riverside County (population 85,000) -  
Rural agricultural area with one small city (population 25,000)

**THE CALL:** At 9:30 AM on a Tuesday, Nadia receives an urgent call from one of her close community partners, Dr. Sarah Chen at Riverside General Hospital:

"Nadia, I need your help. We've had 12 patients admitted over the past 48 hours with the strangest constellation of symptoms I've ever seen. Each case started with what looked like typical flu - fever, headache, muscle aches. But then around day 3, they develop this distinctive rash pattern on their arms, neck, and torso, and some are showing neurological symptoms - confusion, brain fog, memory issues. None of our usual tests are coming back positive. I'm really concerned."



**THE QUESTION: ?**

**What do you recommend Nadia do with this information? Why? How?**

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### THINGS TO THINK ABOUT:



What decisions does Nadia have to make?

Possible Decision Examples:

- Notify her LDH, start a case report, check other surveillance systems, go back to Dr. Chang and ask for more information, what else?

What information is missing? Why is that information important?

What do you do with the additional information?

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# CASE STUDY

## PART 2- DAY 1: MORE INFORMATION IS AVAILABLE

### THE INFORMATION:

- Local news reports that people who attended the weekend-long annual Harvest Festival (held this past weekend from Friday through Sunday) are "getting sick."
- Social media posts show complaints about people feeling "weird" after the festival.
- The festival had approximately 3,000 attendees from across the county and nearby counties.
- All 12 of the hospitalized patients at Dr. Chang's hospital attended the Harvest Festival.
- Nadia's LHD and Dr. Chang's hospital have limited resources and limited staffing (recall from case 1 that Nadia only has 2 epidemiologists and a part time intern.)

### THE QUESTIONS: ?

**Q1: Based on the information you have, are any of the activities identified in Part 1 a priority? Why or why not?**

**Q2: With limited resources and limited staffing, which activities would you address first? Why? How?**

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### THINGS TO THINK ABOUT:

- Who needs to be notified immediately?
- What other information should be collected?
- What other resources might be needed?
- What communications need to occur?



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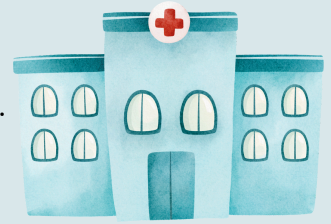
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# CASE STUDY

## PART 3-DAY 1: MORE INFORMATION ARRIVES

### FROM THE HOSPITAL: (THE ONLY ONE IN THE COUNTY):

- 12 hospitalizations with similar symptoms confirmed.
- Symptom onset: All between Sunday evening and Tuesday morning.
- Patient ages: 15-67 years old.
- No deaths, but 3 patients in ICU.
- No obvious connection in patients besides festival attendance.



### FROM THE HARVEST FESTIVAL: ( FESTIVAL DETAILS)

- Harvest Festival hours are from Friday 10 AM through Sunday 8 PM
- Activities included: Food vendors, live music, sunset drum circles, “daytime fireworks” and nighttime pyrotechnics, face and henna painting, craft booths, small animal petting zoo, corn maze, haunted house.
- Weather: Unseasonably warm for October (85°F average all days).



### THE QUESTIONS: ?

You now have considerable details about the situation. What should you and Nadia do with this information?

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### THINGS TO THINK ABOUT:

- Do we have sufficient evidence of an outbreak? What criteria are we using?
- What additional data sources could help us determine scope? Where do you get those?
- Do you communicate anything to the public? Do you have any prevention messages or measures? Do you have any control and containment messages or measures?
- Can you check other surveillance systems to see if those are above baseline (e.g., flu surveillance, rash surveillance, others)?



# CASE STUDY

## PART 4-DAY 2: A NEW DAY, NEW INFORMATION!

### NADIA'S NEXT STEP DECISIONS

With your consultation and guidance, Dr. Nadia has established the existence of an outbreak. She recognizes some of the next steps required are outside of the resources that their 2-person epi team can manage. She has formally requested help from her regional epidemiology contact. That person notified the state department of health office, and the state department of health office notified CDC.

### FROM THE LABORATORY

- Initial tests results from first patients are received from the hospital: electron microscopy shows unusual viral particles, full genome sequencing in progress.
- Test results thus far ruled out influenza, COVID-19, common bacterial infections.
- Preliminary findings suggest a novel pathogen.
- CDC's Special Pathogens Unit is involved in asking for additional lab specimens to be collected.
- CDC helps Nadia with the development of a new CDC-specific case investigation reporting form that everyone is using for the cases specific to the Harvest Festival.



### DATA COLLECTION STRATEGY (using CDC case investigation form):

- Detailed exposure questionnaire.
- Focus on timing, duration, and specific activities.
- Food and beverage consumption patterns included.
- Contact with animals or other people included.
- Patient's locations within festival grounds over time included.



### THOUGHTS?

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# CASE STUDY

## PART 4-DAY 2: A NEW DAY, NEW INFORMATION!

CONTINUED...

**CASE DEFINITIONS** (Working definition developed with preliminary information Nadia collected from the hospital and CDC.)

- **Case Definition for Suspect Case:** Person who attended Harvest Festival AND has two of the symptoms: severe headache, muscle aches, distinctive rash, neurological symptoms.
- **Case Definition for Probable Case:** Person who attended Harvest Festival AND developed fever ( $\geq 100.4^{\circ}\text{F}$ ) plus at least two of the symptoms: severe headache, muscle aches, distinctive trunk rash, neurological symptoms.
- **Case Definition for Confirmed Case:** Probable case plus positive laboratory confirmation (when available).

**THE QUESTION:** ? What does Nadia do with this information now? Why? How?

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### THINGS TO THINK ABOUT:

- If communicating this information internally or externally, what does that look like?
- What happens to routine reporting at this point during the outbreak?
- What are the implications of investigating a completely novel pathogen?
- How do we balance public health action and public trust with scientific uncertainty?



# CASE STUDY

## PART 5-DAY 3: THE CURRENT SITUATION AND THE UNIVERSAL EXPOSURE CHALLENGE

After Nadia notified the health department officer, emergency staff were activated which included their preparedness office (2 people) and their school health nurse. It also included implementing their Incident Command Systems (ICS) plan. She also became aware of the following:

- Two different neighboring counties had epi interns that they are also allowing to support the county effort.
- A festival attendance list doesn't exist.
- Tickets were sold at the gate (cash and cards).
- Local news coverage and social media provide some attendee information.
- Word is spreading, causing both panic and potential over-reporting.

**THE QUESTION:**  **What does Nadia do with this information now? Why? How?**

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### THINGS TO THINK ABOUT:

- How can we systematically identify potential cases when we don't have a clear attendee list?
- What creative approaches might help us reach people who attended?
- What role should social media and news media play in case finding?
- How can you use them? How do you know to use them?
- Deploying dashboards or surveillance tools, what would that look like?
- Any additional Data Sources to Consider in case finding?

Ideas!

- Local business credit card records from festival?
- Parking lot security cameras?
- Social media posts and photos?
- School absentee reports?
- Employee call-in data from major employers?
- Healthcare provider networks?



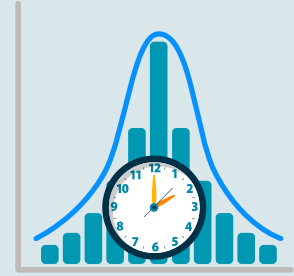
# CASE STUDY

## PART 6- DAY 3: NEW INFORMATION & A PATTERN EMERGES

### THE INFORMATION:

#### TIME DISTRIBUTION

- Symptom onset: 18-72 hours post-festival.
- Peak onset: Sunday evening (48-hour mark).
- Currently 47 probable cases identified.



#### PLACE ANALYSIS

- Cases from 12 different zip codes.
- No clear geographic clustering beyond festival attendance.
- Cases include both county residents and visitors.



#### PERSON CHARACTERISTICS

- Updated age range: 8-78 years.
- No clear gender predominance.
- Most severe cases were in festival workers and volunteers.
- Mix of local residents (60%) and out-of-county visitors (40%).
- Various occupations, no workplace clustering in the larger group other than the festival workers who were impacted.



**THE QUESTION:** ? What does Nadia do with this information now? Why? How?

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#### THINGS TO THINK ABOUT:


- What does the incubation period tell us about the potential pathogen?
- Are there any patterns in person characteristics that suggest specific risk factors?
- How might the mix of residents and visitors affect our investigation?
- What additional person-level data should we collect?



# CASE STUDY

## PART 7- DAY 3: DEVELOPING YOUR HYPOTHESIS; THE UNIVERSAL EXPOSURE DILEMMA CONTINUES

Since virtually every suspected case was exposed to the festival environment, Nadia must think creatively about sub-exposures and dose-response relationships.

**THE QUESTION:**  Based on the information you have received up to this point, what is your exposure hypothesis? Why?

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### REMINDER

Activities included food vendors, live music, sunset drum circles, “daytime fireworks” and nighttime pyrotechnics, face and henna painting, craft booths, small animal petting zoo, corn maze, haunted house.

### THINGS TO THINK ABOUT

- Food/Beverage Sources: Specific vendors, shared items
- Environmental Sources: Dust, aerosols, contaminated surfaces
- Animal Contact Sources: Petting zoo, working animals
- Activity-Specific Sources: Corn maze, haunted house, face and henna painting, specific entertainment
- Time-Based: Specific time periods with higher risk



# CASE STUDY

## PART 8- DAY 4: EVALUATE YOUR HYPOTHESIS - ANALYTICAL STUDY DESIGN

### THE PROBLEM:

With universal exposure to the festival, traditional case-control studies are complicated.

Nadia and her epidemiologists have developed a hypothesis, and started some analyses – they have done a case-to-case analysis, a cohort study among attendees, and a hybrid approach:

### OPTION 1: CASE-TO-CASE ANALYSIS

#### What happened in the analysis:

- Compared 12 hospitalized cases (severe) with 35 mild/moderate cases identified through surveillance.
- Analyzed exposure duration, specific activities, and demographic factors.
- Examined dose-response relationships and individual susceptibility factors.

#### What they found:

- Age pattern: Children under 12 and adults over 65 had significantly higher rates of severe illness (hospitalization rate of 45% vs 15% for other age groups).
- Exposure duration: Festival workers and volunteers who spent >8 hours on the grounds and who had set up the petting zoo and corn maze had 3x higher severe illness rate.
- Ground-level exposure: Individuals who spent time in low-lying areas (corn maze, potato sack race, children's activities near ground, etc.) showed more severe symptoms
- Timing: Cases with longest exposure to Saturday afternoon heat (peak temperature 87°F) had earlier symptom onset and more severe neurological symptoms.
- Immunocompromised individuals: 4 of 12 hospitalized cases had underlying conditions vs 3 of 35 mild cases.

### THOUGHTS?

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# CASE STUDY

## PART 8- DAY 4: EVALUATE YOUR HYPOTHESIS - ANALYTICAL STUDY DESIGN

CONTINUED...

### OPTION 3: HYBRID APPROACH

#### What happened in the analysis:

- Used 200 non-attendee controls from same geographic area for comparison.
- Focused on exposure intensity/duration among attendees.
- Analyzed environmental factors and specific location mapping within festival.

#### What they found:

- Risk gradient: Clear exposure gradient from corn maze center (highest risk) radiating outward.
- Environmental factors: Cases clustered among those present during peak afternoon temperatures and peak festival attendance when dust/particulates were most disturbed.
- Material handling: 100% attack rate among 6 volunteers who helped set up the corn maze materials, arts and crafts booths, and Petting Zoo on Thursday-Friday
- Air pattern analysis: Cases corresponded with prevailing wind patterns carrying airborne particles from corn maze and petting zoo areas.
- Critical insight: No cases among attendees who visited only in early morning hours before 10 AM or after 7 PM when temperatures were cooler
- Imported materials: Maze construction used decorative materials imported from overseas supplier - delivery manifests showed arrival 1 week before festival and delivery the day before the festival started.

**QUESTIONS:**  What other approaches could Nadia have taken? Why? How?




### CLOSER TO HOME:

- Do you have staff that could conduct these analyses or other analyses?
- What tools do you use and what people do you have trained in those tools or resources?
- What resources do you have to get those tools, people and/or training?

# CASE STUDY

## PART 9- DAY 7: BREAKTHROUGH

Laboratory analysis reveals: Disease X is a novel virus that likely originated from ...

**THE QUESTIONS:**  What does Nadia do now? Why? How?

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### **CLOSER TO HOME:**

- What new information did you learn from Nadia's experience and what could you use or apply to your LHD?
- What are your barriers to using this information or new ideas?
- What are your next actionable steps?

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# CASE STUDY

## PART 10- CASE CLOSED

Nadia and her teams are now implementing control and prevention measures.

- They initiated a trace back investigation with federal partners to identify which exact material was the culprit.
- They have removed the XXXXX from the festival worker access.
- They have notified other festival organizers, issued news alerts for people impacted advising them to seek medical attention, and contacted the manufacturer to recall the items.
- Monitoring cases continues.
- The outbreak was considered closed when there were no additional cases after 2 incubation periods.
- Everything was communicated in ICS, final communications to the media, and a final report for the agency.
- This outbreak investigation is now closed!

The following year, Nadia presents her case and findings at the NACCHO Preparedness Summit.

You are in the audience and watch as after the session she is approached by an epidemiologist at a rural county LHD- and asked if she would consult with them on how to strengthen their epidemiology program. You smile knowing your knowledge, skills, abilities and flexible critical thinking made a difference.

For now, your work here is done.



# What Are Your Next Actionable Steps?



**In the Next 48 Hours I Will:**

**In the Next Week I Will:**

**In the Next Month I Will:**



# What Are Your Next Actionable Steps?

Take  
the Next Step  
Now

## SOME IDEAS!

### In the Next 48 Hours I Will:

- Schedule to take one of the trainings on the curated list.
- Continue to gather or share knowledge on outbreak investigations using the VC - Post a question, comment or information on the platform.
- Reach out to at least 1 VC participant to discuss the topic.
- Think about which outbreak investigation elements need to be strengthened or implemented in my jurisdiction.
- Discuss which outbreak investigation need to be strengthened or implemented in my jurisdiction with at least one colleague or a mentor.

### In the Next Week I Will:

- Discover and Draft an outline of steps that our LHD would need to take to strengthen our outbreak investigation process.
- Share key elements of that outline with at least one colleague or a mentor.
- Determine what partners would need to be involved in the steps in my outline.

### In the Next Month I Will:

- Determine what resources would be required for my outline.
- Determine which colleagues can work with me to expand on my concept and recruit them.
- Contact one potential partner and establish rapport.

