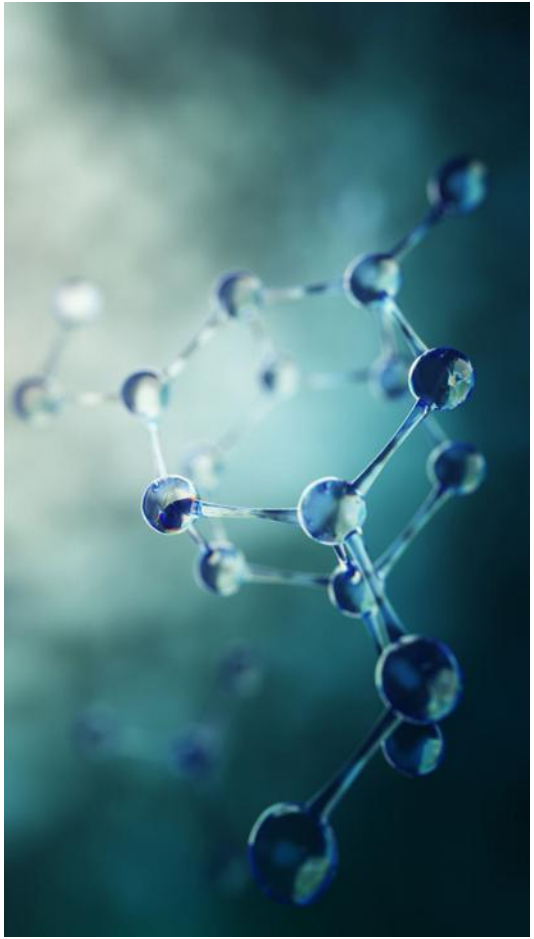
Toxicological Outbreak Investigation

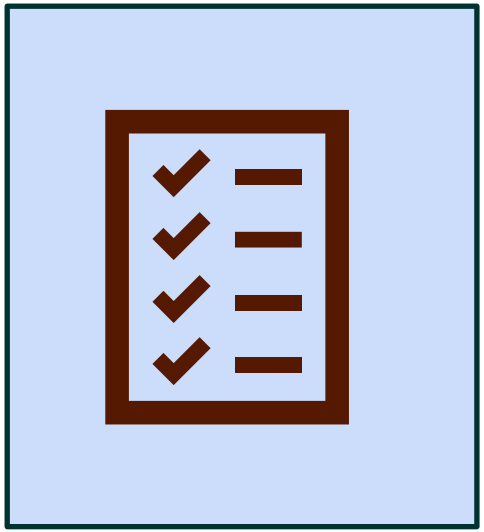
Module 7: International Case Study

Welcome

- Welcome to Module 7 of Toxicological Outbreak Investigation. In this module, you will have the opportunity to practice what you have learned in Modules 1–5 by completing an international case study.
- This module should take about 90 minutes to complete.

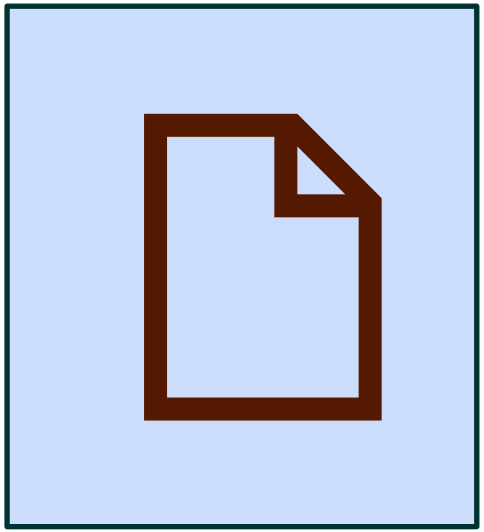


After completing this module, you will be able to:



Apply toxicological outbreak investigation steps

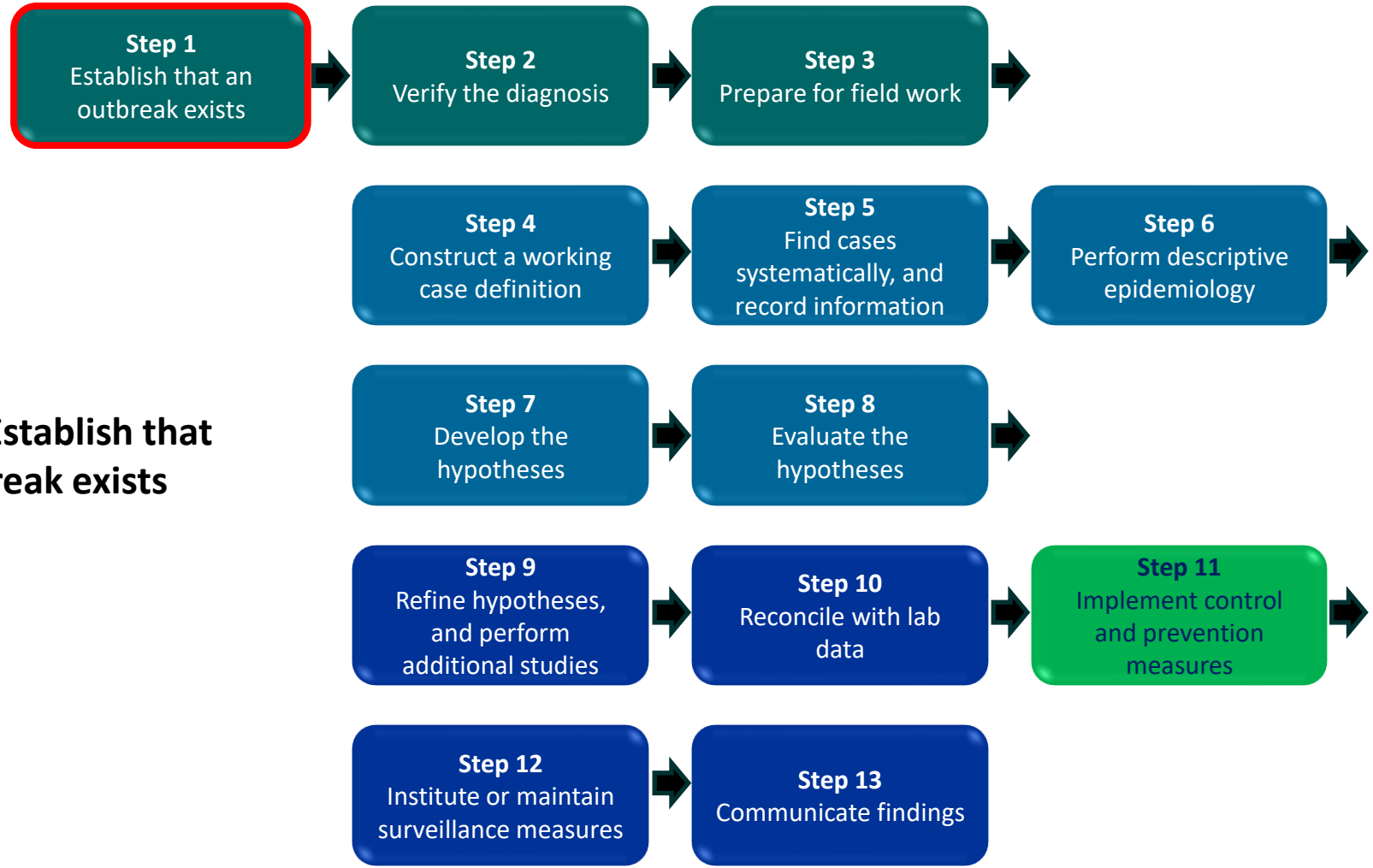
Interpret lab sample results



Describe relevant toolkit resources

Note About Case Study

- This case study is loosely based on an actual investigation conducted in Bangladesh in 2009. However, many details have been modified, and in some cases, fictional data are used for instructional purposes.
- A reference for an abstract on the actual outbreak investigation is provided at the end of the case study.



Step 1: Establish that an outbreak exists

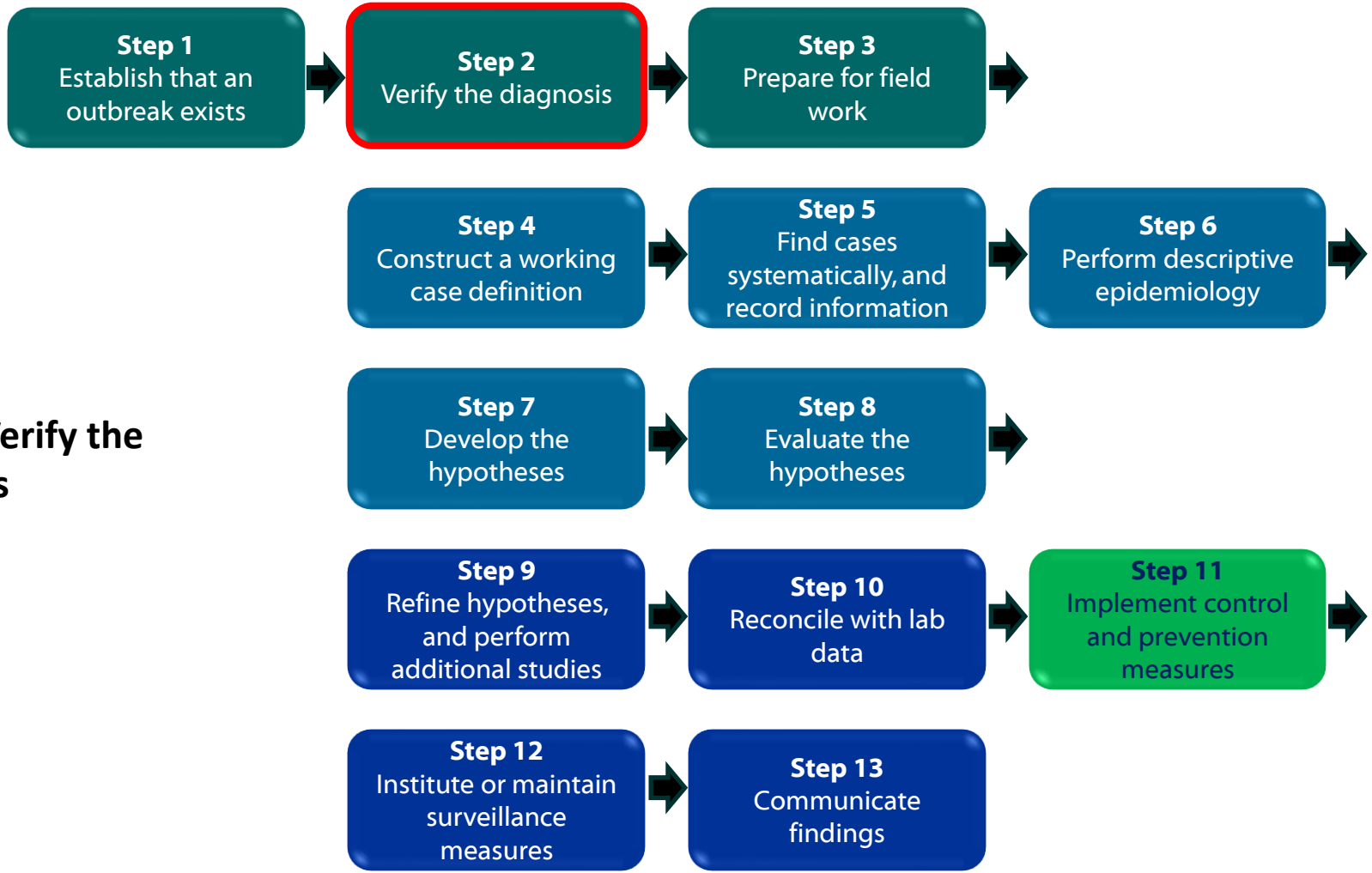
The Call

- In April, a doctor at a rural hospital contacts the District Public Health Surveillance Officer.
- That month, he saw 11 children in the hospital with sudden illness. Three children died.
- Symptoms included difficulty breathing, frothy oral secretions, and loss of consciousness.
- The children were aged 7 months to 10 years.
- The children all resided in one rural farming village or a nearby village.

Background Information

- The District Public Health Surveillance Officer speaks with local doctors and learns more information.
- Several calves and puppies in the region had become suddenly ill and died around the same time that the children had become ill.
- A similar group of illnesses occurred at this time last year.
- Last year, laboratory tests were negative for influenza, Japanese encephalitis, and Nipah virus.
- The District Public Health Surveillance Officer contacts the Ministry of Health.
- The Ministry of Health decides that this is an outbreak.
- They decide to investigate to find the cause of the outbreak and address public concerns.
- Your team gets called into action.

Step 2: Verify the diagnosis



Toxicological Outbreak

- At this point, there is no specific diagnosis to verify.
- However, the Ministry of Health realizes this might be a toxicological outbreak for the following reasons:
  - Prior tests for an infectious disease were negative.
  - Fever has not been mentioned as a prevailing symptom.
  - Illness seemed to have a rapid onset.
  - So far, all reported cases had similar symptoms.
  - Concurrent animal illnesses were reported.

What do you need to consider right away once you learn that an outbreak might have been caused by a toxic agent?

Toxicological Outbreak

- **If you suspect that an outbreak might have been caused by a toxic agent, remember to**
  - Consult with a toxicologist.
  - Discuss sample collection procedures (e.g., what types of samples to collect, how to collect them, the types of containers to use, how to process the samples, sample storage) with the toxicologist and the laboratory that might be performing sample testing.
  - Gather biological and environmental samples as early as possible.

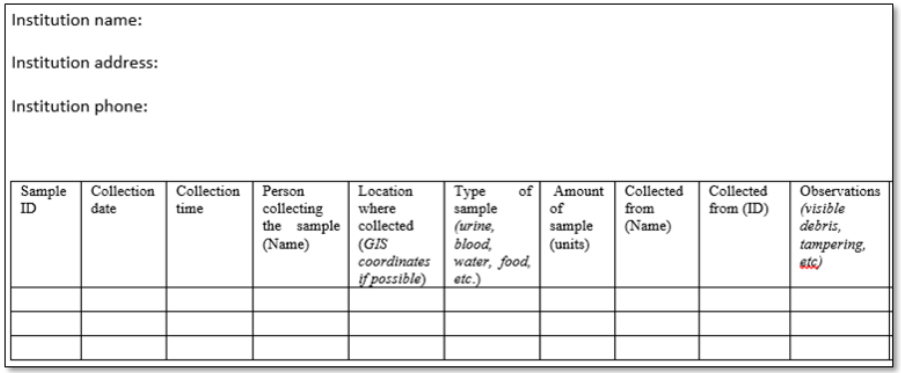
Team Consults with Local Toxicology Experts

- The team consults with a toxicologist and laboratorians.
- They contact the district hospital and learn that blood samples were collected from seven cases. The samples were processed to separate the serum, and the serum is now being stored in a freezer.
- They ask the district hospital to complete a specimen log to record descriptive information for the specimens.

What information do you want to collect on the specimen log?

Sample Log

- Information recorded in the sample log would include the following:
  - Identifying information (e.g., person's name)
  - Collection date and time
  - Sample type (e.g., blood, urine)
  - Location where the sample was collected
  - Descriptive data (e.g., age, sex)
- The toolkit includes a modifiable sample log.



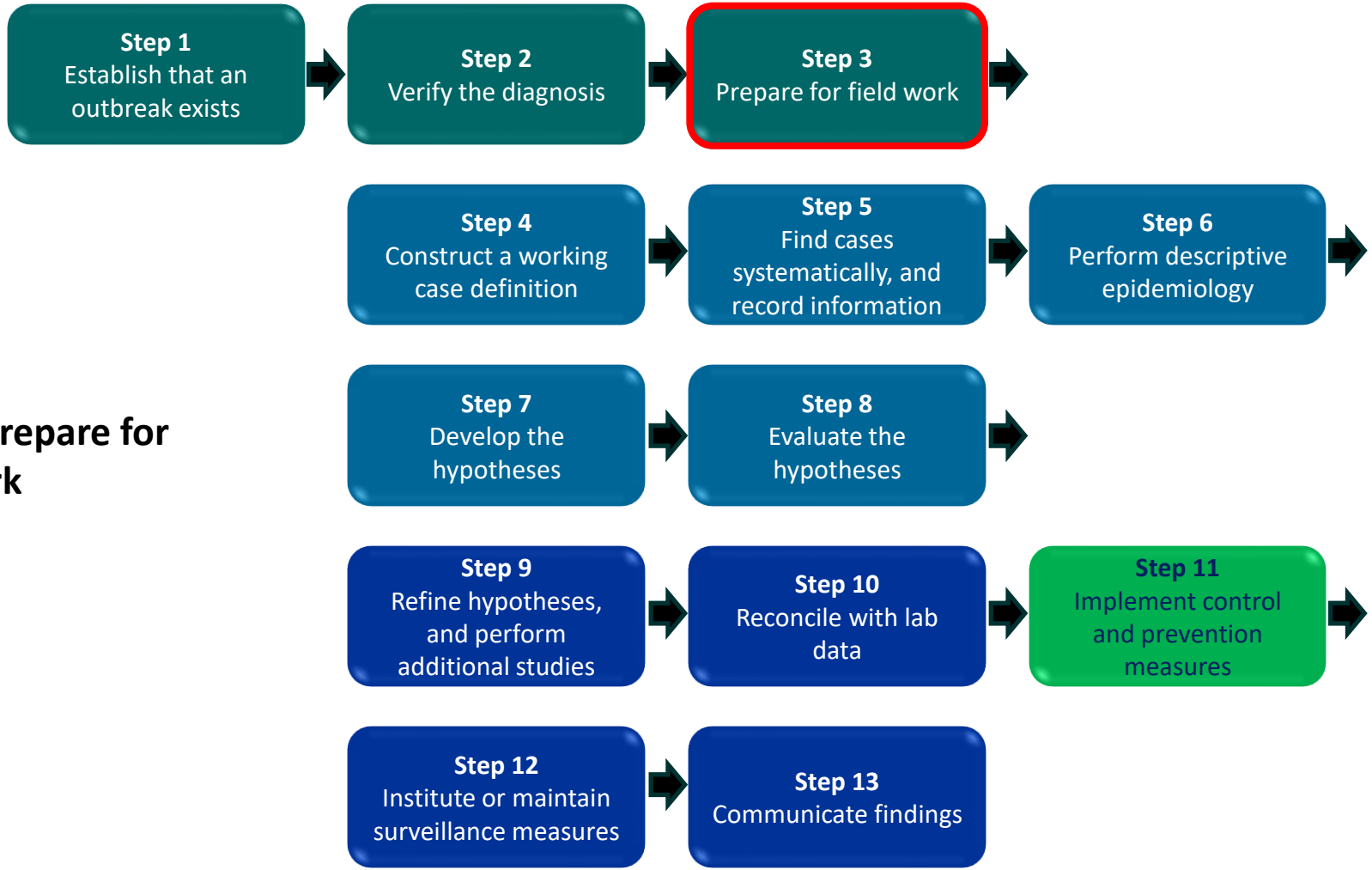
Institution name:

Institution address:

Institution phone:

Sample ID	Collection date	Collection time	Person collecting the sample (Name)	Location where collected (*GIS coordinates if possible*)	Type of sample (*urine, blood, water, food, etc.*)	Amount of sample (units)	Collected from (Name)	Collected from (ID)	Observations (*visible debris, tampering, etc.*)

Step 3: Prepare for field work



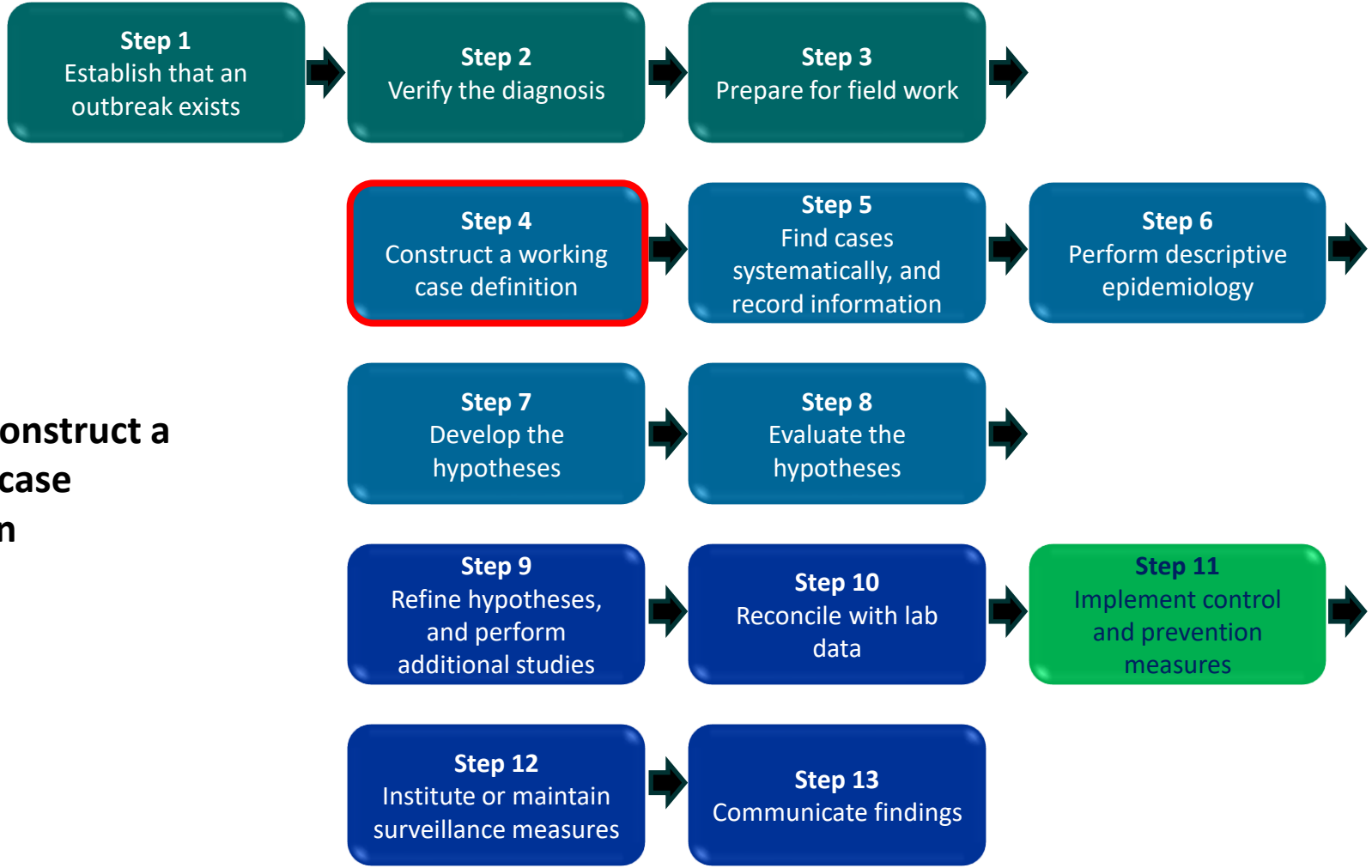
Preparing for the Field Investigation

- The initial team begins to plan for the field investigation.
- They develop four objectives:
  - Describe the illness
  - Determine the extent of the outbreak
  - Identify the etiology
  - Identify the route of exposure

Who should be included in the investigation team?

Preparing for the Field Investigation

- They assemble a broader team and define the roles of each team member.
- The team includes the following people:
  - District public health surveillance officer
  - Medical officer (physician) or another clinician
  - Epidemiologist
  - Toxicologist
  - Laboratorian
  - Anthropologist
  - Veterinarian
- The team starts planning for the logistics of the field investigation, including gathering needed supplies.



Step 4: Construct a working case definition

Understanding the Illness

- The team speaks with the clinician who saw the patients to gain an understanding of the most common symptoms.
- The most common symptoms included
  - Difficulty breathing
  - Excessive sweating
  - Frothy oral secretions
  - Loss of consciousness
  - Convulsions/fits
  - Urinary incontinence
  - Vomiting
  - Weakness in arms or legs

Develop a working case definition. Be sure to include all elements of a case definition (what, when, who, and where).

WHAT	WHEN	WHO	WHERE

Case Definition

- **The team develops the following working case definition:**

WHAT - Any two of the following symptoms occurring on the same day

- Difficulty breathing
- Excessive sweating
- Frothy oral secretions
- Loss of consciousness
- Convulsions/fits
- Urinary incontinence
- Vomiting
- Weakness in arms or legs

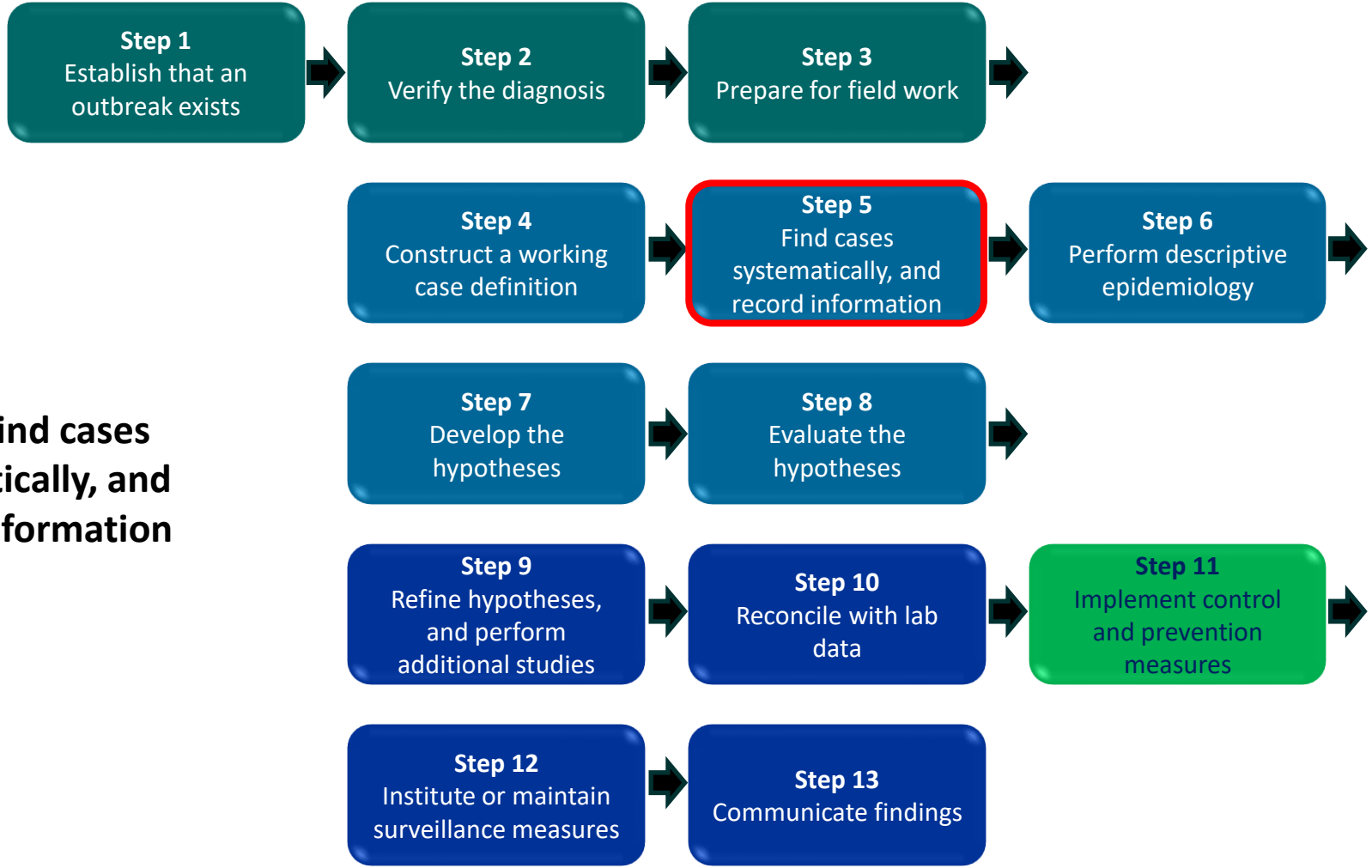
The team decides to require the presence of at least two of the symptoms, to be more specific and reduce the risk of categorizing other sick people (not related to the outbreak) as cases.

WHEN - Occurring on or after March 1

They decide to go back to March 1, in case the outbreak started earlier but was missed.

WHO - In a person aged ≤10 years

WHERE - Who resides in village A or B



Step 5: Find cases systematically, and record information

Find Cases Systematically, and Record Information

- The team heads to the villages to start determining the extent of the outbreak.

How would you search for additional cases?

Find Cases Systematically, and Record Information (cont.)

- The team searches for additional cases by:
  - Visiting nearby hospitals, discussing the outbreak with staff, and reviewing medical records
  - Contacting public health officials in neighboring districts
  - Asking village leaders and family members for reports of similar illness
  - Contacting local veterinarians to ask if they had seen similar cases in animals
- No additional cases are found; it appears the outbreak is not ongoing.

Line List Excerpt

- The team constructs a line list to record information about the cases. An excerpt of this line list is shown below:

Age	Sex	Start Date	Frothy Secretions?	Excessive Sweating?	…	Outcome	Blood Sample?
2	F	April 2	Yes	No		Died	No
3	M	April 7	Yes	Yes		Survived	Yes
5	M	April 8	No	Yes		Survived	No
8	F	April 10	Yes	No		Survived	Yes
3	M	April 13	Yes	Yes		Survived	Yes

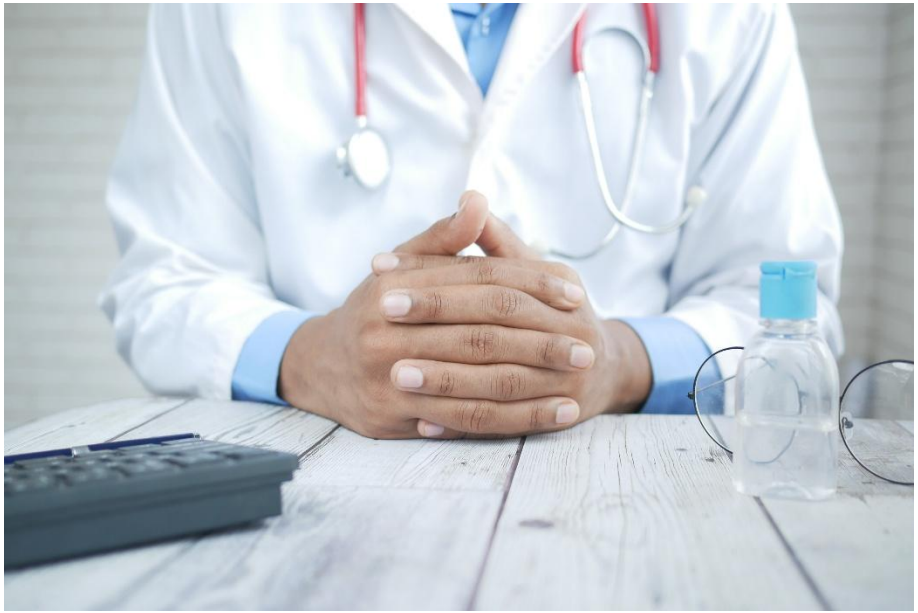
What is missing in this line list?

Line List Excerpt

- The line list could have also included the following:
  - Required
    - Name/ID
    - Date of blood sample collection
  - Optional
    - Address
    - Time of presentation to the hospital or clinician’s office
    - Other items felt to be of importance
- The tool kit includes a sample line list.

Hypothesis-Generating Interviews

- The team conducts hypothesis-generating interviews with the physician who saw the cases to learn more about the timeline of illness.
- The physician recalls three cases in detail, as shown on the following slides.



Patient #1

- A girl aged 2 years was brought to the emergency room.
- According to her parents
  - She was quite healthy.
  - After breakfast, she suddenly developed weakness in her right leg while she was playing with other children. This forced her to lie down on the ground.
  - Frothy secretions started coming through her mouth and nose, and she became unconscious. She also had convulsions and severe trouble breathing.
- Patient #1 died on the way to a hospital.

Patient #2

- A boy aged 3 years was brought to the emergency room presenting with severe trouble breathing and frothy secretions coming from the mouth and nose.
  - The child was semiconscious and gradually became unconscious.
  - His pupils were pinpoint (very small) and not reacting to light.
  - His whole body was sweaty, cold, and clammy.
  - His heart rate and breathing were fast (pulse 179 beats/min, respiratory rate 62 breaths/min), and his lungs were full of fluid.
  - The patient was provided oxygen and intravenous fluids. He received atropine, antibiotics, and steroids.
- Patient #2 recovered completely.

Patient #3

- A girl about 8 years of age was brought to the emergency room at 8.30 a.m.
  - The patient presented with severe trouble breathing, frothy secretions coming from the mouth, and loss of control of bowels.
  - Her pupils were pinpoint.
  - The patient was provided oxygen and intravenous fluids. She received atropine, antibiotics, and steroids.
- Patient #3 recovered completely.

Toxidrome

- The team reviews a list of classic toxidromes to see if one of these matches with the clinical picture.

Toxidrome	Signs and Symptoms	Potential Toxic Agent
Opioid	Lethargy, miosis, respiratory depression Can progress to coma, pulmonary edema, hypotension, bradycardia.	Opium/snuff, heroin, prescription medications, codeine, hydro/oxycodone, hydro/oxymorphone, fentanyl, desomorphine (aka krokodil)
Anticholinergic	Cutaneous flushing, hyperthermia, dry skin, dry mucous membranes, disorientation, hallucination, seizures, tachycardia, hypertension, urinary retention	*Belladonna* alkaloids, jimsonweed/*Datura sp.,* angel's trumpet/*Brugmansia sp.,* diphenhydramine
Hallucinogen	Disorientation, hallucination, panic	Peyote cactus, psilocybin-containing mushrooms, lysergic acid diethylamide (LSD), phencyclidine (PCP), lysergic acid–containing plants (e.g., morning glory, Hawaiian woodrose)
Sympathomimetic	Tachycardia, hypertension, hyperthermia, diaphoresis, mydriasis, hyperreflexia, anxiety, seizures	Amphetamines, cocaine, *Ephedra sp.* ("ma huang," Mormon tea) and ephedrine, khat (*Catha edulis)* and other cathinones (e.g., "bath salts")
Cholinergic	Salivation, diarrhea, lacrimation, bronchorrhea, diaphoresis, urination, miosis, fasciculations, weakness, bradycardia or tachycardia, hypotension or hypertension, altered mental status, seizures	Nicotine, organophosphate insecticides, carbamate insecticides, medicinal carbamates (e.g., physostigmine)

Do any of these toxidromes match the clinical picture for this outbreak?

(Reminder: There is a Toxidromes Chart in the Tool Kit.)

Toxidrome (continued)

- The team decides that the illness most closely resembles a cholinergic crisis.
- Based on this, and because the outbreak occurred in a farming region, they narrow their focus to organophosphate and carbamate insecticides.
- The team interviews local farmers and family members to figure out what insecticides are used in the area.

What are some questions you might ask farmers?

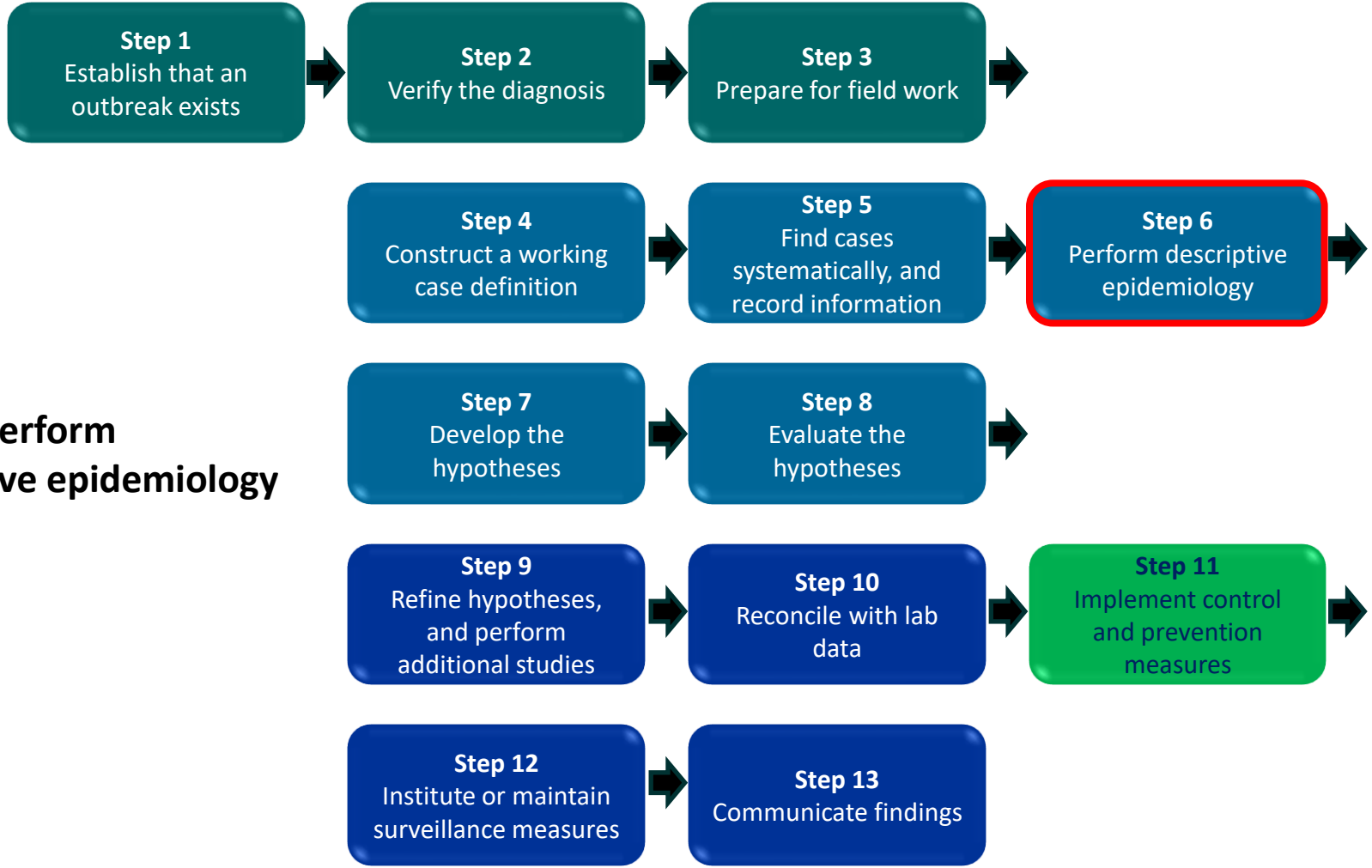
Hypothesis-Generating Interviews

- Some questions you could ask of farmers include the following:
  - What types of insecticides are used in farming in this area?
  - How are those insecticides used?
  - Have there been any recent changes in insecticide use in the area?
  - When was the last time those insecticides were applied?
  - Where were the insecticides purchased?
  - Where are the insecticides stored?
- **Reminder**: There is a Qualitative Epidemiological Questions job aid in the Tool Kit.

Hypothesis-Generating Interviews (cont.)

- Several farmers report spraying chemicals on their fields to help keep the pests away.
- Two insecticides that are reported by multiple farmers include carbofuran and diazinon.

Chemical	Purpose	Application
Carbofuran	• Rice paddy • Home vegetable gardens	• Purchased in pellet form • Mixed in a large bowl with urea and thrown by hand into wet paddy fields
Diazinon	• Rice paddy • Home vegetable gardens	• Mixed with urea and spread on paddy field by hand • Mixed with topsoil in vegetable gardens • Mixed with water and sprayed on rice paddy fields



Step 6: Perform descriptive epidemiology

Descriptive Epidemiology

- The team then summarizes the data they collected during the case finding and hypothesis-generating interviews by
  - Person
  - Place
  - Time

Summarizing by Person

- Investigators refer to the line list they created and summarize demographic characteristics of the case-patients. Those data are summarized below.

		Number of cases (N=11)
Age	≤1 year	1
	2–3 years	4
	4–6 years	3
	7–9 years	2
	≥10 years	1
Sex	Male	4
	Female	7
Village	A	10
	B	1

What can you conclude? What additional information might be helpful in interpreting these data?

Summarizing by Person (continued)

- The highest number of cases were among
  - Children aged 2–6 years
  - Females
  - Children who lived in village A
- Based on these findings, you might do further informal data collection to identify particular characteristics and activities of children in these groups.

Symptom Frequency

- The team describes symptom frequency:

Symptom	n	%
Cold Skin	10	91
Excessive sweating	9	82
Frothy secretions	9	82
Weakness in arms or legs	8	73
Loss of consciousness	7	64
Difficulty breathing	5	45
Convulsions	5	45
Fatigue	5	45
Fever	3	27
Vomiting	3	27
Confusion	3	27

Observations

- The team performs observations in Village A to identify ways in which children could have been exposed to pesticides.
- They note that the village consists of a cluster of houses surrounded by a rice paddy and vegetable fields.
- The team also follows a small number of children around for the morning and observes the types of activities they perform.
- They choose the morning hours because that is when most affected people became ill.

Observational Summaries

- Children spend most of their time playing outside, in and around mud piles.
- Children spend unsupervised time outdoors.
- Children sometimes eat unripe mangoes that fall on the ground overnight. The mangoes are not washed before eating.

Summarizing by Place – Village A Map

- They draw a map of village A so they can better visualize where the children with cases resided.

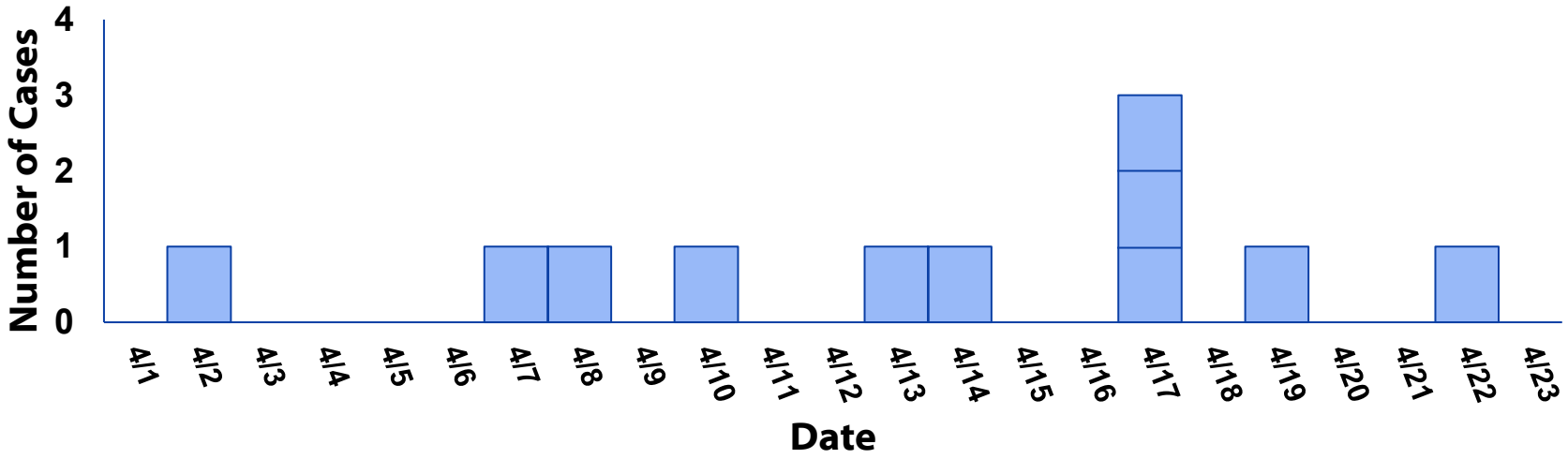
What can you conclude?

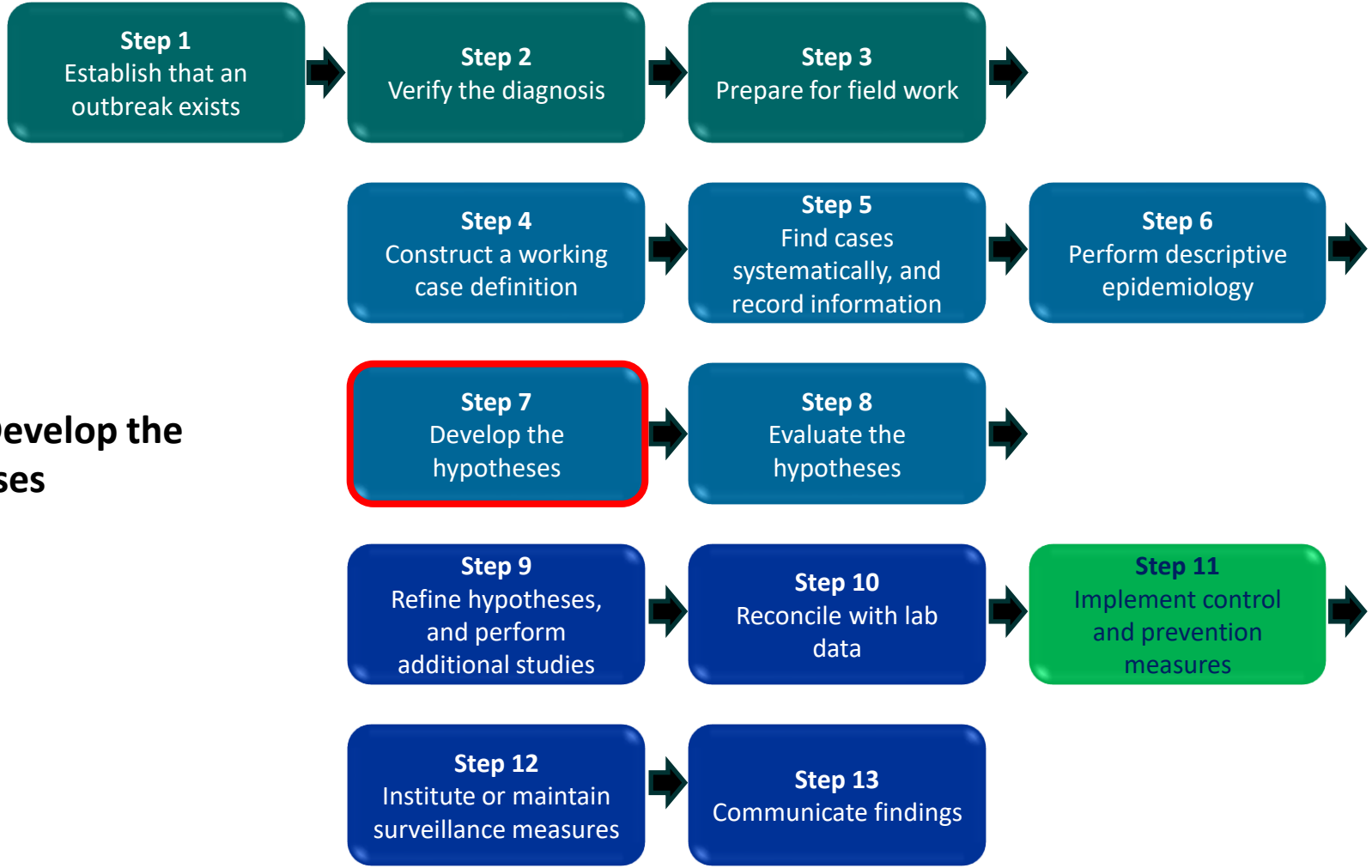
Summarizing by Place

- Most, but not all, cases occurred in households near the grass and chili fields.
- The information on the map is difficult to interpret because it does not necessarily reflect where the children spent the most time.

Summarizing by Time

- The team constructs an epi curve.



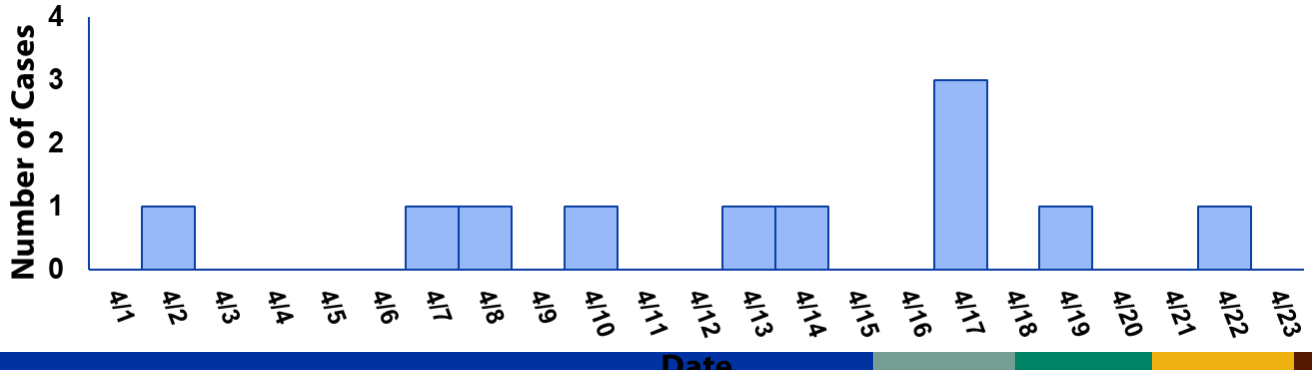


Step 7: Develop the hypotheses

Develop Hypothesis: Etiologic Agent vs. Exposure

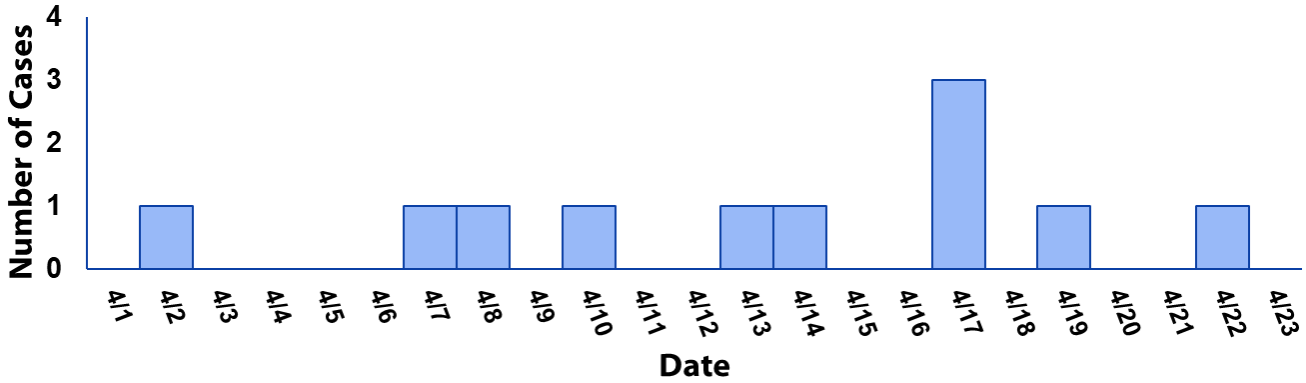
- The team previously developed a hypothesis that the etiologic agent might be an organophosphate or carbamate insecticide.
- They would like to develop a hypothesis for what exposure caused the outbreak.

What is one hypothesis you might draw from the epi curve?



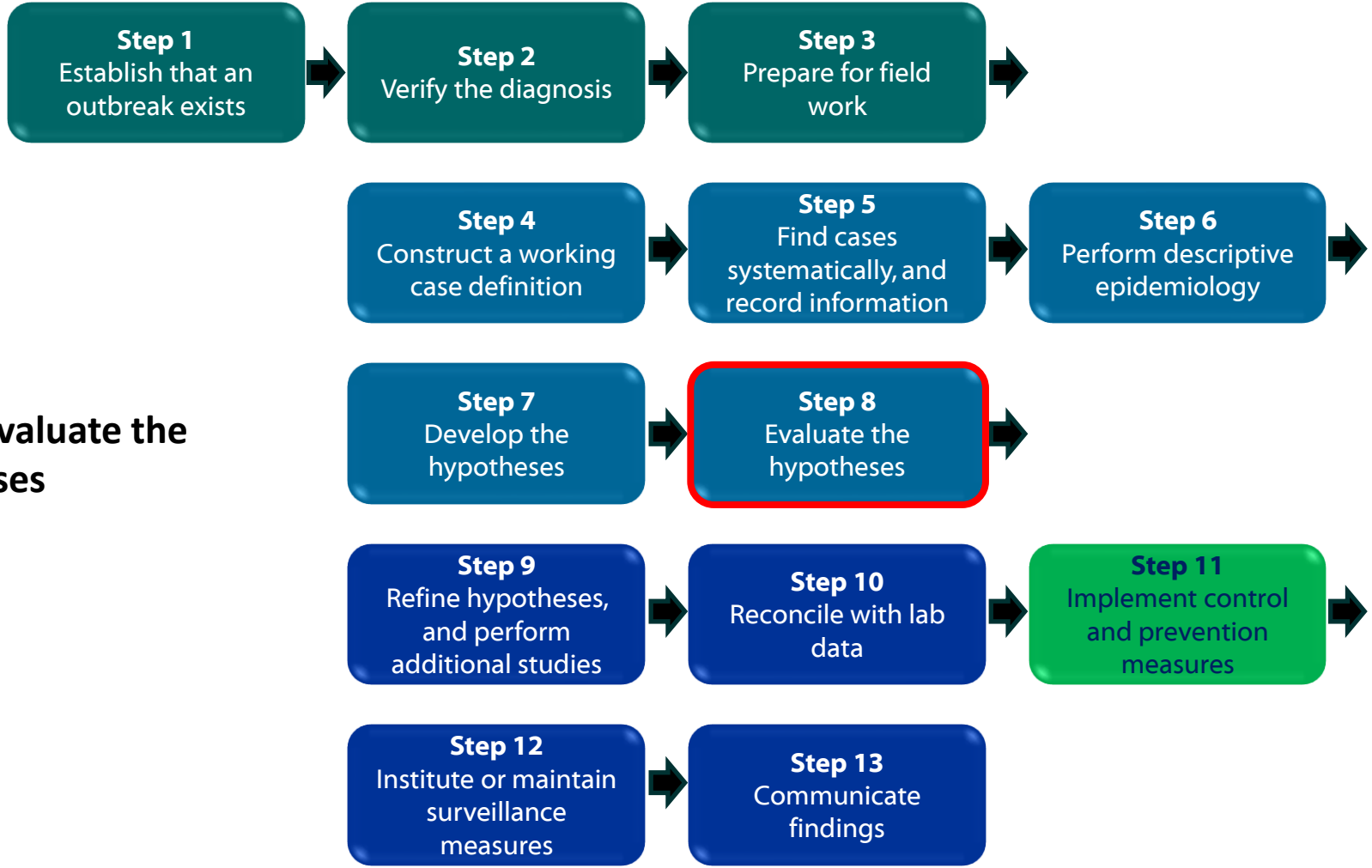
Develop Hypothesis

- Based on the epi curve, it does not appear that all children were exposed during a single event.
- If that had been the case, we would have expected the cases to have occurred within a shorter range of time.
- Thus, they hypothesize the risk must have been present in the environment over a period of time.



Develop Hypothesis (Continued)

- The team hypothesizes that there was not a single exposure that caused the illness but rather an exposure that occurred multiple times.
- Based on their observational summaries, they decided to focus their investigation on
  - exposure to mud or
  - exposure to eating food that has dropped to the ground



Step 8: Evaluate the hypotheses

Evaluating Hypotheses

- Once you have developed hypotheses, the next step may be to conduct an epidemiologic study to evaluate these hypotheses.
- One consideration in planning a study relates to selecting an epidemiologic **study design**. Two commonly used study designs include cohort studies and case-control studies, although other study designs can be used.

Cohort study

Case-control study

- Another consideration in planning a study relates to **data sources**. A typical investigation involves collecting questionnaires, medical records, and laboratory data.

Questionnaire data

Medical records data

Laboratory data

Evaluating Hypotheses

What type of study design would you use? Why?

Case-Control Study

- The team conducts a case-control study because it would be difficult to clearly define a cohort, and a case-control study could be conducted quickly and efficiently.

What would you consider when selecting controls?
How would you select controls?

Case-Control Study (cont.)

- Controls need to be carefully selected.
- The distribution of exposure among control participants should represent the distribution of exposure in the **source population.**
- Selection as a control participant should be independent of exposure status (within any matching strata). This can require careful thought.
- In this case, because all cases occurred in children, you could consider children in the area as the source population.

Would you use matching when selecting controls? Why or why not?

Case-Control Study (cont.)

- The purpose of matching is to allow more efficient control for confounding.
- You cannot assess associations with any matching variable.
- Be sure not to match on the exposure of interest (intentionally or unintentionally).
- Special kinds of analysis are needed if matching is used.
- In this case, because the age distribution of the cases is somewhat distinctive and age could be a confounder, it might be helpful to match on age.
- The team decides to match on age (in categories based on what children tend to do during the day) and aims to enroll three controls for every one case.
- They select controls from randomly selected homes in the village and aim to get a similar percentage of children in each category for cases and controls (called frequency matching).

Questionnaire Development

- The team needs to develop an epidemiologic questionnaire to collect data for the case-control study, including data on potential exposures.
- There is a sample questionnaire in the Tool Kit that can serve as an example, but the questionnaire needs to be tailored to each situation.

How would you ask about exposure to mud on the questionnaire?

Questionnaire Development

- When designing questions about mud exposure, consider the following:
  - In addition to asking about what the cases were exposed to, attempt to quantify how much exposure occurred.
  - Be sure to clearly state the time frame during which you are asking about exposure. In this case, questions should focus on the period right before the illness occurred for cases and on a similar time frame for controls.
- The team decides to ask the following questions about mud exposure:
  - Did your child play in mud on [date]?
  - If yes, how long did your child play in mud on [date]?

Biologic Sample Collection

- Most organophosphate and carbamate insecticides have short half lives in blood, ranging from hours to days.
- The team decides to do those measurements on the samples collected from the cases at the start of the investigation (close to their illness onset times).
- The team decides to also collect blood samples from controls, to serve as a comparison group.

Could there be any concerns related to this plan for collection of comparison samples?

Biologic Sample Collection

- If the time frames during which blood samples are collected from cases and controls are very different, it might be difficult to determine whether any differences between test results for cases and controls might be due to the difference in the timing of sample collection rather than to case status.

Environmental Sample Collection

- The investigators decided to collect mud samples and samples of mangoes that had fallen to the ground.

How would you choose where to collect mud and mango samples from? What are some factors to consider when making this decision?

Environmental Sample Collection (cont.)

- Collect two types of samples:
  1. Samples that seem to be associated with illness (for example, the mangoes that cases ate prior to becoming ill or the mud that children were playing with before they became ill)
  2. Samples that do not seem to be associated with illness (for example, samples from a different part of the village)
- Collect samples based on what case-patients would have been exposed to.
  - For example, if children were playing on a large mud pile, then it would make more sense to collect samples from the surface of the pile (or just below the surface) as opposed to sampling from the very bottom of the mud pile.
- When interpreting the results, it might again be important to consider the timing of sample collection relative to when the cases occurred.

Case-Control Study (cont.)

- The team collected epidemiologic data from 11 cases and 29 controls.
- Here are data relating to exposure to mud:

Play in mud?	Case	Control
Yes	9	9
No	2	20
Total	**11**	**29**
% exposed	**82%**	**31%**

How would you assess the strength of the association between mud exposure and case status?

Case-Control Study

- Because this was a case-control study, you cannot calculate risks or a risk ratio. Instead, you would calculate an odds ratio.

		Outcome: Yes (case-patient)	Outcome: No (control)
Exposure	Yes	a	b
	No	c	d
		a+c	b+d

Crude Odds Ratio=

$$\frac{Odds\ of\ exposure\ among\ patients}{Odds\ of\ exposure\ among\ controls} = \frac{a/c}{b/d} = \frac{ad}{bc}$$

- If there is no association between exposure and disease, then the odds ratio will be close to 1.0.
- The further the odds ratio is from 1.0, the stronger the association between exposure and disease.
- Because controls were frequency matched to cases on age, the analysis would need to control for age (either using stratification or logistic regression modeling).

Case-Control Study (cont.)

Play in mud?	Case	Control
Yes	9	9
No	2	20
Total	**11**	**29**
% exposed	**82%**	**31%**

$$Odds\ of\ playing\ in\ the\ mud\ among\ cases = \frac{9}{2}$$

$$Odds\ of\ playing\ in\ the\ mud\ among\ controls = \frac{9}{20}$$

$$\text{Crude Odds Ratio} = \frac{\frac{9}{2}}{\frac{9}{20}} = \frac{9*20}{2*9} = \frac{180}{18} = 10$$

Can we conclude that playing in mud caused the outbreak?

Case-Control Study

- The crude odds ratio of 10 suggests a strong association between playing in mud and becoming a case.
- Because the controls and cases were matched on age, it would be important to control for age in the analysis. However, the OR after controlling for age would be expected to be greater than or equal to the crude OR.
- Nevertheless, it is possible the observed association could be confounded by a factor (a risk factor for disease that is associated with playing in the mud) other than age.
- Evidence implicating the mud would be strongest if we can detect high levels of insecticide in the mud where children were playing.

Step 1
Establish that an outbreak exists

Step 2
Verify the diagnosis

Step 3
Prepare for field work

Step 4
Construct a working case definition

Step 5
Find cases systematically, and record information

Step 6
Perform descriptive epidemiology

Step 7
Develop the hypotheses

Step 8
Evaluate the hypotheses

Step 9
Refine hypotheses, and perform additional studies

Step 10
Reconcile with lab data

Step 11
Implement control and prevention measures

Step 12
Institute or maintain surveillance measures

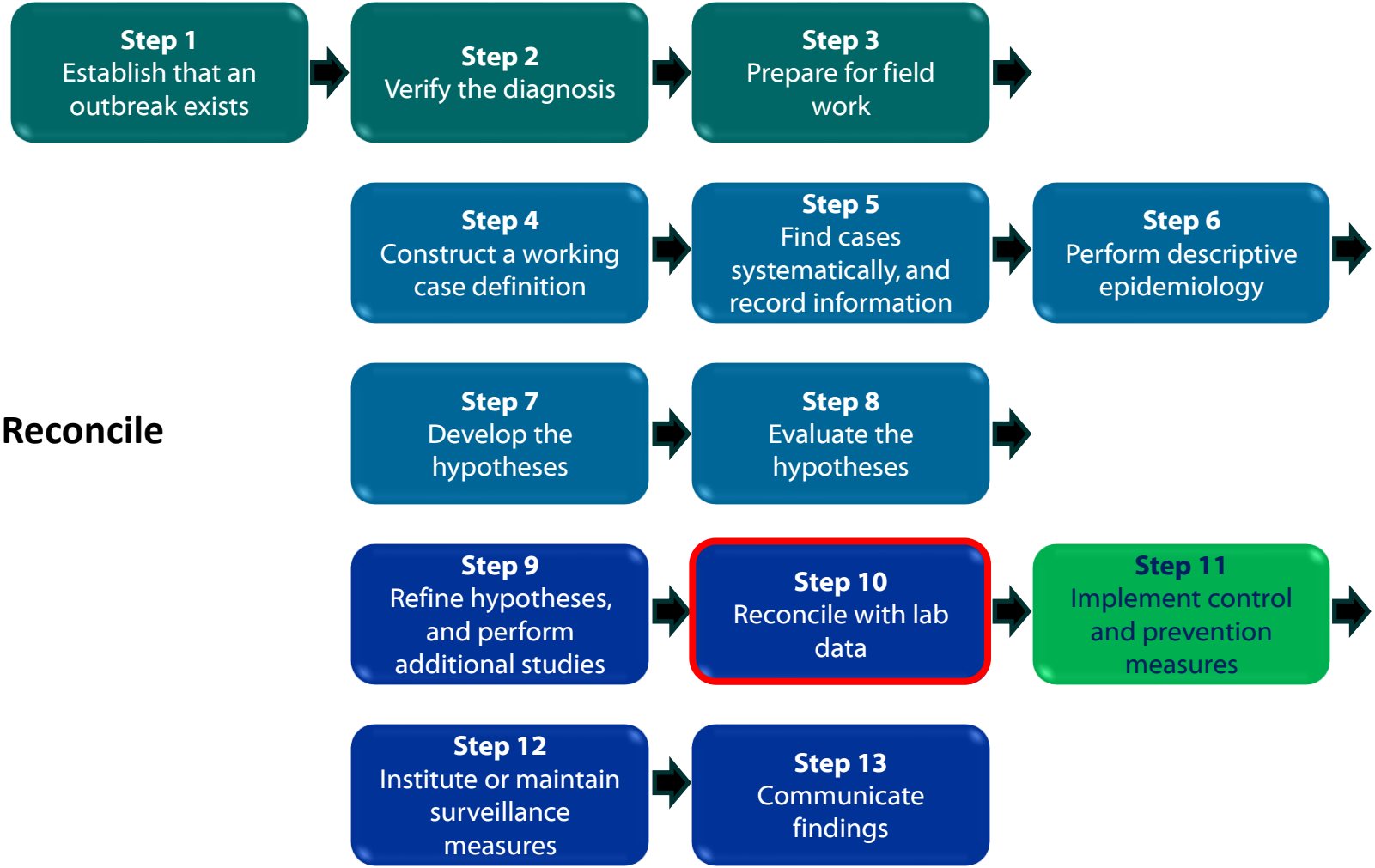
Step 13
Communicate findings

Step 9: Refine hypotheses and perform additional studies

Refine Hypotheses and Perform Additional Analyses

- Based on the initial findings, the team might want to conduct more detailed analyses relating to mud exposure (e.g., dose-response analyses).
- The team asks the laboratory to test the blood samples collected from cases and controls, and the environmental samples, for carbofuran and diazinon which are carbamate insecticides that are sold in the nearby market.

Step 10: Reconcile with lab



Reconcile with Laboratory and Environmental Data

- The team examines the results of testing done on the serum samples.

Chemical	Cases (n=7)	Controls (n=13)
Carbofuran		
% Detected	29%	0%
Range	9.5 to 1061	<LOD
Diazinon		
% Detected	0%	0%
Range	<LOD	<LOD

Carbofuran was detected in only 29% of serum samples from case patients. What might be some reasons for that?

Interpreting Biological Sample Results

- Some people who were ill might have had serum carbofuran levels that were below the limit of detection for the test.
- Carbofuran might have already been eliminated from the body when the blood was drawn in some cases.

- Carbofuran has a very short half-life in the body, so the team decides to stratify on how soon the blood sample was collected after presentation to the hospital.
  - The two samples that were collected within two hours of hospital presentation had detectable levels of carbofuran.
  - The seven samples that were collected >10 hours after hospital presentation did not have detectable levels of carbofuran.

	<2 hours (n=2)	**>10 hours (n=5)**
Carbofuran		
% detected	100%	0%
Range	9.5-1061	<LOD

Interpreting Biological Sample Results

- These data suggest that carbofuran may be the etiologic agent that caused the illness, because
  - Levels are higher in cases than controls.
  - Case samples in which carbofuran was not detected were collected more than 10 hours after illness onset, and carbofuran might have already been eliminated from the body.
- Not much is known about how much carbofuran is required to be ingested before it causes illness. However, from the little data that does exist, it appears that the levels in the biologic samples from the two cases were high enough to cause the toxic syndrome that was seen.

Environmental Sample Results

- The investigators also receive data from testing done on the environmental samples that had been collected.
- The table below shows carbofuran and diazinon levels in various environmental samples collected from locations possibly associated with case-patients.

Type of Sample	Carbofuran (µg/kg)	Diazinon (µg/kg)
Mango #1	<LOD	<LOD
Mango #2	<LOD	<LOD
Mango #3	<LOD	<LOD
Mango #4	<LOD	<LOD
Soil #1	68	<LOD
Soil #2	0.8	<LOD
Soil #3	417	<LOD
Soil #4	0.3	<LOD

Interpreting Environmental Sample Results

- None of the environmental sample test results seem to be high enough to have made the children sick. The highest level detected was 417 ug/kg of soil.
- Based on previous information, this level would not necessarily be expected to cause the illness that was observed, even if the children ate a couple of tablespoons of soil.
- Similar levels were found in samples collected from locations not associated with case patients.

What are some possible reasons why the levels were not that high in the environmental samples associated with case patients?

Interpreting Environmental Sample Results

- Toxic agents are not always distributed evenly throughout media. We do not know if these values are representative of what children were exposed to.
- The carbofuran could have broken down or washed away before these samples were collected.

Conclusions

Given this information, the investigators conclude

- The etiologic agent was carbofuran, due to
    - Levels were higher in serum from cases compared to controls.
    - Levels were higher when serum was collected immediately after illness.
- The source of exposure is unknown, although there is some evidence that playing in the mud might have been a factor.
    - Mud samples that were tested might not reflect levels in the mud to which children were actually exposed.
    - Alternatively, playing in the mud might be a marker of another source of exposure (e.g., air or water) that might have been associated with playing in the mud.
- It is possible that there was not a single exposure source, but rather children may have been exposed in various ways, even in the same village.

Step 1
Establish that an outbreak exists

Step 2
Verify the diagnosis

Step 3
Prepare for field work

Step 4
Construct a working case definition

Step 5
Find cases systematically, and record information

Step 6
Perform descriptive epidemiology

Step 7
Develop the hypotheses

Step 8
Evaluate the hypotheses

Step 9
Refine hypotheses, and perform additional studies

Step 10
Reconcile with lab data

Step 11
Implement control and prevention measures

Step 12
Institute or maintain surveillance measures

Step 13
Communicate findings

Step 11: Implement control and prevention measures

Implement Control and Prevention Measures

- Cases had stopped occurring prior to the team's arrival, and no further cases occurred during their investigation.
- It appeared that whatever the source of carbofuran was in the environment, it had likely gone away. Perhaps a recent rainstorm had washed away pesticide residue from the fields. Thus, there was not an urgent need to immediately implement control and prevention measures.
- However, longer-term prevention measures might still be needed.
- Farmers are not likely to stop spraying potentially toxic chemicals on their fields, because not using these chemicals could mean that pests could destroy crops, and families would not have enough food to eat.

What are some possible control and prevention measures that could be considered?

Possible Control and Prevention Measures

- Educate farmers and village residents about necessary precautions relating to pesticides.
  - Wash fruits and vegetables before eating them.
  - Follow instructions for proper use of pesticides, do not apply too much, and wear proper protective equipment.
  - When a pesticide is applied, keep children away from the area for at least a couple of days.
- More investigation into how pesticides were being used in the area and any recent changes in pesticide use could help identify specific aspects of pesticide use to address in prevention measures.

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Step 12: Institute or maintain surveillance measures

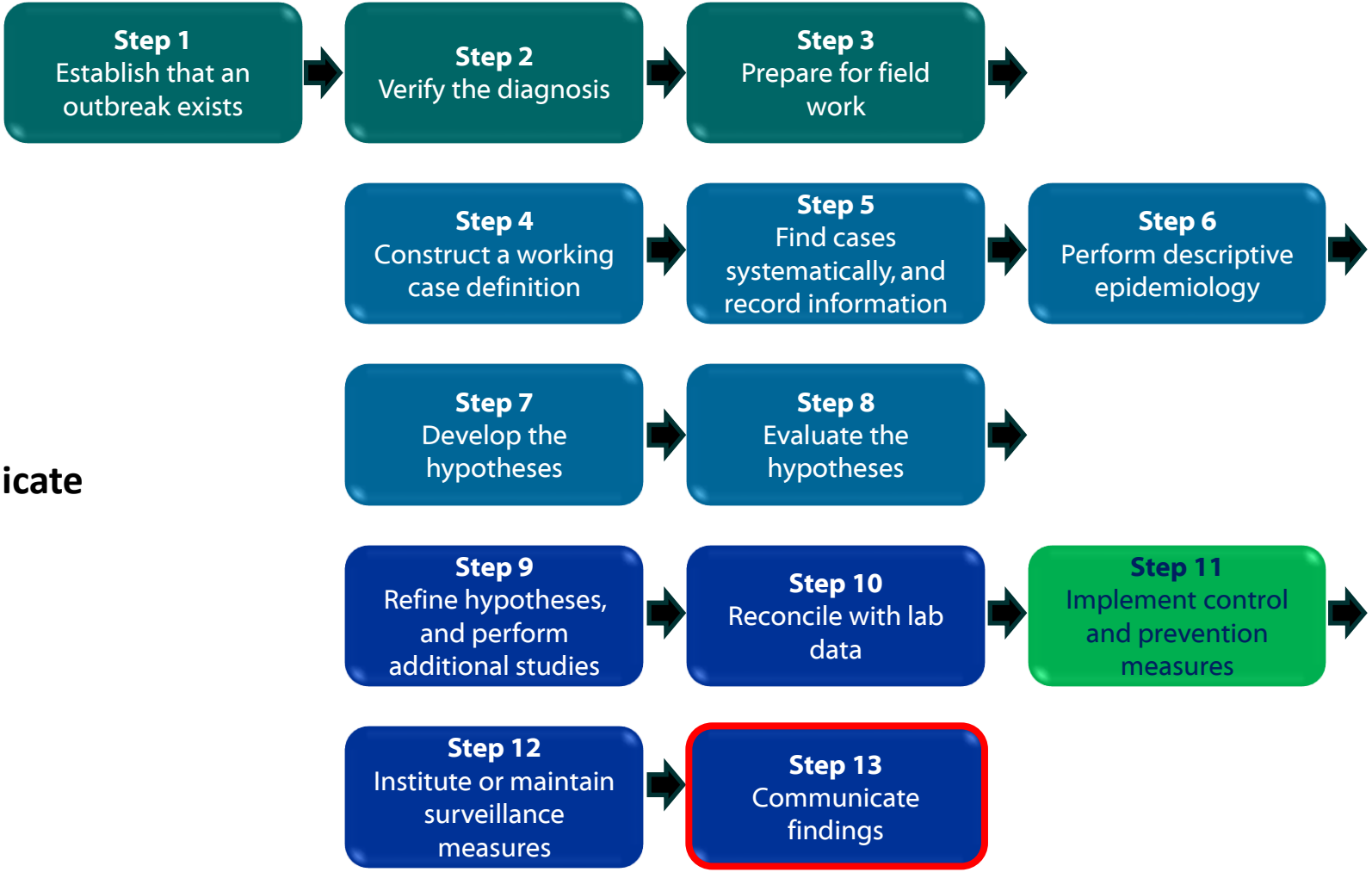
Surveillance

- The team meets with local public health leaders to discuss whether they should initiate surveillance.

What would be the pros and cons of initiating surveillance?
What might be some ways of conducting surveillance?

Surveillance (cont.)

- Surveillance could help quickly identify future illnesses that could be associated with pesticide exposures. This could allow measures to be put in place (e.g., public warnings) to prevent additional illnesses.
- One possible type of surveillance might be to ask healthcare facilities in the area to report cases of illnesses meeting a specified case definition to local public health authorities.
- Surveillance would require communication of the case definition and reporting procedures to healthcare facilities. It would also require coordination of data collection and information sharing. That could require substantial resources.



Step 13: Communicate findings

Communicate Findings

- The team communicates their findings to the local community.
- They know the community will want to know why carbofuran was not detected in all cases.

Develop some talking points to explain why carbofuran was not detected in all cases.

Communicate Findings (cont.)

- Pesticides are metabolized and eventually leave the body.
  - Not all cases had biologic samples collected immediately upon presentation to the hospital.
  - Carbofuran does not stay in the body very long, and it may have already been eliminated from the body before some of the samples were collected.
- If very small amounts of carbofuran can make a person sick, the testing method might not have been able to detect amounts that were still enough to cause illness.

Resources

- Abstract on investigation:

  Martin, et al. Investigation of an outbreak of unintentional acute pesticide poisoning: assessment of exposure to carbamate and organophosphate insecticides, rural Bangladesh, 2009. Epidemiology. 2011;22(S1):S115.

Questions?

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