

INVESTIGATION AND CONTROL OF EPIDEMICS

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Objectives

At the end of this session students will be expected to

-  Describe different types of epidemics
-  Explain reasons for conducting an outbreak
-  Describe steps in epidemic investigation
-  Describe principles of epidemic disease control

Definition of terms

- **Endemic:** refers to occurrence of a disease in a relatively constant or roughly stable level through time.
- The level of endemicity of a disease varies depending on frequency of occurrence of the disease.
- **Epidemic**
- The occurrence of: More cases than **expected in a given area** or among a specific group of people, over a **particular period** of time.
- Have a **common cause** or to be related to one another in some way

Forms of Epidemics

- **Sporadic pattern** refers to occurrence of an epidemic in an irregular intervals or unpredictably.
- For example plaque epidemics are known to occur sporadically.
- **Periodic/Cyclic pattern** refers to occurrence of an epidemic at regular intervals
 - Malaria epidemics occur seasonally after light and heavy rain seasons.

- **Outbreak:**

- ✓ Epidemic limited to localized areas
- ✓ Increase in the incidence of disease

- **Cluster:**

- ✓ An aggregation of cases in a given area over a particular period without regard to whether the number of cases is more than expected

Forms of...

- Measles epidemics which occur every 3 to 5 years due to accumulation of susceptible or non-immunized children.
- Meningococcal meningitis epidemics occur every 10 years in the meningitis belt zone.
- Diarrheal diseases epidemics occur during wet seasons due to contamination of water sources and during dry seasons due to lack of water supply.

Forms of...

- **Secular pattern** refers to slow changes over time. For instance the number of lung cancer cases has increased slowly over decades.
- **Epidemic lasting long may remain endemic.** On the other hand endemic disease can turn out to be epidemic due to increase in susceptibles, ecological changes, increase in n° of carriers and appearance of new strains.

Types of Epidemics

1. Common Source Epidemics

- Common source epidemics occur as a result of exposure to common source for the infectious agent.
- Depending on duration of exposure such epidemics are further categorized as point source and common source with prolonged exposure (continuously or intermittently).

Types of...

1.1. Point source epidemics

- In point source epidemics exposure to the infectious agent is brief and simultaneous and as a result all cases of the epidemic develop within **one incubation period** of the disease.
- Typical examples of such type of epidemics include **food-borne outbreaks due to consumption of contaminated food in an event.**
- The epidemic curve which is constructed by plotting number of cases by date onset of disease shows **rapid rise and fall in the number of cases.**

Types of...

1.2. Common source epidemic with prolonged exposure

- In this type of epidemics exposure to the infectious agent continues over a period of time.
- Depending on nature of exposure whether it is continuously or intermittently such epidemics are further classified as common source with continued exposure and common source with intermittent exposure respectively.

Types...

- The epidemic lasts for more than one incubation period.
- Such epidemics may arise due to consumption of contaminated food by hepatitis A infected food handler intermittently or continuously or drinking water from water contaminated with *Vibrio cholera*.
- The epidemic curve is extended and irregular.

Types...

2. Propagated/Progressive epidemics

- These types of epidemics occur as a result of transmission of the infectious agent from one person to another.
- The epidemic lasts for more than one incubation period.
- Diseases that are known to occur in this pattern epidemic include measles and malaria.
- The epidemic curve typically shows initial slow rise, succession of several peaks and usually sharp fall.

Types of...

3. Mixed epidemics

- This pattern occurs when a point source epidemic is followed by propagated epidemic.
- The epidemic has most of the features of propagated epidemics.
- Such epidemic may occur in shigelloses epidemics whereby exposure to common contaminated food supply is followed by person-to-person spread.

Deciding whether to investigate a possible outbreak...

Factors related to the problem itself include

- ❖ The severity of the illness,
- ❖ The number of cases, the source,
- ❖ Mode or ease of transmission, and
- ❖ Availability of prevention and control measures.

Factors related to the health department include

- ❖ Availability of staff
- ❖ Availability of resources, and
- ❖ Competing priorities.

Reasons for conducting outbreak investigation

Field investigations are usually justified for one or

more of the following reasons:

- ❖ Control or prevention of the health problem
- ❖ Opportunity to learn (research opportunity)
- ❖ Public, political, or legal concerns
- ❖ Public health program considerations
- ❖ Training

Reasons for conducting outbreak investigation...

Control or prevention of the health problem

- ❖ The most important public health reasons for investigating an outbreak
- ❖ Depend on several factors, including
 - knowledge of the agent,
 - the natural course of the outbreak,
 - the usual transmission mechanism of the disease, and
 - available control measures.

Reasons for conducting outbreak investigation...

Opportunity to learn (research opportunity)

- ❖ For most public health problems, health officials cannot conduct randomized trials.
- ❖ However, we can take advantage of what has already happened and learn from it.
- ❖ Some view an outbreak as an experiment of nature waiting to be analysed and exploited.
- ❖ For a newly recognized disease, field investigation provides an opportunity to characterize the natural history including agent, mode of transmission, and incubation period
- ❖ Even for diseases that are well characterized, an outbreak may provide opportunities to gain additional knowledge by assessing the impact of control measures and the usefulness of new epidemiology and laboratory techniques

Reasons for conduction outbreak investigation...

Public, political, or legal concerns

- ❖ Public, political, or legal concerns can be the driving force behind the decision to conduct an investigation.
- ❖ A cluster of cancer cases in a neighbourhood may prompt concerned residents to advocate for an investigation.
- ❖ Sometimes the public is concerned that the disease cluster is the result of an environmental exposure such as toxic waste

Reasons for conducting outbreak investigation...

Program considerations

- ❖ An outbreak of a disease targeted by a public health program may reveal a weakness in that program and an opportunity to change or strengthen program efforts.
- ❖ Investigating the outbreak's causes may identify populations that have been overlooked, failures in intervention strategies, or changes in the agent.
- ❖ Using the outbreak to evaluate program effectiveness can help program directors improve future directions and strategies.

Reasons for conduction outbreak investigation...

Training

- ❖ Investigating an outbreak requires a combination of diplomacy, logical thinking, problem-solving ability, quantitative skills, epidemiologic know-how, and judgment.
- ❖ These skills improve with practice and experience.
- ❖ Thus, many investigative teams pair an experienced epidemiologist with an epidemiologist-in-training.
- ❖ The latter gains valuable on-the-job training and experience while providing assistance in the investigation and control of the outbreak.

Steps of epidemic Investigation

1. Prepare for field work
2. Establish the existence of an outbreak
3. Verify the diagnosis
4. Describe the epidemic with respect to time, place, and person
- 5 . Develop Hypotheses
6. Search for additional cases
7. Evaluate hypotheses
8. Make a decision on the hypotheses tested
9. Implement control and prevention measures

1. Prepare for field work

- A. Investigation related:** obtain appropriate scientific knowledge, supplies, and equipment to carry out the investigation; discuss with knowledgeable people, review applicable literature, and collect sample questionnaire. Who will be responsible for what? Day-to-day activities, supervision, writing report...
- B. Administration related:** assure personnel resources, funding, Travel arrangements (orders) ,Personal matters, Approval
- C. Consultation related:** be a good manager and collaborator as well

2. Verify the existence of an epidemic

- 👉 Compare the reported/observed number of cases with the expected number of cases in the area.

Excess may be due to :

- 👉 changes in local reporting procedures
- 👉 changes in case definition
- 👉 increased interest because of local or national awareness
- 👉 improvements in diagnostic procedures
- 👉 sudden changes in population size

3. Verify the diagnosis

- To Ensure proper diagnosis and rule out lab error as the bias for increased diagnosis
 - ✓ Review clinical findings, lab results
- See and talk with patients if at all possible for
 - Better understanding clinical features
 - Mental image of disease and the patients affected
- ✓ Helps to gather critical information about
 - Source of exposure
 - What they think caused illness
 - Knowledge of others with similar illness
 - Common denominators
- ✓ Helpful in generating ideas for hypothesis about etiology and spread

3. Verify the diagnosis...

3.1 Case definition: Standard set of criteria for deciding whether an individual should be classified as having the health condition of interest

- Includes clinical criteria and restrictions by time, place and person
- Must be applied consistently and without bias to all persons under investigation
- Must not contain an exposure or risk factor you want to test

➤ Classification of cases as:

- **Definite (confirmed):** laboratory confirmed
- **Probable:** typical clinical features without lab confirmation
- **Possible (suspected):** fewer of the typical clinical features

📖 Early in investigation may use a “loose” case definition (highly sensitive)

📖 Later when hypotheses are sharpened investigator may use “tighten” case definition

3. Verify the diagnosis...

3.2 Identify and count cases

- First target health care facilities where diagnosis is likely to be made
 - Enhanced passive surveillance e.g. letter describing situation and asking for reports
 - Active surveillance e.g. phone or visit facility to collect information
- Alerting the public using
 - Media alert to avoid contaminated food product and seek medical attention if symptoms arise
- If an outbreak affects a restricted population, and large proportion of cases are unlikely to be diagnosed (e.g. on school, worksite)
 - Survey entire population

3. Verify the diagnosis...

- Ask case-patients if they know of any others ill with the same symptoms (snow ball)

❑ **Information to be collected about every case**

- ✓ Identifying information (name, address)
- ✓ Demographic information-
 - Provide “person” characteristics for defining population at risk
- ✓ Clinical information (date of onset, sign and symptom etc)
- ✓ Risk factor information
 - Tailored to specific disease in question
- ✓ Reporter information
 - Id of person making report

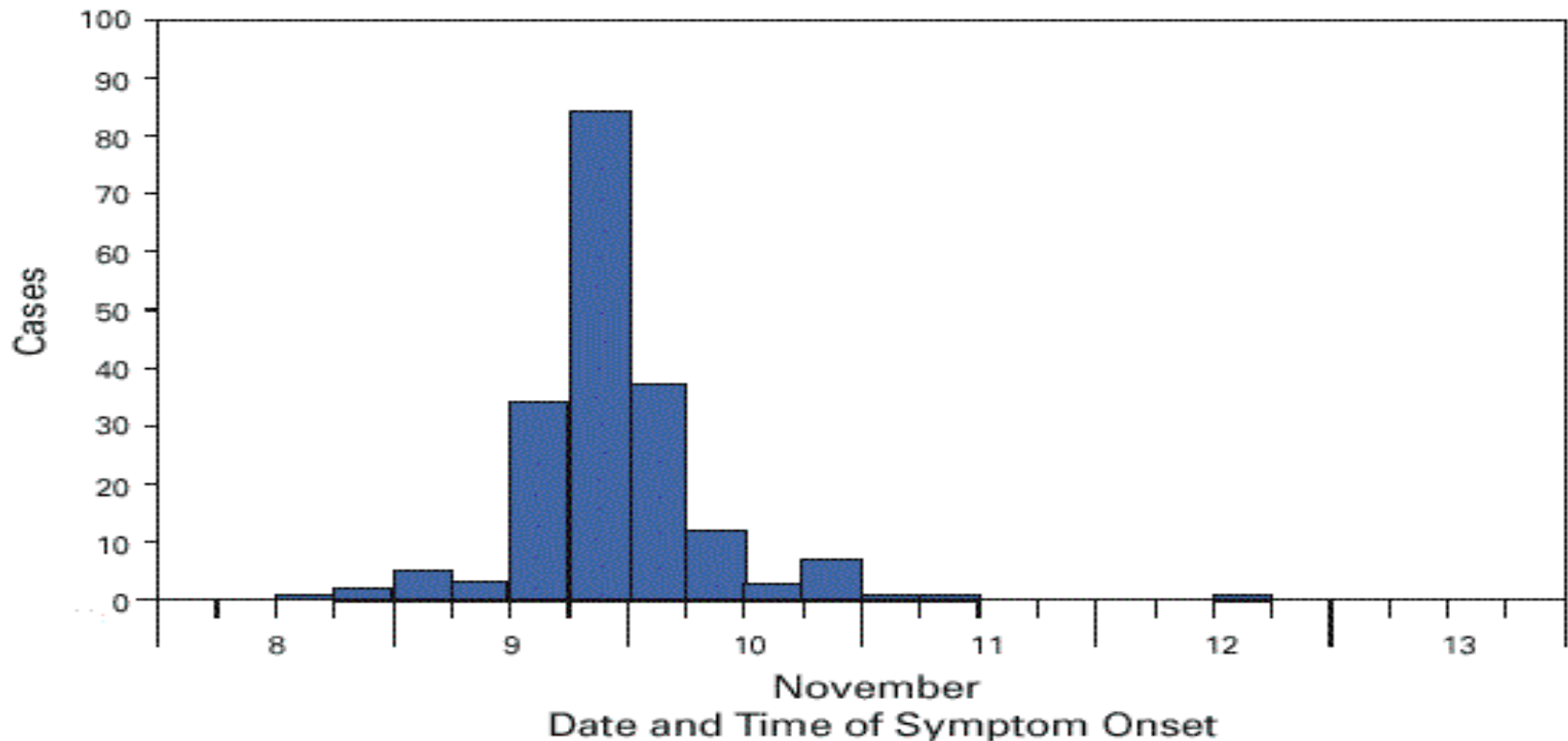
4. Describe the epidemic with respect to time, place, and person

Time

- Epidemic curve-is
 - Histogram of the number of cases by their date of onset
 - Visual display of the outbreak's magnitude and time trend
- ✓ Helps to know-
 - Where you are in the time course of the outbreak
 - Probable time period of exposure
 - Helps in development of questionnaire focusing on that time period

4. Describe the epidemic with respect to time, place, and person

FIGURE 1. Number of cases of Norwalk-like viral gastroenteritis among company employees, by date and time* of symptom onset — Anchorage, Alaska, November 8–13, 1999



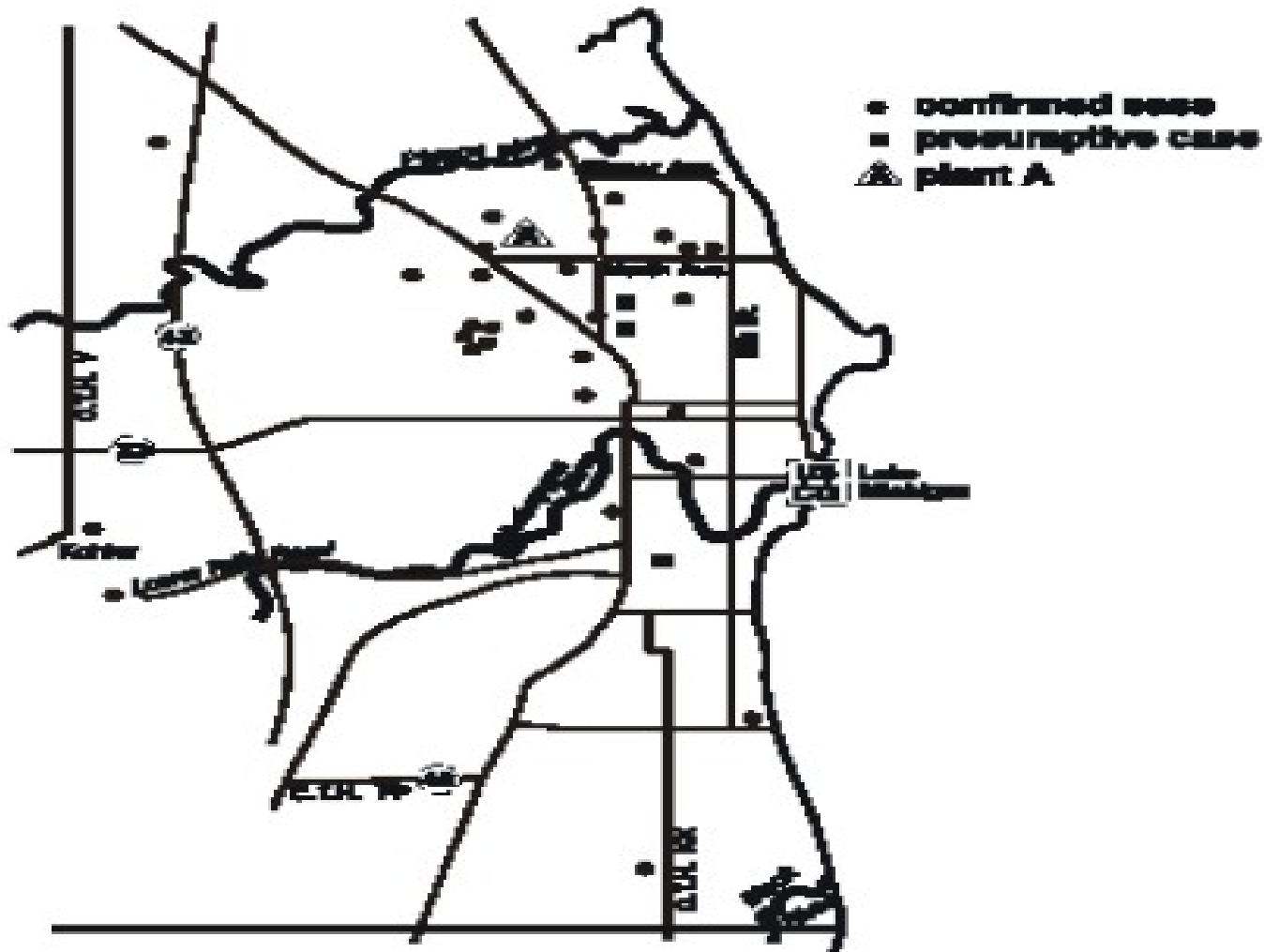
*6-hour intervals.

4. Describe the epidemic with respect to time, place, and person...

place

- Geographic extent of problem
- Clusters or patterns providing important etiologic clues
- Spot maps :where cases live, work or may have been exposed

4. Describe the epidemic with respect to time, place, and person ...



4. Describe the epidemic with respect to time, place, and person ...

Person

Helps to determine what population at risk

Usually define population by host characteristics(age, race, sex, or medical status) or exposure

Attack rates calculate rates of illness in population at risk.

Outbreak described by PERSON:

Overall Attack Rate of Reported Meningococcal Meningitis Cases by age group in Addis Ababa. 2000

Age group	Estimated Population From 1994 census	Cumulative Number of Cases	Attack rate per 100,000
0-4	170,667	117	68.5
5-14	599,146	293	48.9
15-29	820,316	531	64.7
30+	522,608	173	33.1
Total	2,112,737	1114	52.7

5. Develop Hypotheses

- The Hypotheses should address
 - Source of the agent
 - Mode of transmission
 - Exposure that caused disease
- should be testable,

6. Search for additional cases: locate un recognized or unreported cases.

- **Passive:** inquire physicians or hospitals or both whether they have seen similar cases.
- **Active:** do intensive investigation in the community on asymptomatic persons or contacts of the cases. For example: doing liver function test in an investigation of hepatitis A outbreak.

7. Testing the hypothesis

- Evaluate the credibility of your hypotheses by:
 - ✓ Comparing the hypothesis with established facts-
 - When clinical, lab, and environmental undoubtedly support hypothesis
 - ✓ Use analytic epidemiology to quantify relationships and explore the role of chance by-
 - Cohort studies
 - Case control studies

7. Test Hypotheses cont...

- Cohort study –mostly retrospective
 - If Small, well defined population
 - Contact each attendee and ask a series of questions
 - Look for source or exposure
 - Attack rate is high among those exposed
 - Attack rate is low among those not exposed
 - Relative risk = measure of association between exposure and disease
 - Avoid the roll of chance

7. Test Hypotheses cont...

➤ Case-control

- If population not well defined
- Cases and comparison group (controls) questioned about exposure(s)
- Compute measure of association = Odds Ratio

✓ Controls Selection: is too difficult

- Representative ,if randomly identified population-based controls (e.g. Random digit dialing)
- Other common sources of control
 - Neighborhood controls
 - Other patients of same physician
 - friends of cases

8. Make a decision on the hypotheses tested

- All the findings must be consistent with one, and only one, hypotheses.

9. Intervention and follow-up

- Make recommendations for control measures based on:
 - causative agent
 - source and reservoir
 - mode of transmission
 - susceptibility to agent
- Evaluate effectiveness of measure

10. Report of the investigation

- At the end prepare a comprehensive report and submit to the appropriate/concerned agency (or agencies).
- The report should follow the usual scientific format: introduction, background, methods, results, discussion, and recommendations.
- The report should discuss in detail:
 - Factors leading to the epidemic.
 - Effectiveness of the measures used for the control of the epidemic.
 - Recommendations for the prevention of similar episodes in the future

Managing Outbreak/epidemics

- 1. Measures Directed Against the Reservoir**
- 2. Measures that interrupt the transmission of organisms**
- 3. Measures that reduce host susceptibility**

Managing Outbreak/epidemics...

Measures Directed Against the Reservoir

Domestic animals as reservoir	<ul style="list-style-type: none">•Immunization•Testing of herds•Destruction of infected animals
Wild animals as reservoir	<ul style="list-style-type: none">•Post-exposure prophylaxis
Humans as reservoir	<ul style="list-style-type: none">•Removal of the focus of infection•Isolation of infected persons.•Treatment to make them non-infectious.•Disinfection of contaminated objects.

Managing Outbreak/epidemics...

Measures that interrupt the transmission of organisms	
For diseases transmitted by ingestion	<ul style="list-style-type: none">•purification of water•pasteurization of milk•inspection procedures designed to ensure safe food supply.•improve housing conditions.
For disease transmitted by respiratory routes	<ul style="list-style-type: none">•chemical disinfection of air and use of ultraviolet light.•work on ventilation patterns, like unidirectional ("laminar") air flow to reduce the transmission of organisms in hospitals
For diseases whose cycles involve an intermediate host	<ul style="list-style-type: none">•clearing irrigation farms from snails to control schistosomiasis.

Managing Outbreak/epidemics...

Measures that reduce host susceptibility

Active immunization	<ul style="list-style-type: none">• Mass vaccination• Selective vaccination
Passive immunization	<ul style="list-style-type: none">• Transfer of maternal antibodies to the fetus through the placenta.• Prophylaxis administration of immune serum globulin (ISG).
Chemoprophylaxis	<ul style="list-style-type: none">• use of antibiotics for known contacts of cases• use of prophylaxis to persons travelling to endemic areas.

Thank You