



# Steps of an outbreak investigation

Robert Koch Institute, Berlin  
Department for Infectious Disease Epidemiology

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REGIONAL OFFICE FOR

**World Health  
Organization**

**Europe**



BUREAU RÉGIONAL DE L'

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**Europa**



**Всемирная организация  
здравоохранения**

**Европейское** региональное бюро

# Learning objectives

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*After this session, participants will be able to:*

- Know in detail the steps of an outbreak investigation as stated in the Outbreak Investigation and Response (OIR) guidelines for the Republic of Kyrgyzstan and be able to apply these steps in real outbreak situations
- Be able to use the outbreak investigation forms as suggested in the Annexes to the OIR Guidelines

# Scope and purpose of the National OIR Guideline

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- Operational guidance on how to practically respond to infectious disease outbreaks in the Republic of Kyrgyzstan
- Step-by-step instructions on how to investigate and respond to the outbreaks
- Target audience: rapid response teams, public health specialists (national and regional), post-diploma students, teachers, students
- Focus on the investigation and response to communicable diseases

# National OIR Guideline structure

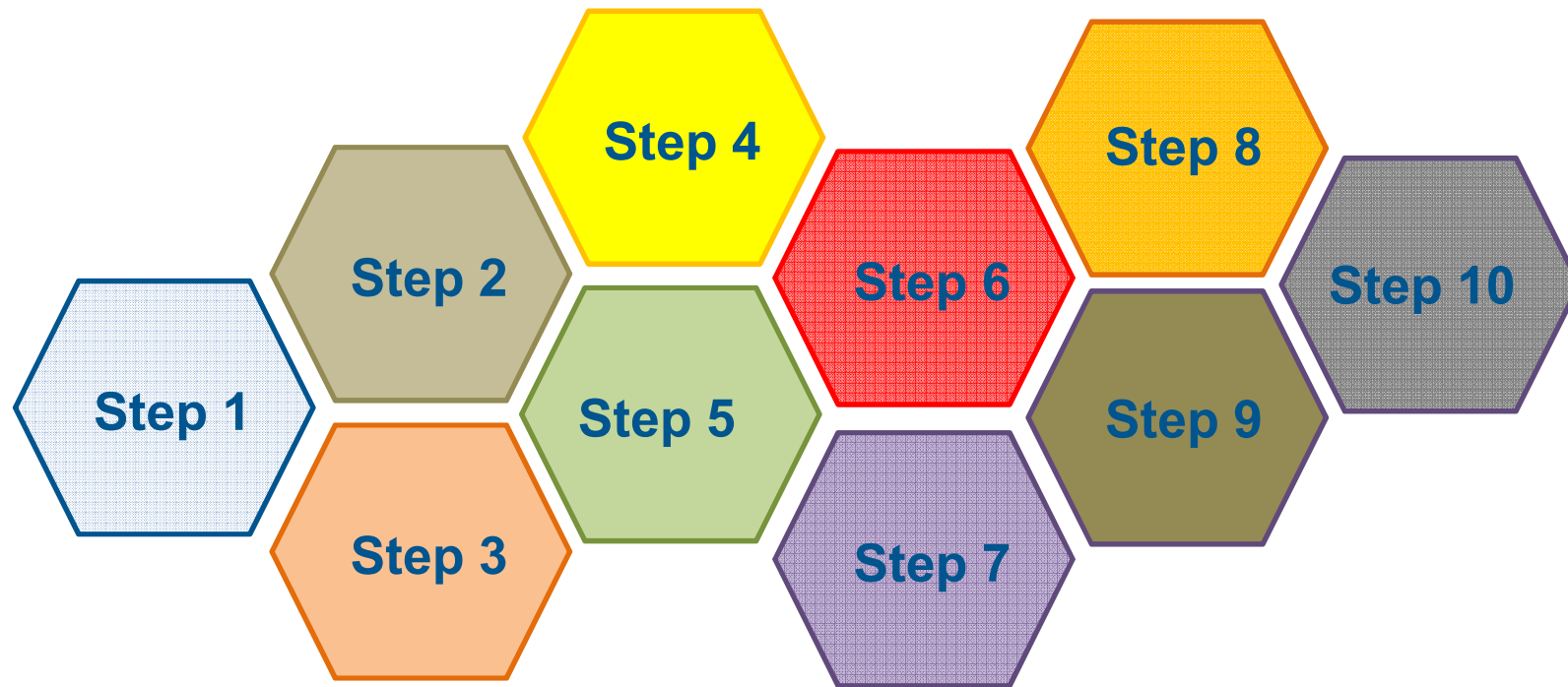
- Introduction
- Outline of the guideline
- Policy and legal context
- Review of investigation and response to outbreaks
- Steps of outbreak investigation
- Characteristics of investigation of the outbreak by route of transmission
- Communication and social mobilization of the population
- Annex 1: Regulatory, legal acts and other documents
- Annex 2: Line list form example
- Annex 3: Rapid risk assessment form
- Annex 4: Guidelines for extra-ordinary reports linked to outbreaks
- Annex 5: Annex 2 of IHR (2005)
- Annex 6: Questionnaire samples
- Annex 7: Laboratory sample collection
- Annex 8: Structure for outbreak report
- Annex 9: Examples of outbreak reports

# National OIR Guideline structure

- Introduction
- Outline of the guideline
- Policy and legal context
- **Review of investigation and response to outbreaks**
- **Steps of outbreak investigation**
- Characteristics of investigation of the outbreak by route of transmission
- Communication and social mobilization of the population
- Annex 1: Regulatory, legal acts and other documents
- **Annex 2: Line list form example**
- **Annex 3: Rapid risk assessment form**
- Annex 4: Guidelines for extra-ordinary reports linked to outbreaks
- Annex 5: Annex 2 of IHR (2005)
- **Annex 6: Questionnaire examples**
- Annex 7: Laboratory sample collection
- **Annex 8: Structure for outbreak report**
- Annex 9: Examples of outbreak reports

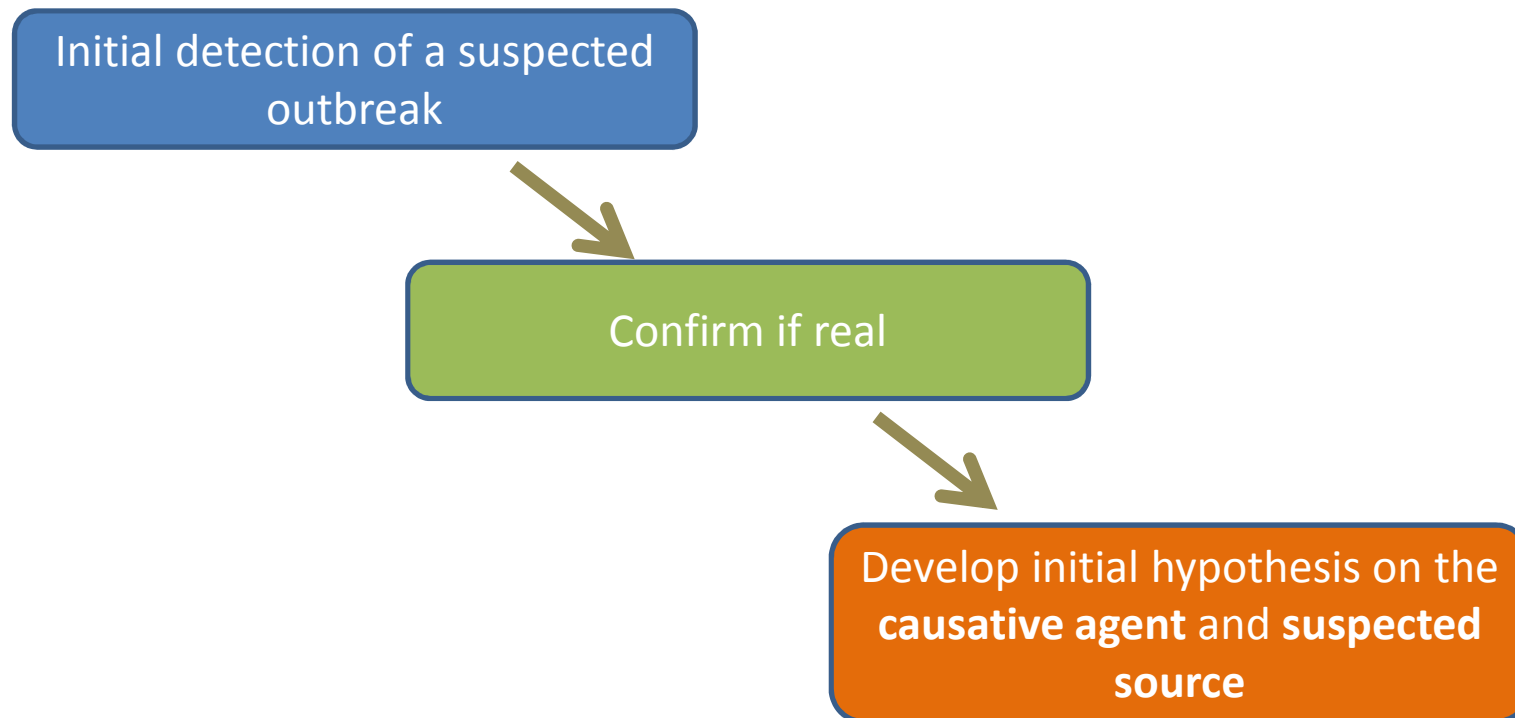
# Steps of an outbreak investigation

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# Confirm the outbreak

Step 1



# Confirm the outbreak

## Step 1

- If an increased frequency of a disease is observed locally and is obviously linked to a common source => easy to understand that it might be an outbreak
- Examples:
  - Several people got ill after attending a city fair and eating at a pirozhki stand there
  - Several cases of Salmonellosis among workers of a local factory who ate lunch on the same day at their canteen



# Confirm the outbreak

## Step 1

- If there is no obvious link between the cases, important to understand the following:

Is the number of cases more than usual for:

- This time of the year?
- This location/place?
- This group of persons?

# Preliminary investigation and response

## Step 1

### **At the district level the epidemiologist:**

1. Collects preliminary data by phone, electronically or in person
2. Receives information from the national surveillance system
  - “Tracking of infectious, parasitic diseases of the population and food safety” (AIS)
3. Analyses surveillance data
  - Compares number of cases for current week with number of previous week(s)
4. Communicates with other districts
  - Are similar cases registered or increasing number of such cases?
5. Prepares line listing on cases involved in the outbreak (Annex 2)
6. Conducts rapid risk assessment
  - “Questionnaire on rapid risk assessment” (Annex 3)
7. Organizes implementation of initial response measures (Step 9)
8. Prepares preliminary report and submits to higher levels (Annex 4)

# Preliminary data gathering

## Step 1

- the person(s) who made the diagnosis and reported the suspected outbreak/event,
- the doctors who have treated the ill persons
- local public health staff



Source of the pictures: <http://cliparts.co/computer-cartoon-images>; <https://www.graphicstock.com>

# Annex 2: Case Line Listing Form

Step 1

Village/town: Administrative – territorial unit: Total population of the affected locality: Region: Type of outbreak: Main signs and symptoms:													
ID number <sup>1</sup>	Name	Date of Birth	Sex	Address	Onset date	Date sought care	Date hospitalised	Diagnosis	Specimen collected	Lab results	Symptoms	Health status <sup>3</sup>	Remarks <sup>4</sup>

<sup>1</sup> **ID number** – is the number written on the Epidemiological Investigation Card of the patient

<sup>2</sup> **Symptoms** – it is recommended that a separate column be allocated for each symptom

<sup>3</sup> **Health Status** – 1) recovered; 2) illness ongoing; 3) hospitalized; 4) died

<sup>4</sup> **Remarks** – could include any relevant information to the current outbreak (e.g. immunization status in a vaccine preventable disease, outbreak, occupation, date of death or recovery, laboratory testing results, etc.).

# Suggested Form: Outbreak/Event Data Collection Form

Step 1

## **I. Details of receipt of report**

## **II. Details of person reporting outbreak**

## **III. Outbreak/event description:**

- Date onset of outbreak/event
- Outbreak / event location(s) (affected communities)
- How was outbreak identified?
- Number of cases and deaths (by community/location)
- Description of cases
- Address of outbreak setting (if restaurant, factory, school etc.)
- Is outbreak/event still ongoing?

## **III. Further information**

e.g. animal deaths?, suspected type of outbreak, central level notified?

## **IV. Control measures undertaken**

# Preliminary investigation and response

Step 1

## **At provincial level, the epidemiologist:**

1. Monitors outbreak investigation and organises prevention and control interventions at district level
2. Provides consultative-methodological support
3. If needed, communicates with other provinces
  - Are similar cases registered or increasing number of such cases?
4. Summarises and reports information on the outbreak to national level

# Preliminary investigation and response

## Step 1

### **At national level, the epidemiologist:**

1. Provides distant consultative-methodological assistance.
2. If needed, communicates with other provinces or neighboring countries
  - Are similar cases registered or increasing number of such cases?
3. Within 24 hours, sends information about all events to the National Coordinator on IHR, who then reports to or consults WHO according to Annex 2 of the IHR (2005) (Annex 5).

### Also?

- Analysis of national surveillance data – detection of national outbreaks
- Undertake analytical studies e.g. case control study
- Conduct national risk assessment

# Rapid risk assessment

Step 1

What is the risk?



What is the level of risk?



Which actions need to be taken?  
At what level?  
How quickly?



# Annex 3: Rapid Risk Assessment Tool

## Step 1

<b>Assessment is conducted by the epidemiologist at district and national levels:</b>	Yes	No	Don't know
1. Is the event unusual/unexpected in the community? (e.g. unknown origin, highly pathogenic, unusual / unexpected disease for that area, or higher-than-expected morbidity/mortality)			
2. Does the suspected disease/agent have a high potential for spread? (a large, rapidly growing outbreak, or a highly contagious disease – measles, cholera, etc.)			
3. Are there disease cases among health care workers?			
4. Are there dead cases?			
5. Could the disease be caused by a contaminated commercially available product? (e.g. a food item or bottled water)?			
6. Are there any ill persons who have travelled to/from another country?			
7. Are there both human AND animal illness/death cases?			

# Annex 3: Rapid Risk Assessment Tool

## Step 1

### Perception for this event

Is the outbreak / event causing any political concern/attention from mass media? ☐ Yes ☐ No

☐ Unknown

If yes, describe.....

### Guidance on assessment

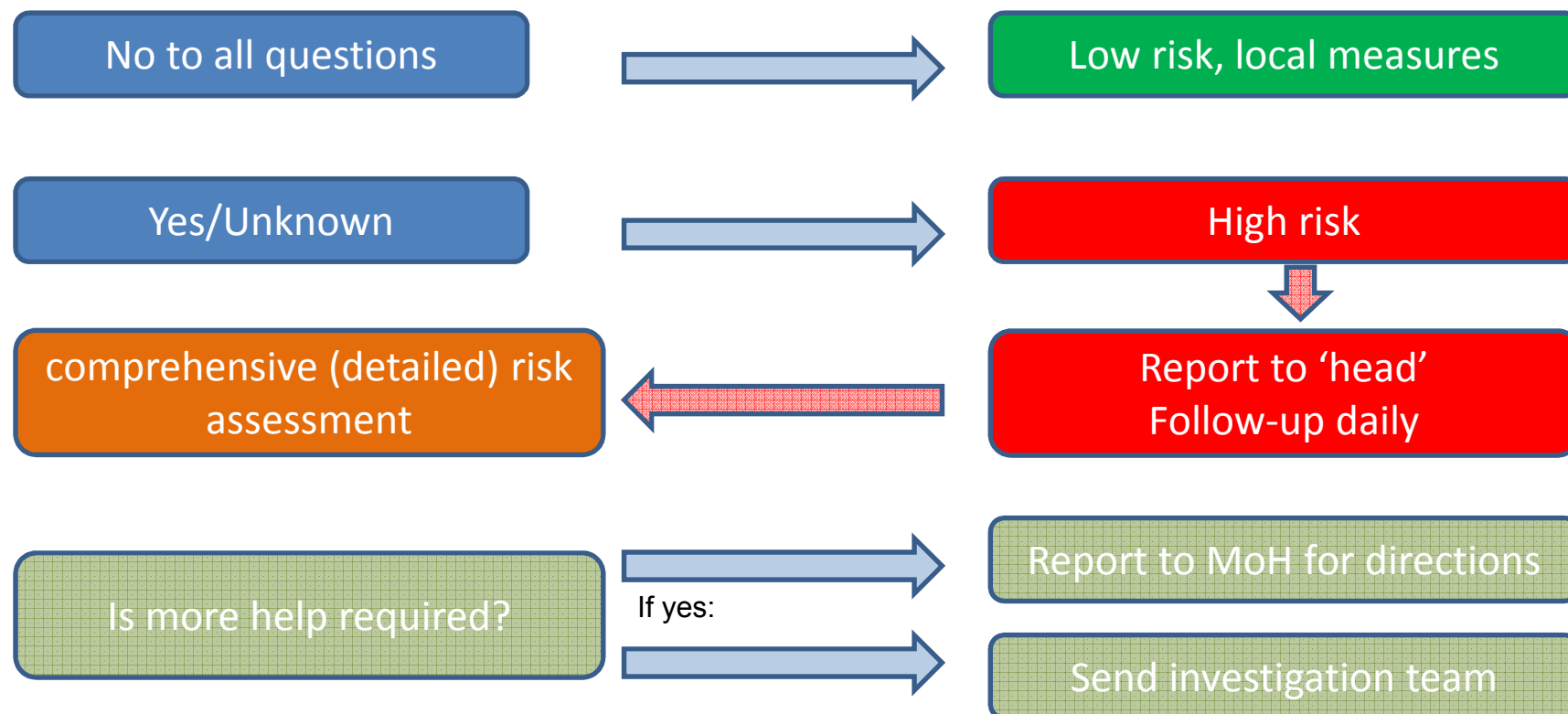
If you answered “**No**” to all above-listed questions, → release this event from control and keep records

If you answered “**Yes**” or “**Unknown**” to one of above-listed questions, this event is considered as “urgent”, → it is necessary to report to ‘head’ and follow-up daily with district or province for further information.

- Use the line list for the initial descriptive analysis
- If needed → collect additional data

# Rapid Risk Assessment Tool

Step 1



# Reasons to send RRT

Step 1

## **Objectives:**

- Identify the source of the outbreak
- Prevent additional cases

## **Also:**

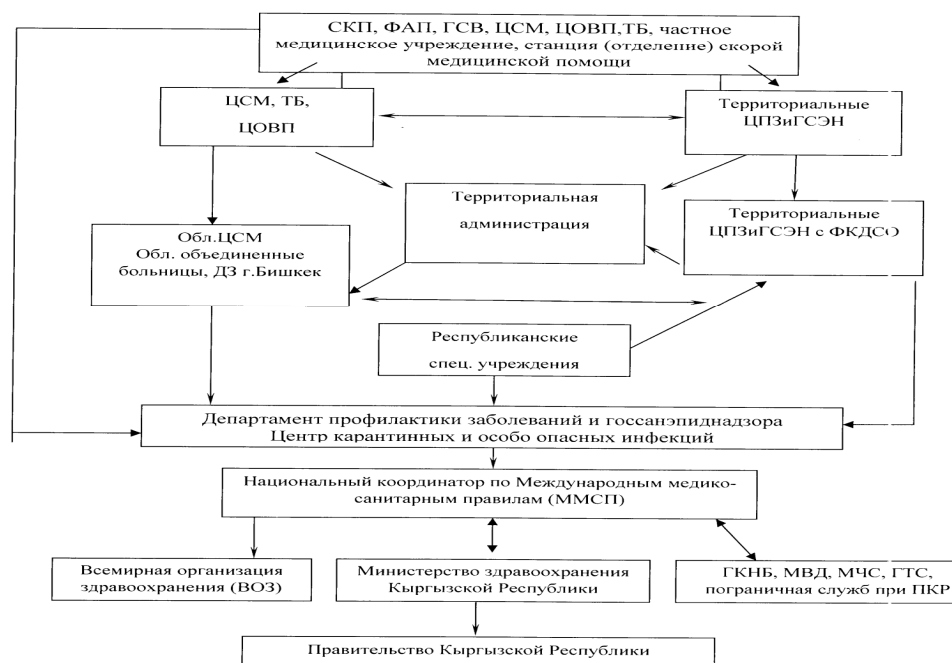
- To provide technical input on the investigation and management of the outbreak
- When it is a new disease about which there are little data
- When there is public anxiety or political concern
- As an opportunity to train staff (such as field epidemiology trainees)

# Reporting outbreaks and other public health events I

## Step 1

Приложение 2  
к приказу МЗ КР  
№ \_\_\_\_ от \_\_\_\_ 2015 года

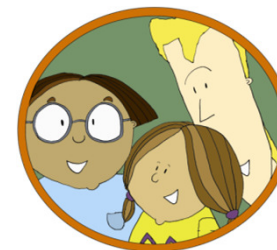
### СХЕМА оповещения при выявлении больного (группа) или подозрении на высокопатогенный птичий грипп, коронавирусную инфекцию (ГОРС, БВРС-КоВ)



# Reporting outbreaks and other public health events II

Step 1

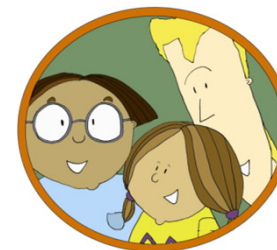
- Outbreak detected at district level: information is submitted to higher level according to national legislation (Decree No. 227)
- Mandatory epidemiological investigation not later than 24 hours from the receipt of the emergency notification (Order No. 610)
- Report to other Ministries and Agencies according to risk assessment
- Consider if need to report to WHO under the International Health Regulations (2005): within 24 hours



# Exercise: Disease detectives

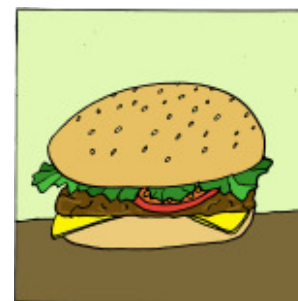
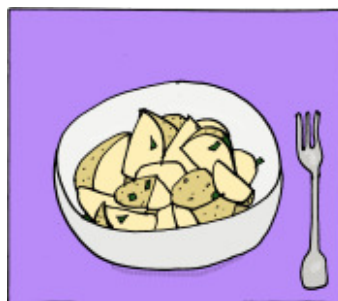
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- <http://www.disease-detectives.org/Welcome.html>
- Free of charge comics and a card game
- Methods needed to conduct an outbreak investigation
- Authors: Esther Kissling, Florian Burckhardt

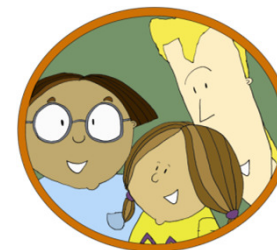


# Background

- Pre- Workshop dinner
- Friday (14 July 2017)
- Restaurant „Central Asia “ in Bishkek
- Consumed food:
  - Potato salad
  - Beef burger
  - Chocolate mousse



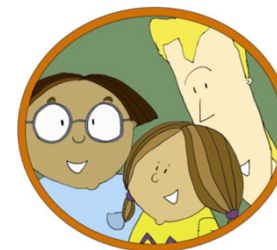




# Worrying signal

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- Monday (17 July 2017), several of the workshop participants report to be ill



# Confirming an outbreak

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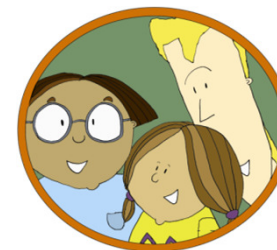
- Is this an outbreak?
- Please use relevant forms (e.g. line list, case investigation form, risk assessment form) to record information relevant for the outbreak investigation and rapid risk assessment
- Is there a need to send a rapid response team?

# Communication

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- Who needs to be informed?



# Control measures

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- Is the outbreak over or on-going?
- Are immediate control measures required?
  - Person-to-Person transmission or food-related transmission?
  - Need to contact veterinary authorities /Food-controlling authorities

# Preparing for the outbreak investigation

## Step 2

- Who will form the RRT?
- Objectives of the investigation and plan for action (work plan)
- Equipment taken to the field
- Safety considerations

The public health unit (PHU) of the Ministry of Health (MoH) coordinates activities on investigation and response to infectious disease outbreaks

Sector-based order issued → determines composition of RRT

# Composition of the RRT

## Step 2

### **RRT members:**

- Epidemiologist (team leader)
  - Laboratory Specialist
  - Infectious Disease Expert
- 
- ❖ RRT forms and departs within 24 hours from receiving initial outbreak notification
  - ❖ Head of team allocates functions and appoints person for Public Relations

### **To consider additionally:**

- Immunisation expert
  - Veterinarian
  - Sanitary Physician
  - Expert in health promotion
  - Infection control specialist
  - Cadets of Field Epi Training
- 
- ❖ Depends on type and size of outbreak

# Planning for outbreak investigation

## Step 2

1. Review the clinical and epidemiological data to discuss differential diagnoses, the size of the outbreak, and possible sources.
2. Agree the aims and objectives of the investigation
3. Agree a methodology for the investigation (including a plan for daily activities, meetings and interviews).
4. Agree roles and responsibilities
5. Agree the TOR
6. Create a list of materials required for the investigation

# Duties of the district RRT

## Step 2

Before the team goes to place where the outbreak took place, it has to:

- Address organizational issues related to investigative activities (process travel documents, transport matters and office supplies, etc .).
- Collate, confirm and verify all available data.
- Study the regulations, literature and reports on investigation of similar outbreaks.
- If necessary, to choose a design of epidemiological investigation.
- Elaborate and/or adapt a questionnaire for investigation of the outbreak (Annex 6).
- Discuss possibilities of additional laboratory testing in the higher level laboratories.



# Duties of the national RRT

## Step 2

- Based on preliminary risk assessment, decision is made at national level on practicability of sending RRT to the outbreak site for assistance provision.
  - Taking into account:
    - Shortage of the qualified specialists at district level including a need to train available specialists
    - Registration of new cases of diseases
    - High level of public and political frustration.
- National RRT, if necessary, plans field trip to the outbreak site and adjusts a plan of emergency response (anti-epidemic / controlling).
- RRT organizes provision of the personal protective equipment, laboratory reagents, disinfectants, and other required materials.

# Sample Terms of Reference for a RRT

## Step 2

### An RRT should:

- Investigate the outbreak including:
  - verifying the existence of the outbreak,
  - undertaking a risk assessment,
  - collecting the necessary data and specimens
  - formulating hypotheses on the probable causes and sources of the outbreak;
- Devise a plan to respond to the outbreak
- Put in place initial prevention and control measures
- Agree where indicated further epidemiological, microbiological, environmental and food chain investigations

# Sample Terms of Reference for a RRT

## Step 2

- Make and if possible enact recommendations to ensure that similar incidents do not occur again
- Report on a daily basis to the national level
- Communicate accurate and timely information as needed to other professionals, the media and the public
- Produce as needed situation updates and a final outbreak report which details lessons learned and recommendations
- Declare the outbreak over

# Plan for investigation: Important points

## Step 2

- The plan for the investigations should be appropriate for the available resources
- The plan may be revised during the investigations
- All investigation team members, main contact point at national level and relevant regional/district offices must be briefed on the plan

# Planning for arrival to the field

## Step 2

- Consult local colleagues in advance to ensure that resources are in place
- Assemble items to be taken (use check list –next slide)
- Consult laboratory colleague on a sampling strategy → document sampling strategy in the outbreak investigation plan

# RRT pre-departure checklist

## Step 2

- Personal protection equipment
- Items for waste management
- Items for blood collection
- Items for respiratory specimen collection
- Items for stool specimen collection
- Sample kits for other specimen collections
- Transport and storage materials
- Other Items (e.g. questionnaires, education materials, drugs, mobile phones, cameras)

# Preparing for the outbreak investigation



- Who should be part of the outbreak investigation team?
- What are the objectives of the investigation?
- What equipment should be taken to the field?

# Verify the diagnosis (cause) of the outbreak

## Step 3

- Collection of further information:
  - Review the clinical findings
  - Review the laboratory findings and collect clinical specimens for confirmatory diagnosis
  - Review epidemiological data and situation in the field
- Develop a hypothesis on:
  - Possible exposures
  - Mode of transmission
  - Source



# Review the clinical and laboratory findings

## Step 3

- Review the clinical notes and the laboratory results
- Interview the doctors and other health care staff who diagnosed and manage the cases
- Interview several cases, including severe (hospitalized) and milder cases, atypical cases, if possible - the index case and outliers.
- Complete an Outbreak Case Investigation Form (Annex 6) for the interviewed cases.
- Consult the infectious diseases diagnostic and treatment protocols used for diagnosing and treating the cases.

# Annex 6: Case Investigation Form

## Step 3

- Case ID Number
- Demographic information: name, address, date of birth, sex, ethnicity, nationality, occupation
- Clinical information: date of onset, symptoms
- Laboratory investigations: specimens taken, date and time when taken
- Hospitalization
- Treatment
- Current health status; co-morbidities
- Immunization status
- Epidemiological history (exposures, travel history)
- Follow-up Form (case classification)

# Review the clinical and laboratory findings

## Step 3

- Combine and analyse the information based on:
  - Symptoms
  - Date of onset
  - Severity of illness
  - Common or potentially important exposures
- Even in the absence of laboratory results it should be possible to generate a **syndromic case definition** using signs and symptoms e.g. fever and rash and temperature > 38 degrees

# Confirmatory diagnosis / laboratory testing

## Step 3

- Laboratory testing is important even if all patients have recovered
  - To determine the cause of the disease
  - To implement effective control measures
  - To link the cases
  - To inform treatment
  - To facilitate early detection of an outbreak
  - To identify asymptomatic cases → to establish the true size of an outbreak
  - To monitor changes to the pathogen, i.e. development of resistance

# How to determine the sampling strategy?

## Step 3

Depending on:

- the epidemiology and size of the outbreak
- the suspected mode of transmission (waterborne, airborne, foodborne);
- the severity of the disease

Sample all subjects or a proportion who are representative of the cases

# Who to sample in outbreak situation?

Step 3

## Cases

- “typical” cases → more likely to carry the pathogen
- untreated patients
- “strange” atypical cases = outliers (e.g. atypical clinical presentation or demographic, geographic features)

## Contacts

- Even if they are asymptomatic (outbreak specific)

## Controls

- laboratory controls to check that the test is indeed negative

# When to sample?

## Step 3

### Once (Single sample)

- acute or convalescent phase
- depends on disease
  - blood culture first, then serology (typhoid)
- depends on symptoms
  - fever spikes (e.g. malaria, septicaemia)

### Multiple times

- Follow up sample to see the increasing antibody
- Monitoring of cure
- Acute and convalescent serum

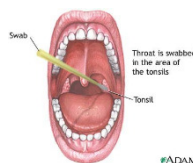
# Plan in collaboration with the laboratory

## Step 3

specimen



place of collection



collection method

labelling



storage



transportation



See Annex 7



# Clarify with the laboratory from the start

## Step 3

- Clarify who will transport the specimens
- Clarify who will process the specimens
  - Local or regional laboratory
  - National (reference) laboratory
  - Laboratory abroad?
- When will the results be ready?
- What are the results needed for? (*e.g. diagnostic before treatment/case confirmation/confirmation of source*)
- Who will help interpret the results?
- To whom will the results be reported?

# General procedures for collecting human specimens

## Step 3

1. Before doing anything, explain the procedure to the patient
2. Prepare your sampling kit & organize the area before you start
3. Label specimen tube
4. Make sure all safety precautions are taken
5. Make sure you know what you need to do before you start
6. When collecting the specimen, avoid contamination
7. Use clean/sterile container
8. Use vacutainers for blood specimens
9. Take a sufficient quantity of material
10. Use the correct transport media



# Labelling specimens

## Step 3

- **Unique ID number**
- Patient's name, Sex and Age
- Specimen type
- Date, time and place of collection
- Name/ initials of collector



# Some Tips: labelling

## Step 3

- Permanently fix the label to the specimen container
- Glass slides for microscopy labelled individually
- If possible, pre-print labels
- One specimen – one lab request
- Each slide should have the patient's name, unique identifier, and date of collection
- Original documents kept by investigation team
- Inform the laboratory about the arrival of specimens

# Laboratory Referral Form

## Step 3

- Specimen type, place and date of collection
- Case name and Case ID number
- Beneficial: clinical information
  - date of onset of symptoms, clinical and immunization history, risk factors or contact history where relevant, anti-microbial drugs taken prior to specimen collection
- Surname of person who collected the specimen



# Packaging and transport

## Step 3

- To follow on Day 2

# Food, environmental and animal samples

## Step 3

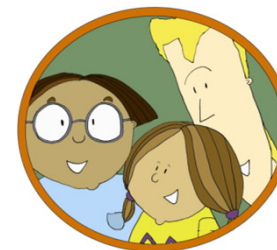
**Food:** in cooperation with **Food Safety Service / Dept. of Disease Prevention and State Sanitary Service**

- Samples of the rest of prepared food items
- Samples of the food samples from the same series
- Samples of surfaces
- Samples from kitchen staff

**Water:** in cooperation with **State Agency for Environmental Protection**

- Sample from the source (e.g. waterborne outbreak)
- Large volume preferable, minimum 200 ml

**Animal:** in cooperation with **Ministry of Agriculture**



# Verify the diagnosis

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- Which pathogens may have caused this outbreak?
- Who would you co-ordinate with for specimen collection sampling strategy and lab confirmation?



# Identify the size of the outbreak

Step 4

## Important in order to:

- Facilitate the treatment of cases
- Allow control measures to be put in place to prevent further spread
- Plan adequate resources to contain the outbreak
- Estimate the cost and impact of the outbreak

# Define cases

## Step 4

- Establish a case definition:
  - Criteria to classify the cases into those belonging to the outbreak and those who are not
  - Components
    - Person
    - Place
    - Time

# Case definition

Step 4

## Person

- **Age**
- **Gender**
- **Typical symptoms**
- **Lab results**
- **Vaccination status**

## Place

- **Location of exposure**
- **Location where cases were detected**
- **Place of residence**
- **Travel history**

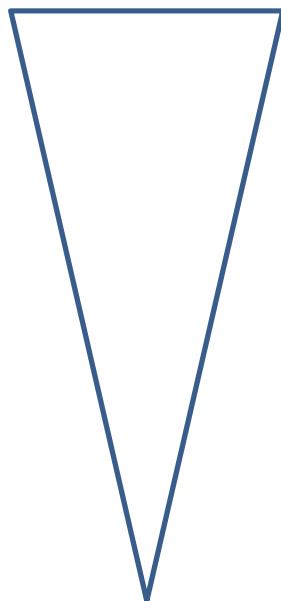
## Time

- **Onset date**
- **Period of exposure**

# Categories of case definition

Step 4

Sensitivity

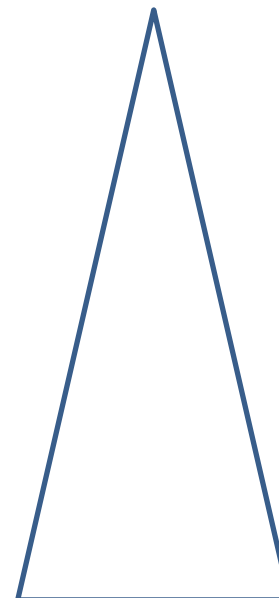


**Suspect case**

**Probable case**

**Confirmed case**

Specificity



# Case definition

## Step 4

- Different case definition categories could be used:
  - Search for new cases => high sensitivity important
  - Confirming the hypothesis => high specificity important
- Case definitions should be used from the beginning of the outbreak investigation
- Developed by RRT
- May be modified throughout the outbreak as new information becomes available

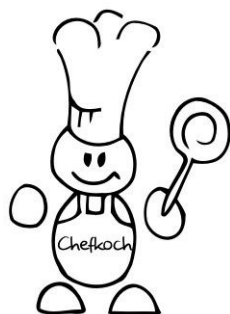
# Case definition examples

Step 4

**Outbreak of dysentery caused by *Shigella flexneri* in Karakol city, the Kyrgyz Republic, March-April 2006**

- **Suspect case definition:** Persons living in Karakol City who had the following clinical symptoms : diarrhoea (lasting not less than three days, not less than 3 times a day & mucus in stool ), abdominal pain and increased temperature with onset of symptoms from 1 March 2006.
- **Confirmed case definition:** Cases meeting the suspected case definition and with laboratory confirmation of *Shigella flexneri*

**Index case**

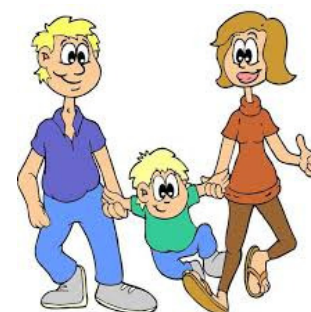


**Affected persons**



**Primary cases**

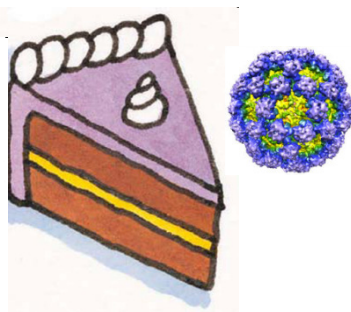
**Exposed to primary cases**



**Exposed**



©GospelGifts



**Secondary cases**



# Conduct active case finding

## Step 4

- Not all ill persons go to a doctor
- Not everyone is severely ill
- Samples are not always sent to microbiological examination
- Laboratory does not always succeed in identifying a pathogen in a sample
- Not all identified or suspected patients are notified to centers for disease control and prevention



# Conduct active case finding

## Step 4

- Better estimation of the magnitude of the outbreak
- Increases the chances of identifying a source of an outbreak
- Facilitates access to treatment and care for cases
- Ensures full coverage by control measures

# Conduct active case finding

## Step 4

- Looking through list of patients recently admitted to family medical centres and hospitals, speak to health staff
- Talk to out-patient doctors and nurses, laboratory experts
- Talk to pharmacists, school teachers, work colleagues
- Identify and trace contacts of cases, talk to all possibly infected persons
- Check neighbouring villages (household visits, door-to-door)
- Possibly: establish a system of enhanced surveillance

**Update Case Line Listing Form: Annex 2**  
**Use Contact Tracing Form**

# Collect data during active case finding using a questionnaire

Step 4

## Interview questionnaire:

- Clinical symptoms specific for suspected illness
  - Exposures → focus on identifying the source
  - Contacts
  - Travel history
  - Should allow classification into suspect, probable, confirmed cases and non-cases
- Questionnaires for foodborne illness and Anthrax in Annex 6.
  - For some outbreaks, best to design a new questionnaire: specific to clinical features and suspected exposures for the outbreak.

# Interview methods

## Step 4

- Face-to-face interview
- Telephone interview
- Self administered questionnaire
  - Online
  - Mail

# Contact Tracing Form

Step 4

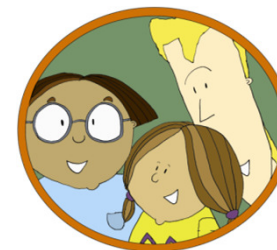
Region: Administrative-territorial unit: Type of outbreak:								
Patient Name and ID number	Contact Name	Age (Years)	Sex F/M	Address	Type of contact (family, workplace, school, healthcare worker, etc.)	Last contact date	Prophylaxis Y/N/n/a	Remarks <sup>1</sup>

<sup>1</sup> **Remarks** – could include any relevant information to the current outbreak (specimens collected or not, laboratory testing results, etc.).

# Data management

## Step 4

- Collected data should be entered into a dedicated database (e.g. EpiData, EpiInfo, Excel)
- Line listing format
- All data linked by unique patient's identifier
- Samples properly labelled, identifiers linked to associated epi data
- When possible, double data entry

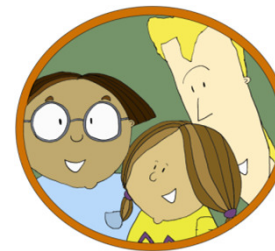


# Establishing a case definition

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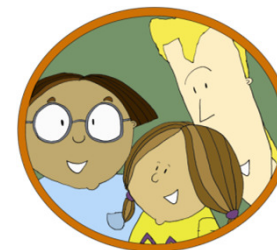
- Which case definition would you use for case finding?

# Active case finding



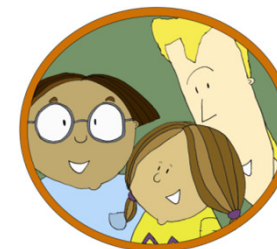
- How would you look for other cases?





# Identify the size of the outbreak

- Fill in the Case Line Listing Form



# Form 1: Case Line Listing Form

Village/town: Bishkek Administrative – territorial unit: City Centre Total population of the affected locality: 938,000 Region: Capital Type of outbreak: probably foodborne Main signs and symptoms: diarrhea, vomiting, abdominal cramps, fever									
ID number <sup>1</sup>	Name	Address	Age	Sex	Symptoms <sup>2</sup>	Onset date	Specimens collected	Health status <sup>3</sup>	Remarks <sup>4</sup>
1			35	F	Vomiting, Fever	15.07.2017 8 am	1 stool sample	inpatient	
2			61	M	Diarrhea, abdominal cramps	16.07.2017 8 am	1 stool sample	outpatient	
3			42	F	Diarrhea, fever	15.07.2017 8pm	1 stool sample	outpatient	
4			51	F	Diarrhea, fever, abdominal cramps	16.07.2017 8 am	1 stool sample	outpatient	
5			66	M	Diarrhea, vomiting, abdominal cramps	16.07.2017 8 am	1 stool sample	outpatient	
6			58	M	Diarrhea, vomiting	16.07.2017 8 am		outpatient	
7			37	F	Diarrhea, fever, abdominal cramps	16.07.2017 8 pm	1 stool sample	outpatient	
8			39	F	Diarrhea, abdominal cramps	17.07.2017 8 am	1 stool sample	outpatient	
9			48	F	Diarrhea, fever	16.07.2017 8 pm		inpatient	
...									

# Describe the outbreak in person, place and time

## Step 5

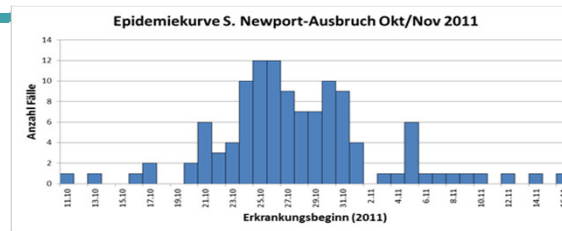
### **Allows to:**

- Generate hypothesis on the possible source (comparing exposure in cases vs. non-cases)
- Estimate the time of the initial exposure
- Identify risk factors for disease and severe disease
- Increase understanding on the transmission mode
- Help to identify efficient means to control the outbreak

# Describe the outbreak in person, place and time

## Step 5

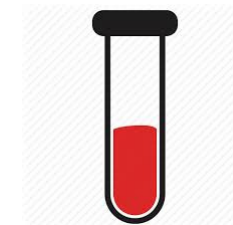
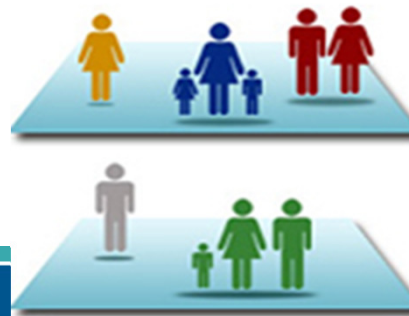
- When? (Time)



- Where? (Place)



- Who? (Person)

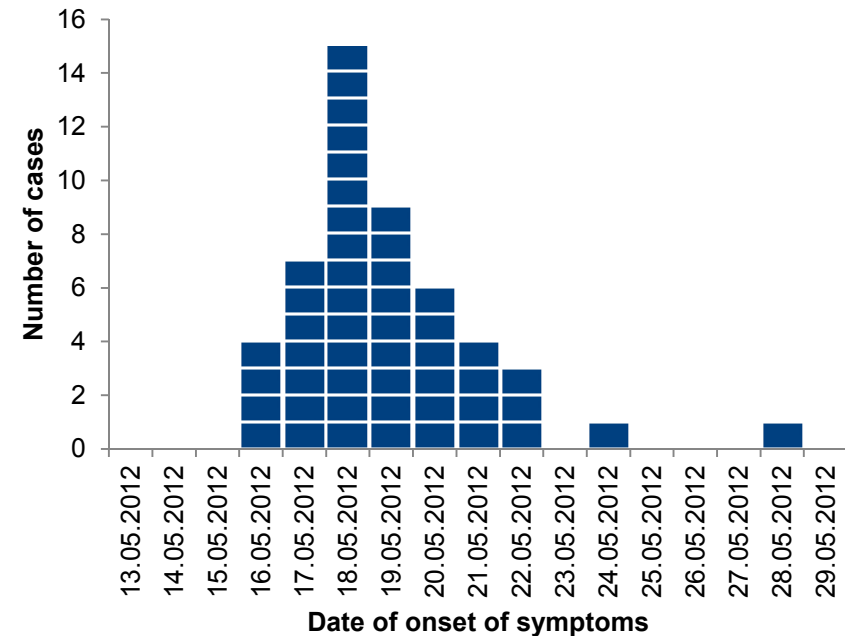


# Epidemic curve

## Step 5

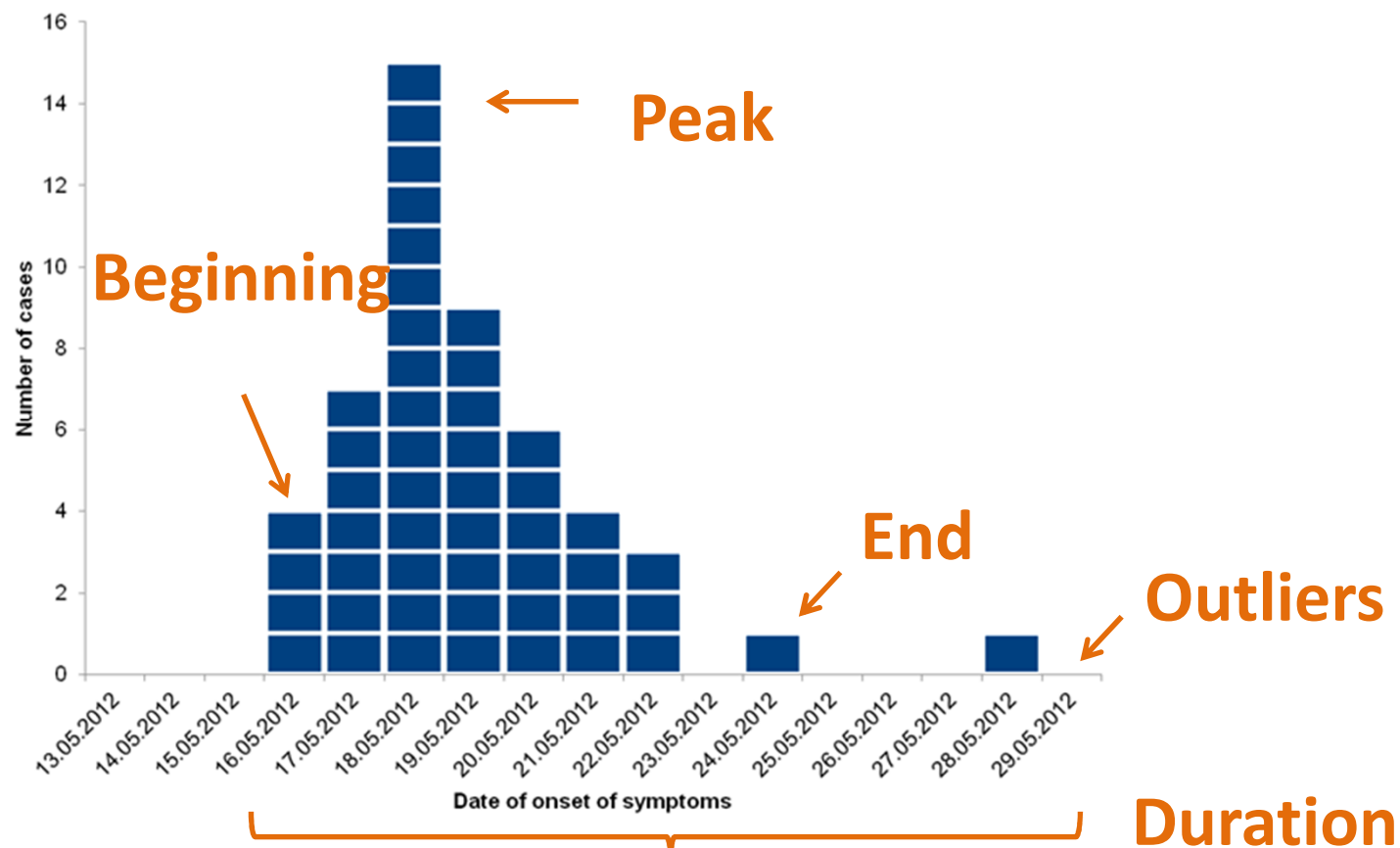
- x-axis
  - Length of time over which cases are distributed
  - Equal class intervals
  - No spaces between columns
- y-axis
  - Number of cases
- Don't forget to label and title the epidemic curve

Title: Outbreak of x in location y in May 2012



# Interpretation of epidemic curves

Step 5



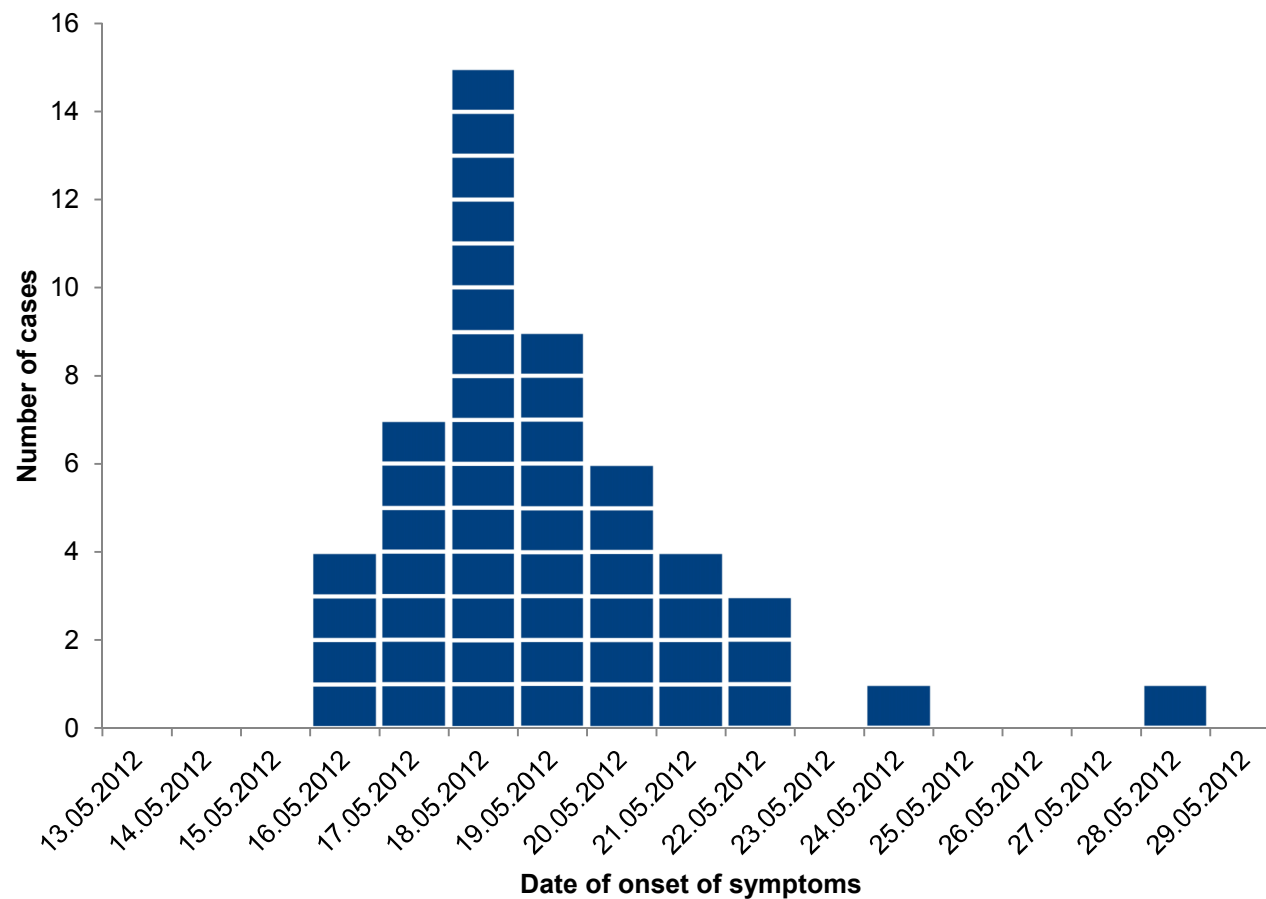
# Interpretation of epidemic curves

## Step 5

- Generating hypotheses
  - Mode of transmission
    - Point source
    - Continuous point or common source
    - Intermittent point or common source
    - Propagation (person-to-person transmission or vector/vehicle transmission)
  - Exposure period
  - Incubation period

# Common point source

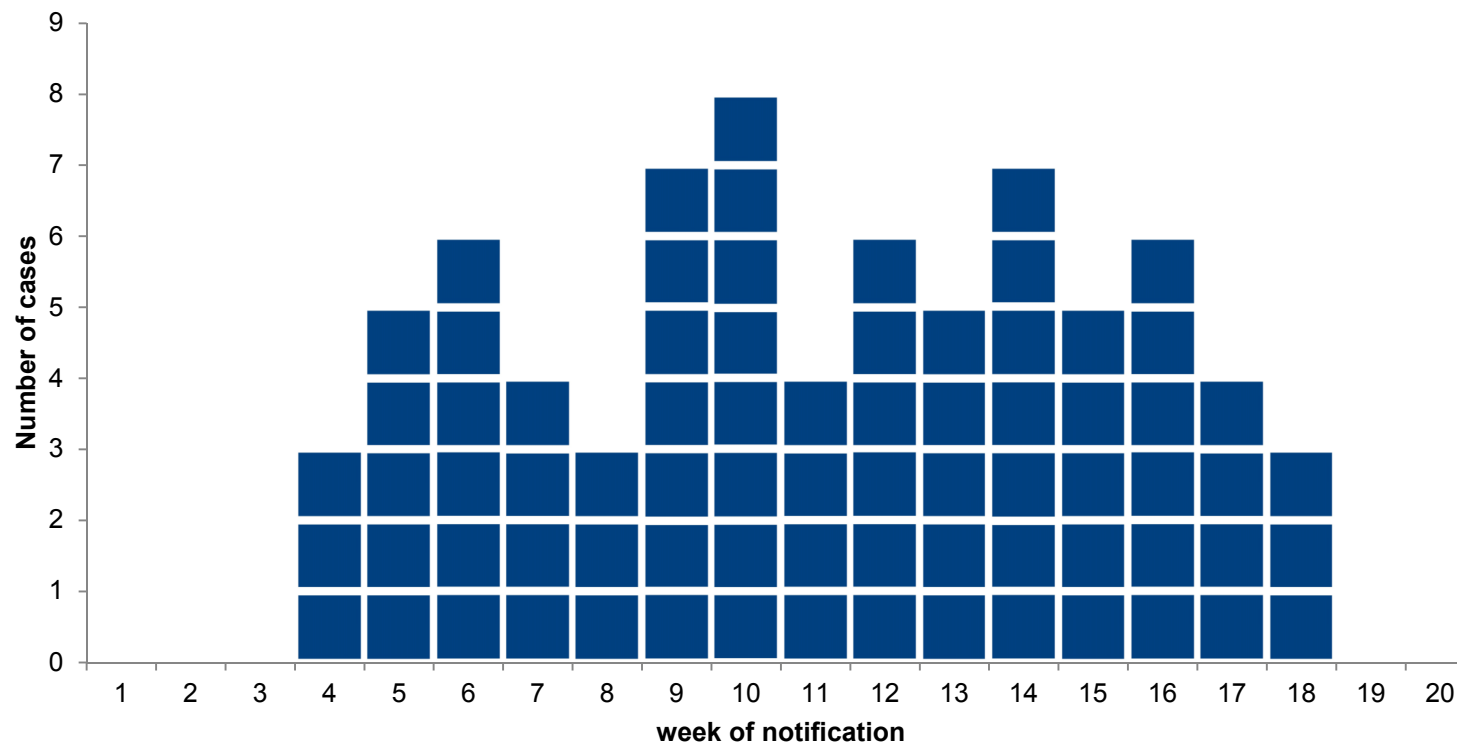
## Step 5





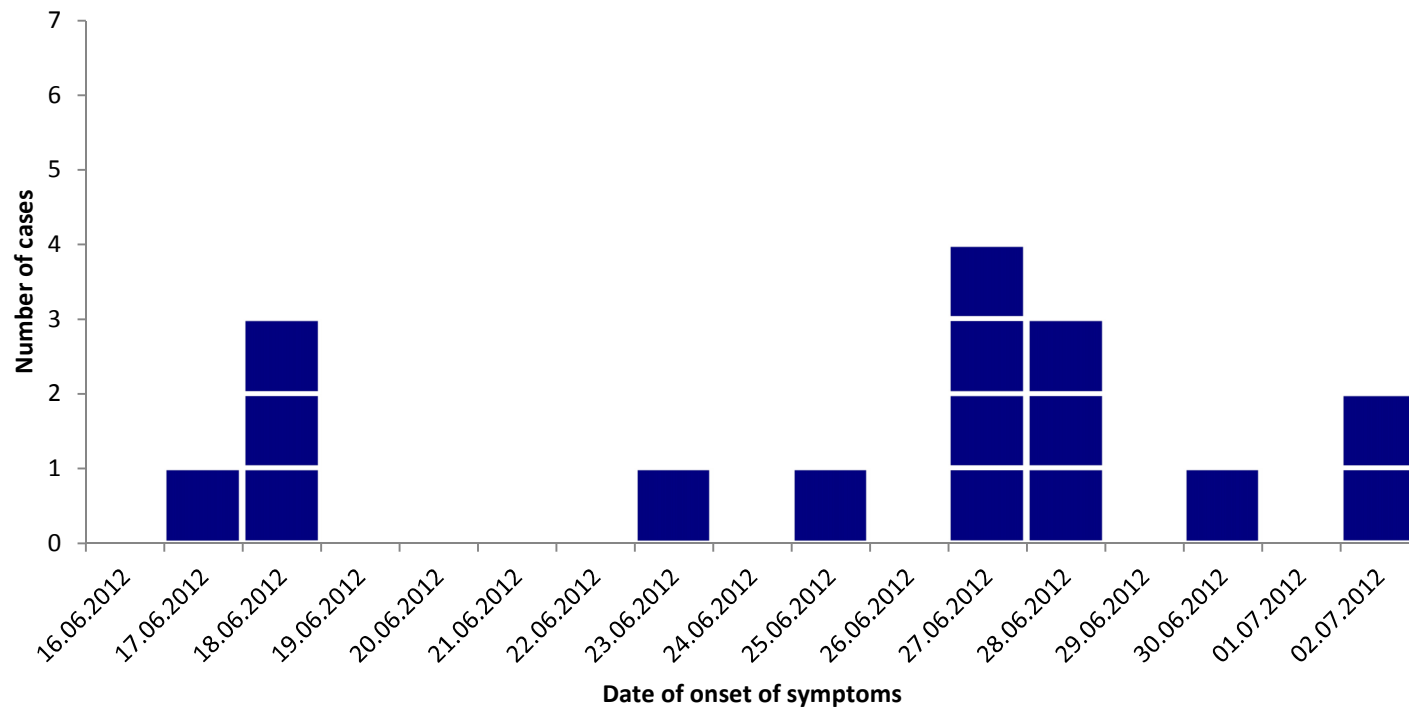
# Continuous common source

## Step 5



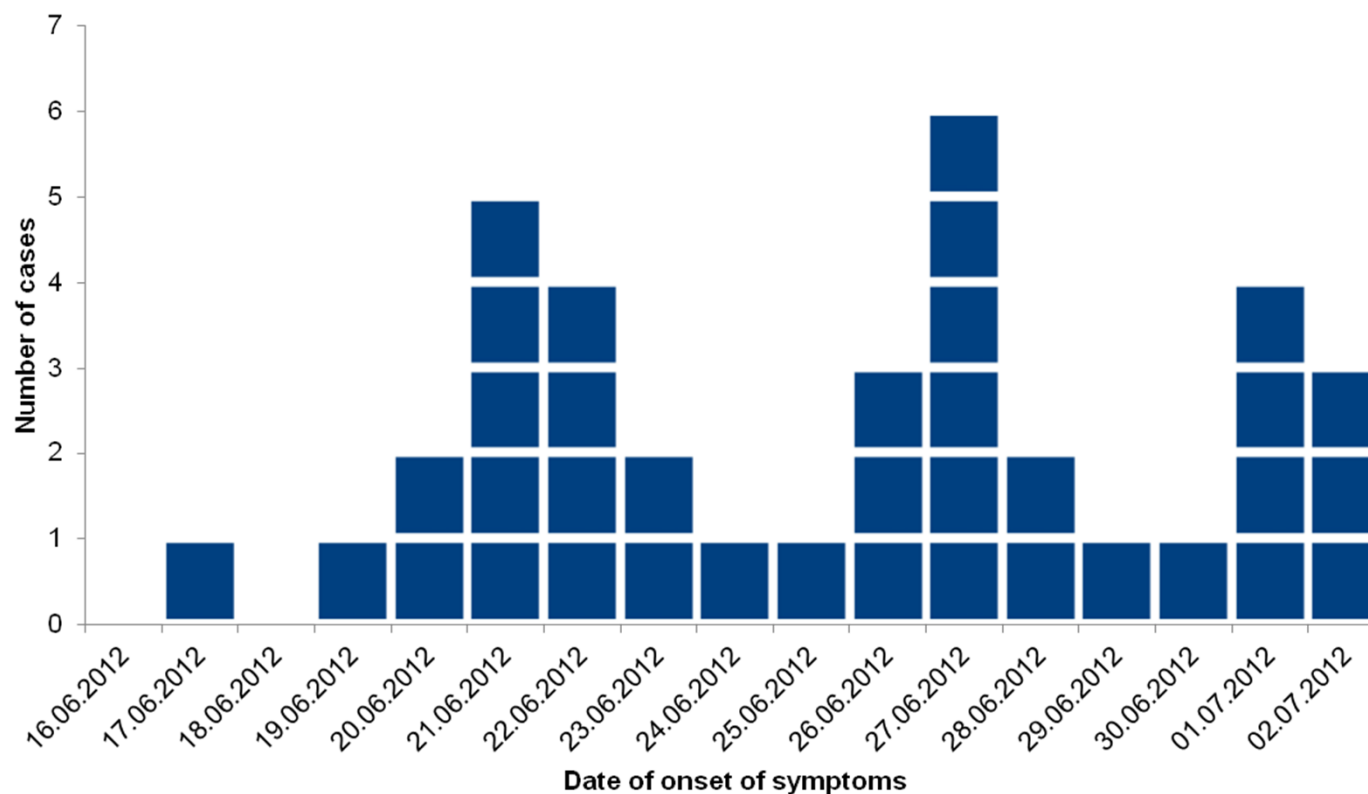
# Intermittent point source

## Step 5



# Person-to-person transmission

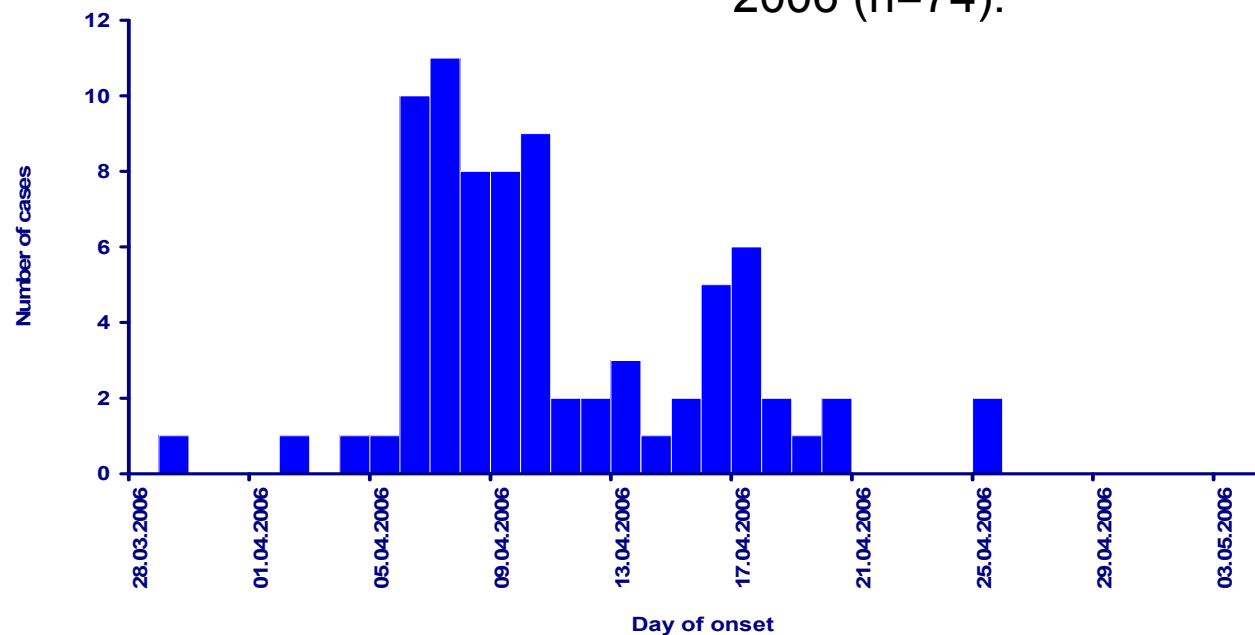
## Step 5



# Shape of epidemic curve? Source?

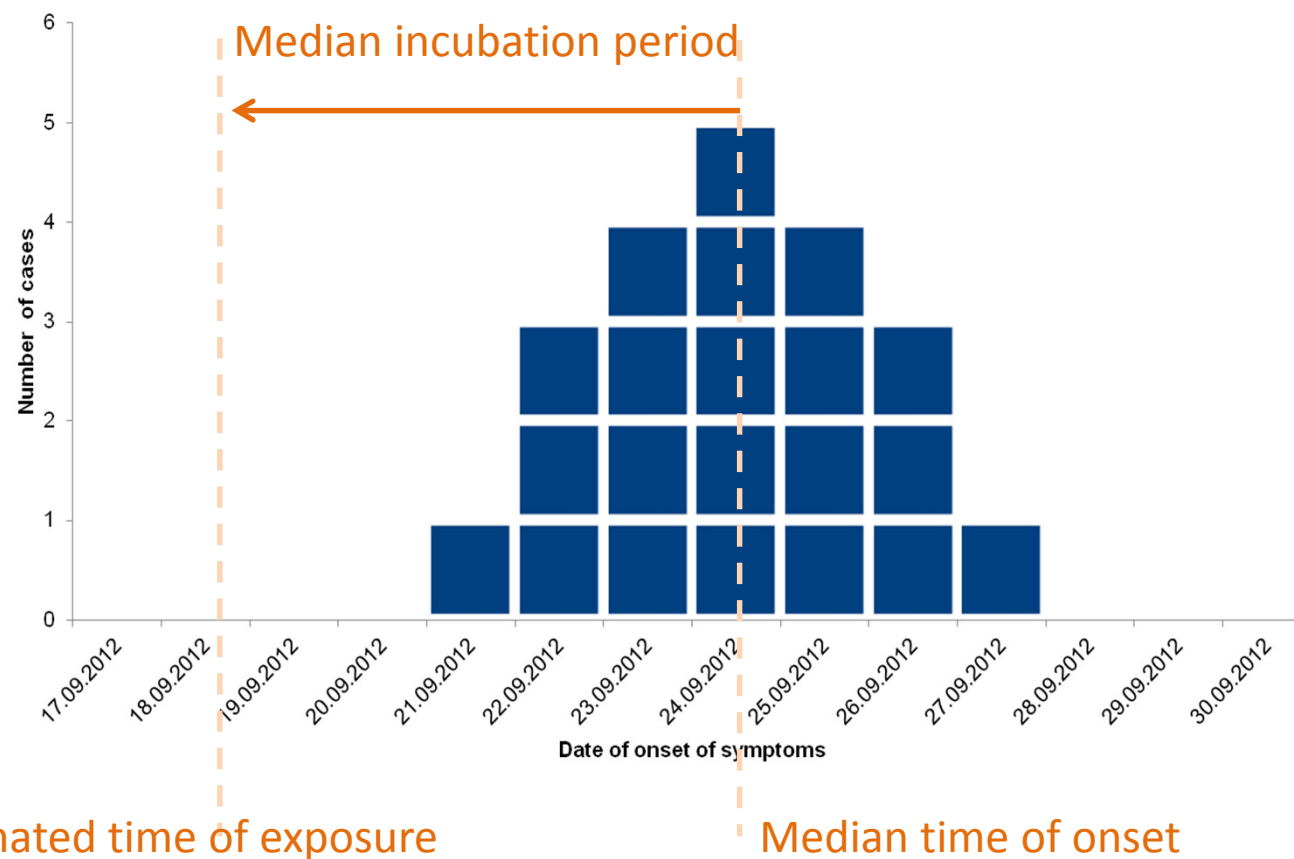
## Step 5

Epidemic curve of dysentery cases in Karakol, the Kyrgyz Republic, March-April 2006 (n=74).



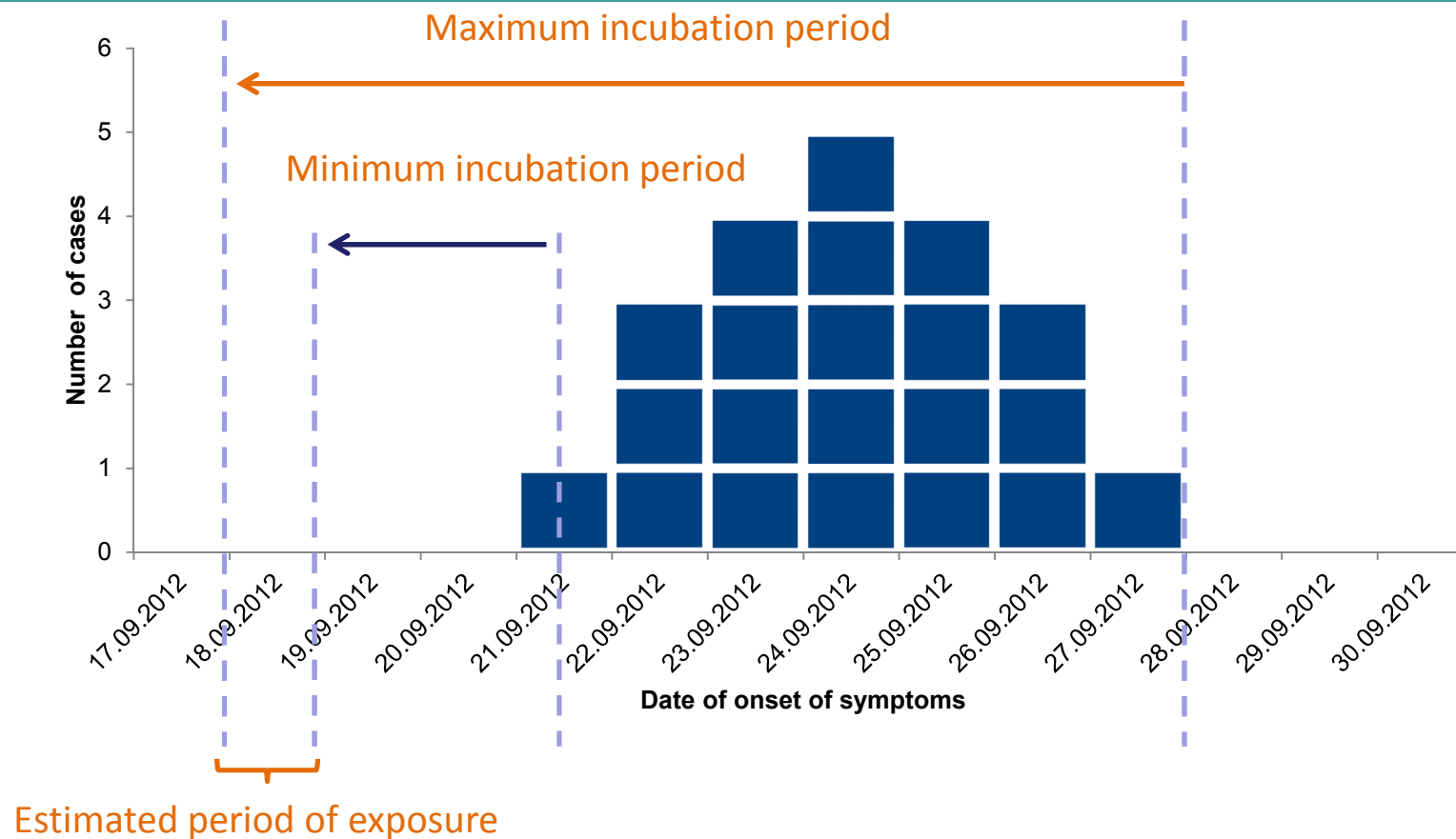
# Determine exposure period

## Step 5



# Determining exposure period

## Step 5



# Describing by person

## Step 5

- Age of ill persons
  - Average age (or median age), age range, age groups
- Sex distribution
- Symptoms, their severity, date of symptom onset, hospitalisation, death, outcome of illness, results of the laboratory tests
- Affected group(s) of persons
  - e.g. the majority are young children, old persons, only ♂, only ♀, particular occupational groups (veterinary doctors, rangers etc.)
  - e.g. persons engaged in particular hobby activities (mountain-bikers, mushroom pickers, cave visitors etc.)

# Describing the outbreak: Person

## Step 5

### *Salmonella*-München Outbreak

No of ill persons in total	247 cases
Symptoms	Diarrhoe (74%), abdominal pain (28%), fever(21%), vomiting (12%)
Laboratory confirmation	237 cases (90% <i>S. Muenchen</i> )
Median age	56 y ( range 1-94 y)
Male/ female ratio	54%/46%
Occupational contact to food	17 cases
Hospitalisation due to salmonellosis	30 cases
Died	4 cases (all females; 81-93 y) → 1 case because of salmonellosis



# Attack rate

Step 5

## Overall attack rate

No. of cases / total population x 100%

## Attack rate in children under 5 years old

No. of cases in children under 5 years old / population under 5 years old x 100%

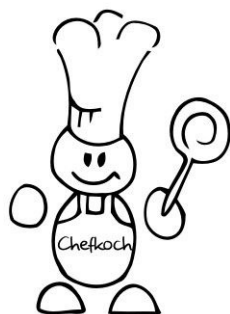
### Denominator:

a total number of a group at risk  
(e.g. consuming sausages, working at a factory)

Analytical epidemiology: -  
what are the risk factors for  
infection?

## Step 7

**Index case**



**Affected persons**

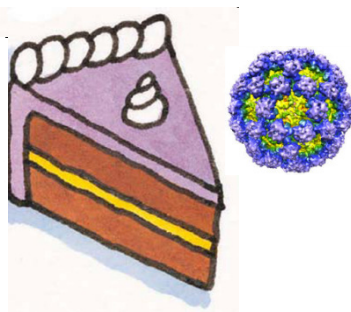


**Primary cases**

**Exposed to primary cases**



**Exposed**



**Secondary cases**

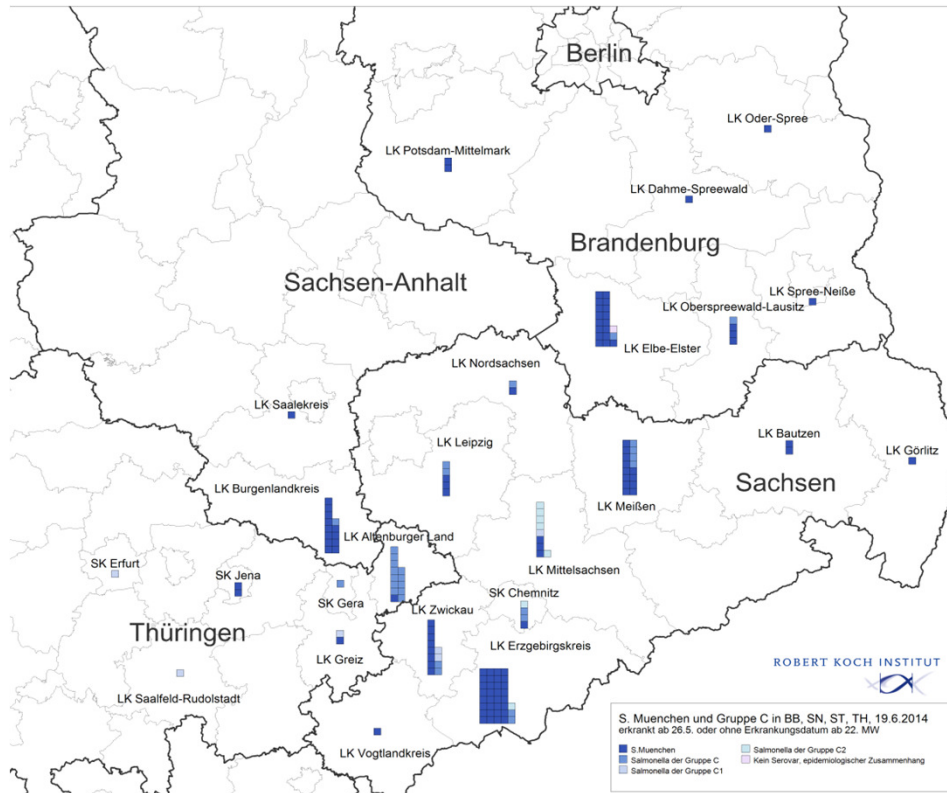


Primary attack rate:  $3/6 = 0.5$  (50%)

Secondary attack rate :  $3/7 = 0.43$  (40%)

# Describing by place

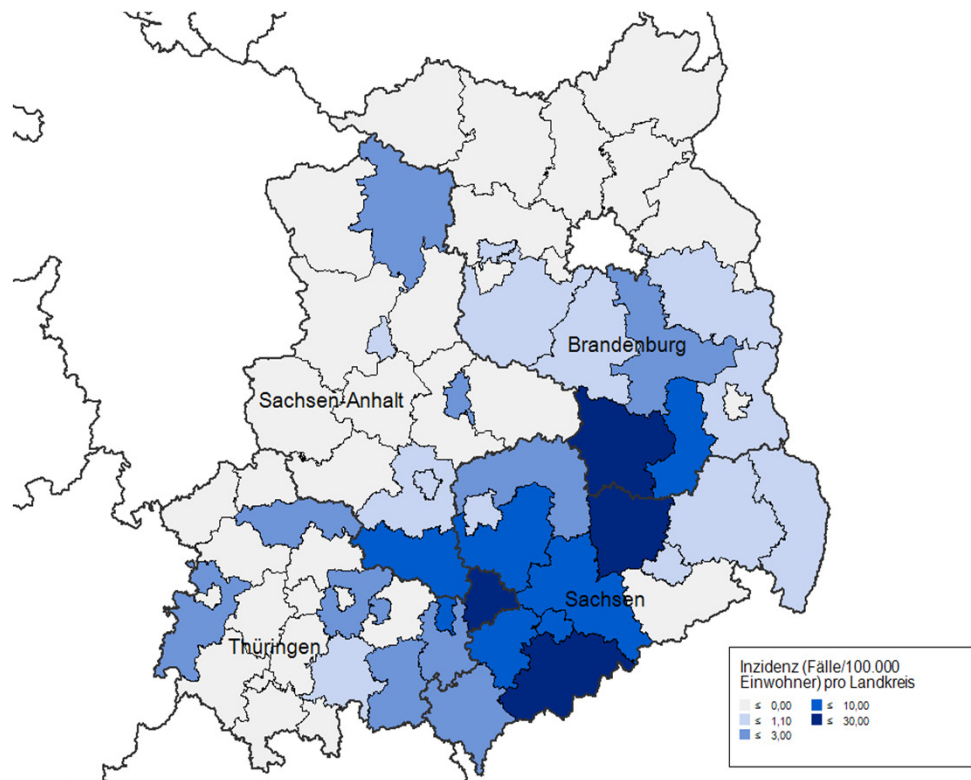
## Step 5



Geographical distribution of Number of cases from *Salmonella*-Muenchen outbreak, Germany

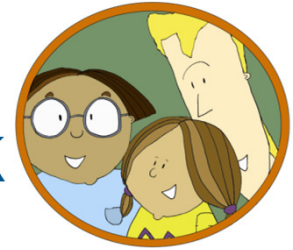
## 5.5.3. Describing by place

### Step 5

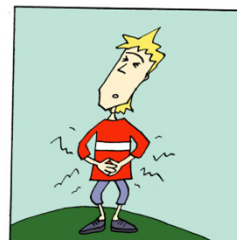


Geographical distribution of incidences of cases from *Salmonella*-Muenchen outbreak, Germany

# Describing and analysis of the outbreak



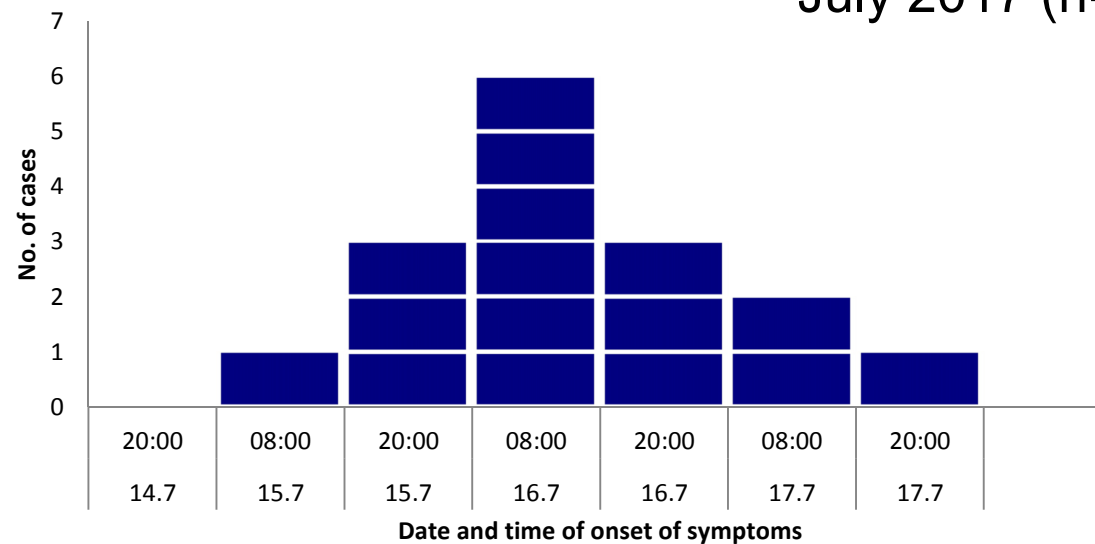
- Age
- Gender
- Symptoms

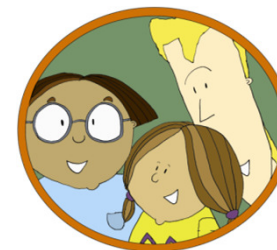


# Describing and analysis of the outbreak



Epidemiological curve of the  
foodborne outbreak in Bishkek,  
July 2017 (n=16)





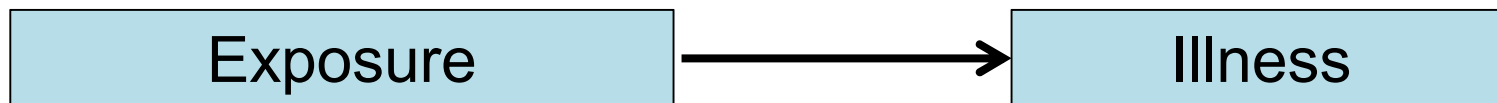
# Immediate action required?

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- Who needs to know at this stage?
- Are immediate interventions necessary?

# Generate a hypothesis about the source of the outbreak

Step 6





# The hypothesis is based on:

Step 6

- Laboratory or clinical data on the cause of the outbreak
- Knowledge on pathogens associated with specific clinical syndromes (where diagnostic data are lacking)
- Knowledge on reservoirs, modes of transmission and known risk factors for disease

# Evaluate the hypothesis - using analytical studies

Step 7

- Not needed if enough data to support a specific hypothesis:
  - Closure of a well → decline in *Cryptosporidium* cases
  - *Campylobacter jejuni* isolated from food items and patients
- Useful if there is no robust circumstantial evidence:
  - Determine if there is an association between exposure and disease

Retrospective cohort studies

Case-control studies

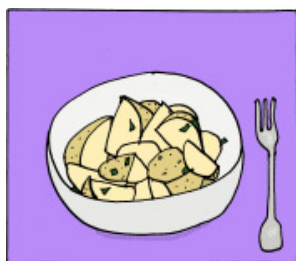
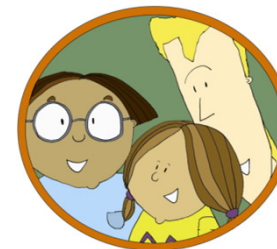
# Evaluate the hypothesis using analytical studies

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- Would you conduct an analytical study?
- If yes, which study type would you choose?
- How would you conduct this study?

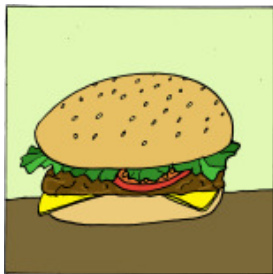
# Results of the cohort study



Consumption of  
potato salad

	case		
	Yes	No	
Yes	10	3	13
No	6	6	12
	16	9	25

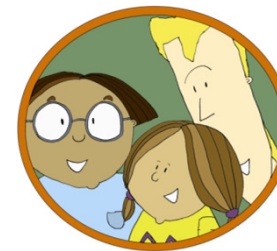
# Results of the cohort study



Consumption of  
beef burger

	case		
	Yes	No	
Yes	12	2	14
No	4	7	11
	16	9	25

# Results of the cohort study



Consumption of  
mousse

	case		
	Yes	No	
Yes	8	6	14
No	8	3	11
	16	9	25

# Reconsider/Revise Hypothesis - Additional studies

Step 8

- Additional evidence to support a hypothesis
- To inform modifications or refinements to a hypothesis (especially if hypothesis is not supported by the available data and results of the analytical studies)
- Development of a new hypothesis if existing evidence does not support the initial hypothesis

Further microbiological  
investigations

Tracing back food items

Re-interviewing cases

# Reconsider/Revise Hypothesis - Additional studies



- Which additional studies could be conducted to support the epidemiological findings?



## 5.9. Implement control and prevention measures

### Step 9

- Control measures should be started **as soon as possible** in order to contain the outbreak.
- Control measures should be started **at any point of time** during an outbreak investigation if a RRT decides them as being appropriate
- Control measures should be **reviewed and revised** as needed throughout the course of the outbreak response



Responsibility of RRT

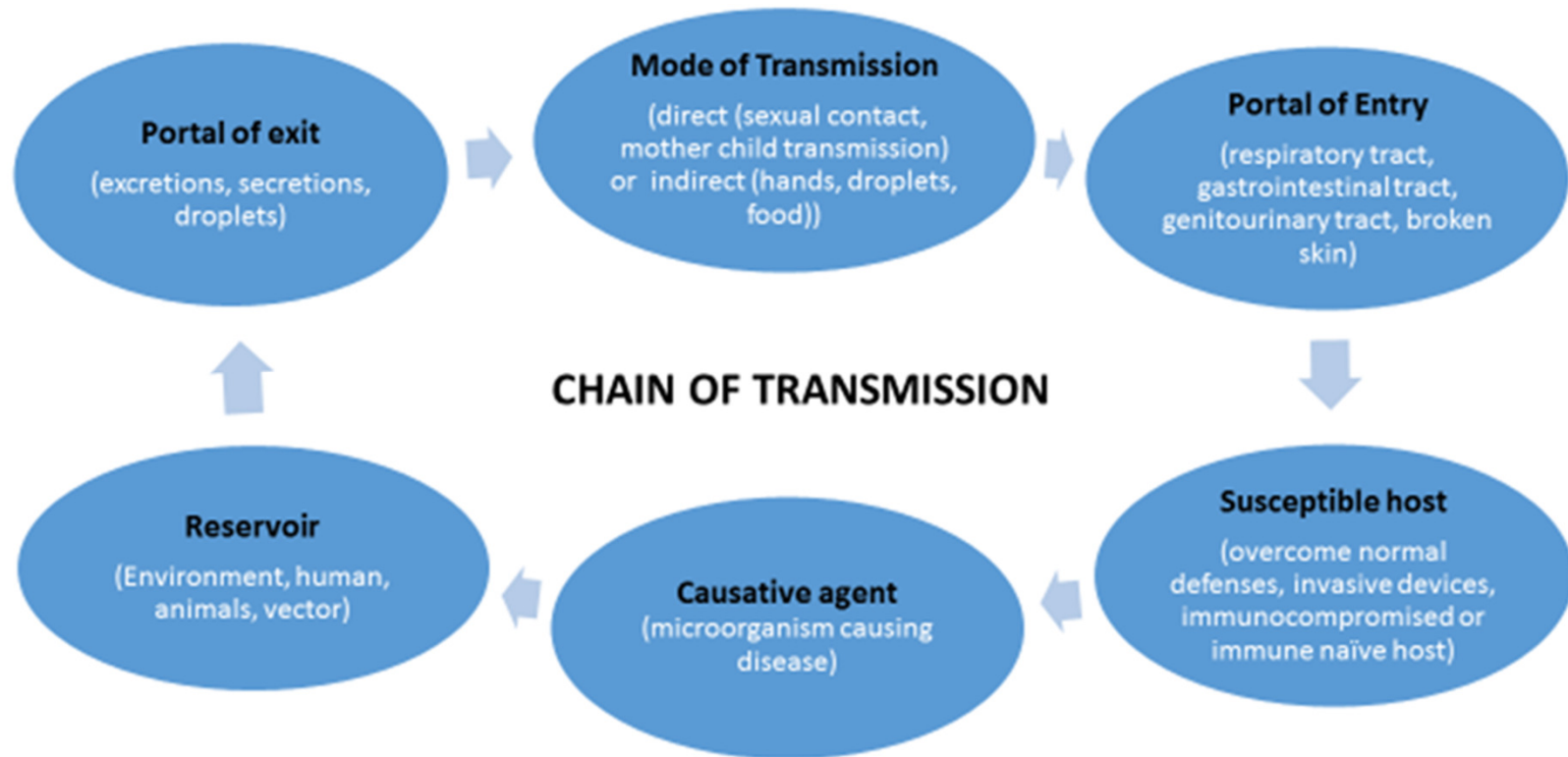
# Control and prevention measures

## Step 9

- **Control measures:** immediate effect to interrupt transmission
  - If there is already a hypothesis on the source of the outbreak and the outbreak is still on-going, advice on **temporarily control measures** could be released even before outbreak investigation is completed
- **Prevention measures:** long-term effect to prevent occurrence of future outbreaks
  - Advice on prevention measures should be issued as soon as possible to **prevent occurrence of secondary cases**

# Break the „chain of transmission“

## Step 9



# Break the „chain of transmission“

## Step 9

- **The agent:** chlorination of water supplies to kill *Vibrio cholera*
- **The reservoir:** vector control programmes to destroy breeding sites of *Anopheles* mosquitoes during a malaria outbreak eliminates the reservoir of the parasite
- **The portal of exit:** latrines to stop contamination of water supplies during a cholera outbreak
- **The mode of transmission:** removal of contaminated food items in a food borne outbreak
- **The portal of entry:** enhanced infection prevention and control practices to stop an outbreak of MRSA
- **The susceptible host:** vaccination to stop a polio outbreak

# Controlling the outbreak

## Step 9

- Isolation and treatment of cases
- Monitoring of contacts
- Waste management
- Safe burial of deceased persons
- Environmental interventions
- Health education of the cases, contacts and community

# Isolation and treatment of cases

## Step 9

- Clinical management of cases in specialised facilities (in- or out-patient)
- Public health actions: see section on 'Characteristics of the outbreak investigation by transmission route'
  - Quarantine or isolation may be needed
  - Temporary prohibition of work (e.g. teacher, food handler)
- Clinical management: see relevant national guidelines on specific infectious diseases

# Monitoring of contacts

## Step 9

- Contact tracing may be necessary for some diseases
  - For example: Avian Influenza, Diphtheria, TB
- Purpose:
  - to inform contacts about a diseases and possible symptoms => advice to seek medical care immediately should feel unwell
  - screening for symptoms
  - possible home quarantine
  - post-exposure prophylaxis when available and time permits

# Waste management

## Step 9

- Biohazard bags for used PPE  
→ improvise a dedicated bag



- Safe disposal or incarceration



# Safe burial of deceased persons

## Step 9

- Safe burials are important in exceptional circumstances (e.g. corpses of persons died from viral haemorrhagic fevers, plague or cholera)
- For RRT it is important to engage experts
- Follow existing national laws

# Environmental interventions

## Step 9

- **Waterborne disease:** eliminate contaminated source, treat the water
- **Foodborne disease:** recall of certain products, warning on consumption, application of strict hygiene control measures
- **Vector borne disease:** destroy mosquito breeding sites
- **Zoonotic disease:** control animal movement, prohibit consumption of certain products. Avian influenza – culling of poultry
  - Involve responsible veterinary health authorities

# Health education

## Step 9

- **Foodborne outbreaks:** education on proper food handling and cooking
- **Respiratory infections outbreaks:** education on cough etiquette
- **Diarrheal and respiratory infections:** education on hand hygiene
- **Vector-borne diseases:** education on destroying mosquito breeding sites and how to avoid being bitten



# Risk communication

Step 9

More on Day 2

# Ineffective control measures

Step 9

## **Waste of resources and time**

- Inappropriate or extreme disinfection
- Giving prophylaxis or placing in quarantine a contact of a contact of a case
- Preventing a worker from working when his disease is not likely to spread while performing the job.

# End of outbreak investigation checklist

## Step 9

END OF OUTBREAK FIELD INVESTIGATION CHECKLIST	
Activity	Completed
Clinical and laboratory findings (in patients and health care workers) reviewed	
Case investigation forms completed for all persons suspected to be ill	
Each person suspected to be ill was added to the line list	
Active case finding in health care facilities and nearby villages	
Appropriate clinical specimens collected from all person suspected to be ill & properly labeled	
Appropriate food, water and, if required, environmental samples have been taken	
Appropriate treatment is ensured	
Appropriate control measures indicated and are being implemented	
Appropriate instructions given to the village mayor as to what to do with ill persons and how to prevent further cases	
Community leaders have provided daily reporting until the outbreak was over	

# Control and prevention measures

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- Which control and prevention measures would you apply?

# Report/Communicate findings

## Step 10

Regular communication of the finding is important for update on

- what happened during the outbreak
- the lessons learned
- recommendations for control and the prevention of future outbreaks.



# Who writes an outbreak report?

Step 10

- **Rapid Response Team**
- First draft by main investigator
- Agreement on contents among all participating agencies

Agree on a reporting  
framework

Specify timing of the  
reports

# How often to report?

## Step 10

- Regular updates during investigation: interim (situation) reports
  - Send to next level SES and local state administration
  - Document activities
  - Interim recommendations for control measures
  - Frequency of reporting may vary throughout the outbreak (addition ad hoc reports as new information becomes available or for urgent recommendations on control measures)
    - Preliminary report: within 24h of outbreak notification
  - Typical content: No of cases for the reporting period and since the beginning; outbreak dynamics; evidence of spread; current status of investigation; recommendations for controls; next steps

# Final Report

## Step 10

- Detailed report at end: final report
  - Investigation methods and results
  - Communicate public health messages
  - Influence public health policy
  - Evaluate performance
  - Training tool
  - Legal proceedings

# Suggested report structure

- Introduction & background
- Outbreak investigation materials & methods
- Results
- Control measures
- Discussion and conclusion
- Recommendations

See Annexes 8 & 9

# Introduction

Step 10

Details of initial investigations

Immediate control measures

Timeline

Objectives of the investigation

# Background

## Step 10

### Brief description of the suspected causative agent

- Incubation period and infectious dose
- Recognised sources and modes of transmission
- Diagnosis
- Characteristics of affected populations etc

### Background prevalence of the disease:

- Locally
- Nationally
- Globally

# Outbreak investigation methods

## Step 10

### Epidemiological

- Case definition
- Questionnaire design
- Descriptive epidemiology
- Analytical epidemiology
- Mapping of cases

### Microbiological

- Name of laboratory
- Samples taken
- Laboratories used
- Laboratory methods

### Environmental

- Samples taken
- Inspections
- Risk assessments

### Veterinary

- Samples taken
- Risk assessments
- Inspections

# Results

## Step 10

### Descriptive epidemiology

- Person, Place, Time
- Total no. of cases
- No of confirmed, probable, suspected cases
- Epidemiological curve
- Secondary cases
- Maps
- Incubation period
- Attack rates (primary, secondary)
- Attack rates (age, sex specific, by exposure/risk factors)

### Analytical epidemiology

- Odds ratio
- Risk ratio

### Investigation results

- Laboratory
- Environmental
- Animal



# Control measures

---

Step 10

Control measures undertaken

Their effectiveness

# Discussion and conclusions

Step 10

Summary

Data validity,  
likely accuracy

Interpretation of  
findings

Strength and  
limitations of  
investigation

Conclusions and their  
justifications

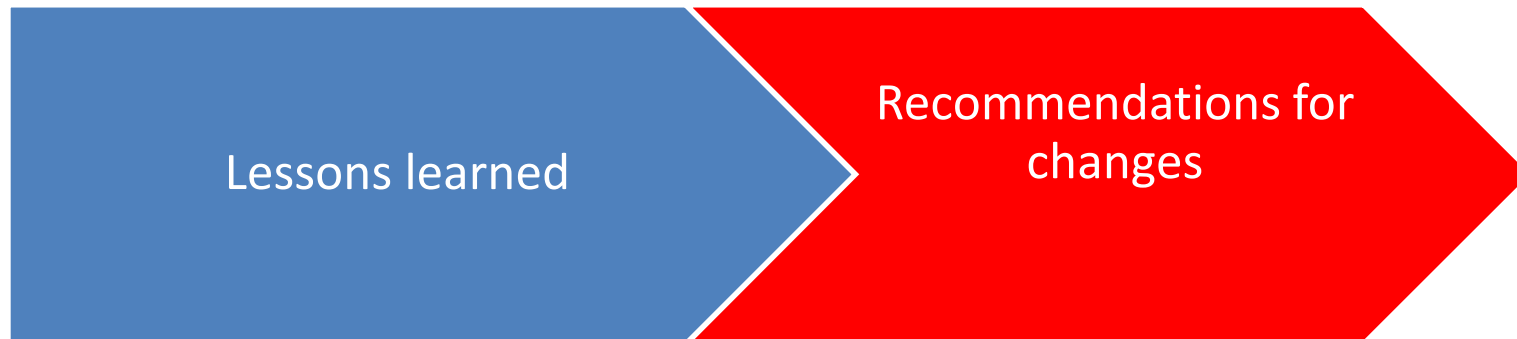
Assessment of  
implemented control  
measures

Encountered problems

# Recommendations

Step 10

- Prevent future outbreaks
- Improve surveillance
- Detection of outbreaks
- Improve the process of outbreak investigation and control



# Final report recipients

- Vary depending on outbreak
- Decided by RRT
- A copy should always be sent to next higher level of SES  
→ further dissemination to relevant partners
- Completed and disseminated to all agreed recipients within 30 days of the end of the outbreak

# Evaluation of the outbreak investigation

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- Self-reflection
- Important to improve the effectiveness of outbreak investigations
- Faster implementation of control measures

# Indicators for evaluation

- Outbreak recognition
  - Initial investigation to clarify the outbreak within 24 hours of notification
  - Rapid risk assessment undertaken and recorded following receipt of initial information
  - Immediate notification of NCDPCP central office
- Outbreak declaration
  - Decision made and recorded at the end of the initial investigation regarding declaring the outbreak and convening an RRT
- Rapid response team
  - RRT deployed within 24 hours of declaring the outbreak
  - All agencies / disciplines involved in the investigation and control represented at the RRT meetings
  - Roles and responsibilities of RRT members agreed and recorded

# Indicators for evaluation

- Outbreak investigation and control
  - Control measures implemented with clear timescales for implementation and responsibility
  - Case definition agreed and recorded
  - Descriptive epidemiology undertaken and reviewed at RRT including: No of cases, epidemic curve, description of key characteristics including sex, geographic spread, possible risk factors; hypothesis generated
  - Analytical study considered and rationale for decision recorded
  - Investigation protocol prepared if an analytical study is undertaken
- Communications
  - Communications strategy agreed at first meeting and reviewed throughout investigation
- End of outbreak
  - Report written within one month of the end of the outbreak

# Outbreak report

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