Introduction to Epidemiology

Epidemic Investigation and Management

By

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Introduction to unit 4 Epidemiology

• Definition, History of Epidemiology
  Purpose/Use of Epidemiology
• Concepts in the infectious diseases
• Disease Causation
• Measurements of Morbidity and Mortality
• Levels of prevention and vaccination
  Screening for diseases and vaccination
• Sources of Data and methods of data collection
• Epidemiological Surveillance
• Epidemic Investigation and Management
Health for all and all for health

#CHOOSEHEALTH

PROMOTING HEALTH, PROMOTING SUSTAINABLE DEVELOPMENT

World Health Organization

9th Global Conference on Health Promotion
SHANGHAI 2016
#CHOOSEHEALTH

1. GOOD GOVERNANCE
   - Strengthening governance and policies to make healthy choices accessible and affordable to all, and to create sustainable systems that make whole-of-society collaboration real.

2. HEALTHY CITIES
   - Creating greener cities that enable people to live, work, and play in harmony and good health.

3. HEALTH LITERACY
   - Increasing knowledge and social skills to help people to make the healthiest choices and decisions for their families and themselves.

3 PILLARS OF HEALTH PROMOTION

World Health Organization
WWW.WHO.INT/SHANGHAI2016
# Presentation outline

<table>
<thead>
<tr>
<th>Introduction and Definitions</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steps in outbreak investigation.</td>
<td>12:00 to 12:10</td>
</tr>
<tr>
<td>Study design for further investigation of the cause of this outbreak.</td>
<td>12:10 to 12:40</td>
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<tr>
<td></td>
<td>12:40 to 12:50</td>
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</tbody>
</table>
Learning Objectives

• To know the different **steps in outbreak investigation.**

• To apply a study design for further investigation of the cause of this outbreak.

• To **gain problem solving skills** in outbreak investigation *(through solving the exercise).*
Introduction

• Investigation is “an examination to find out about something.”

• Investigation is carried out on presumption of occurrence of a health problem.
Definition of outbreak

• Occurrence of more cases of disease than expected in a given area among a specific group of people over a particular period of time.

  or

• Two or more linked cases of the same illness.

• Epidemic: sudden abnormal increases in number of cases in a community.

• Outbreak: an epidemic on a small scale, among confined group (school).

• Public Health, Social, Economic... consequences
Definition of outbreak

• **One case** – for diseases of epidemic potential (e.g., avian influenza, Ebola, etc.)

• **More than the expected number of cases** – for **endemic diseases**

• **Sometimes is quantitative threshold** (e.g. meningococcal meningitis)
Objectives of outbreak investigations:

- To **describe** the epidemic or outbreak
- To **explain** how and why the outbreak took place
- To **develop the effective control** measures.
- To **control** ongoing outbreaks.
- To **prevent future** outbreaks.
- To **strengthen surveillance** at local level.
- To **advance knowledge about a disease**.
- To **provide training opportunities**.
Steps of an outbreak investigation

1) Verify diagnosis
2) Case definition
3) Confirm outbreak
4) Prepare for field work
5) Case identification
6) Descriptive data collection and analysis
7) Develop hypothesis
8) Analytical studies to test hypotheses
9) Implementation of control and preventive measures
10) Communication, including outbreak report

1. Ensuring the existence of an epidemic
2. Confirmation of diagnosis.
3. Defining the population at risk.
4. Rapid search for all cases and their characteristics.
5. Data Analysis.
6. Formulation of etiological hypothesis.
7. Testing of hypothesis
9. Plan a further study among population at risk
10. Prepare a written report and propose control measures.
Main steps

1) **Verify diagnosis**
2) **Confirm outbreak**
3) **Descriptive data collection and analysis**
4) **Develop hypothesis**
5) **Analytical studies to test hypotheses**
6) **Implementation of control and preventive measures**
7) **Communication, including outbreak report**

- 1) Establish the existence of an outbreak
- 2) Confirm the diagnosis
- 3) Define a case
- 4) Count cases
- 5) Perform descriptive epidemiology (time, person, place) Determine who is at risk
- 6) Develop hypotheses explaining exposure & disease
- 7) Evaluate hypotheses
- 8) Communicate findings
Preparation For Investigation

After determining the need for an epidemiological investigation, following preparations are required:

– Notifying essential people and organizations.

– Identifying materials needed for the investigation.

– Time scheduling and travel plan.
1) Prepare for field work

• Review literature.
• Prepare the supplies and equipments.
• Consult laboratory staff.
• Arrange for portable computer, camera.
• Consult local staff.
Outbreak Investigation Team?
Outbreak Investigation Team?

FIELD

Epidemiologist
Microbiologist
Environmental specialist
Ministry / Government
Press officer
Others
Outbreak Investigation Team?

Assess situation
Examine available information
Preliminary hypothesis?
Case definition
Case finding

Epidemiologist
Microbiologist
Environmental specialist
Ministry / Government
Press officer
Others
Coordination

Epidemiologist
Clinicians

Education
Laboratory

Media
Authorities

Vector Reservoir
Dead
Sick
Exposed

Investigation
Surveillance
Prediction

Health personnel
Special groups
General population

Clinical
Specimen transfer
Diagnostic

Decisions
Infrastructure
Regulations
Vaccinations etc
2) Detection of outbreak
2) Detection of outbreak

Routine surveillance
Clinical / Laboratory
General public
Media
2) Detection of outbreak

Is this an outbreak?

Routine surveillance
Clinical / Laboratory
General public
Media
2) Detection of outbreak

Is this an outbreak?

Compare the current number of cases with the number from the previous weeks or months. Or from a comparable period during the previous few years.

Routine surveillance
Clinical / Laboratory
General public
Media
3) Verify the diagnosis

• Describe cases **clinically**.
• Obtain a complete **listing of foods served**.
• Collect **specimens of feces and vomits and send for laboratory**.
• Submit suspected food for **laboratory**.
• Look for the **possible source** of contamination and periods of inadequate refrigeration and heating.
• Inquire about the **origin** of the incriminated food, manner of its preparation and storage before serving.
• Search for **food handlers with skin infections**. Culture all purulent lesions and collect nasal swabs from all food handlers.
4) Case definition

Standard set of criteria:

- Clinical criteria + restrictions of
- time
- place
- person
Example case definition

Patient older than 5 years with severe dehydration or dying of acute watery diarrhoea in town “x” between 1 June and 20 July 1998.
Example case definition

• Possible or suspect
  – Patient with severe diarrhoea.

• Probable
  – Patient older than 5 years with severe dehydration or dying of acute watery diarrhoea in town “x” between 1 June and 20 July 1998.

• Confirmed
  – Isolation of *Vibrio cholerae* from stools of patient.
5) Identify & count cases

Obtain information

Perform descriptive epidemiology

Clearly identifiable groups
- Hospitals
- Laboratories
- Schools
- Workplace, etc
Identify & count cases

Obtain information

Identifying information
Demographic information
Clinical details
Risk factors

Perform descriptive epidemiology
Obtaining information

Clinical Information:
Date of onset, symptoms, signs, ttt, Hospitalization, death

Risk factors Information:
Specific Exposures, Immunity status

Identifying information
Name, address, Telephone no, ....

Demographic information:
Age, sex, race, occupation
Identify & count cases

Obtain information

6) Perform descriptive epidemiology

Orient cases by
- time
- place
- person
Examples of epidemic curves

Point source

Continuing common source

Multiple waves - person to person or further outbreak
Cases of Salmonellosis (n=63) by date and time of onset of illness. Hospital A, Dublin, August 1996

Date and time of onset

I.p: Min 12 h
Max 90 h
Range 78
Mode

15 cases
14
13
1 case patient
12
1 case staff member
11
10
9
8
7
6
5
4
3
2
1
0
00- 06- 12- 18- 00- 06- 12- 18- 00- 06- 12- 18-
27 August 28 August 29 August 30 August

Median (case no 33)
Confirmed cases of meningococcal meningitis type B by residence, Dublin, 1996

1 dot = 1 case
7) Develop hypothesis

- **Who** is at risk of becoming ill?
- What is the **disease** causing the outbreak?
- What is **the source and the vehicle**?
- What is the **mode of transmission**?

**Compare hypothesis with facts**
Calculate the **attack rate:**

\[
\text{Attack rate} = \frac{\text{number of new cases}}{\text{persons at risk}} \times 100
\]

It could be calculated by gender, location, type of food.

**Compare the attack rates in cases and controls.**
8) Test specific hypothesis

Analytical epidemiological studies

- Cohort
- Case-control
Descriptive versus Analytical epidemiology

Descriptive epidemiology:

• generates idea(s) or hypothesis for associations between risk factor and illness.

Analytical epidemiology:

• uses a comparison group to establish an association between risk factors and illness in the two groups.
## Food Specific Attack Rates, Outbreak of Salmonellosis, Prison X, Dover, Delaware, September 1992

<table>
<thead>
<tr>
<th>Food</th>
<th>Ate the food</th>
<th></th>
<th>Did not eat</th>
<th></th>
<th>RR*</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ill</td>
<td>No.</td>
<td>%</td>
<td>Ill</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Chicken salad</td>
<td>182</td>
<td>243</td>
<td>75</td>
<td>3</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td>Bread</td>
<td>165</td>
<td>226</td>
<td>73</td>
<td>20</td>
<td>42</td>
<td>48</td>
</tr>
<tr>
<td>Lettuce</td>
<td>130</td>
<td>174</td>
<td>75</td>
<td>55</td>
<td>94</td>
<td>59</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>122</td>
<td>69</td>
<td>72</td>
<td>63</td>
<td>99</td>
<td>64</td>
</tr>
<tr>
<td>Halves pears</td>
<td>128</td>
<td>180</td>
<td>71</td>
<td>57</td>
<td>88</td>
<td>65</td>
</tr>
<tr>
<td>Iced tea</td>
<td>144</td>
<td>211</td>
<td>68</td>
<td>41</td>
<td>57</td>
<td>72</td>
</tr>
<tr>
<td>Vegetable soup</td>
<td>99</td>
<td>153</td>
<td>65</td>
<td>86</td>
<td>115</td>
<td>75</td>
</tr>
<tr>
<td>Margarine</td>
<td>26</td>
<td>40</td>
<td>65</td>
<td>159</td>
<td>228</td>
<td>70</td>
</tr>
</tbody>
</table>

* RR: relative risk, IC: confidence interval

Relative Risk is calculated for each food item among those who ate or did not eat the item.
### Food Specific Attack Rates, Outbreak of Salmonellosis, Prison X, Dover, Delaware, September 1992

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<th>Ate</th>
<th>Did not eat</th>
<th>RR*</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken salad</td>
<td>75</td>
<td>12</td>
<td>6.2</td>
<td>(2.2, 18.1)</td>
</tr>
<tr>
<td>Bread</td>
<td>73</td>
<td>48</td>
<td>1.5</td>
<td>(1.1, 2.1)</td>
</tr>
<tr>
<td>Lettuce</td>
<td>75</td>
<td>59</td>
<td>1.3</td>
<td>(1.1, 1.6)</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>72</td>
<td>64</td>
<td>1.1</td>
<td>(1.0, 1.4)</td>
</tr>
<tr>
<td>Halves pears</td>
<td>71</td>
<td>65</td>
<td>1.1</td>
<td>(0.9, 1.3)</td>
</tr>
<tr>
<td>Iced tea</td>
<td>68</td>
<td>72</td>
<td>1.0</td>
<td>(0.8, 1.1)</td>
</tr>
<tr>
<td>Vegetable soup</td>
<td>65</td>
<td>75</td>
<td>0.9</td>
<td>(0.7, 1.0)</td>
</tr>
<tr>
<td>Margarine</td>
<td>65</td>
<td>70</td>
<td>0.9</td>
<td>(0.7, 1.2)</td>
</tr>
</tbody>
</table>

* RR: relative risk, IC: confidence interval

The relative risk in blue are the significant ones
9) Implement control measures

- Control the source of the pathogen
- Interrupt transmission
- Modify host response

May occur at any time during the outbreak!!

Prevent recurrence
Control the source of pathogen

- **Remove source** of contamination.
- **Remove persons from exposure.**
- **Inactivate** / neutralise the pathogen.
- **Isolate** and/or treat infected persons.
9) **Implement control measures...**

May occur at any time during the outbreak!!

- a. **Control the source of the pathogen**
- b. **Interrupt transmission**
- c. **Modify host response**

**Prevent recurrence**
b. Interrupt **transmission**

- Interrupt **environmental** sources
- Control **vector** transmission
- Improve **personal sanitation**
9) Implement control measures...

- Control the source of the pathogen
- Interrupt transmission
- Modify host response

May occur at any time during the outbreak!!

Prevent recurrence
c. **Modify host response**

- **Immunise susceptible**
- **Use prophylactic chemotherapy.**
10) Outbreak report

- Prepare written report
- Communicate public health messages
- Influence public health policy
- Evaluate performance
Prepare a written report and propose control measures

The final report be complete and convincing and include the following components:

– **Background**: Location, Climate, Demographic profile, Socio-economic status, Health Services, surveillance system and normal disease prevalence.

– **Historical Data**: Previous occurrence of same disease and other similar disease in the same and nearby areas.

– **Methodology**: Case definition, questionnaire used, survey team and type, laboratory specimen and testing.

– **Analysis of Data**: Clinical data, epidemiological data, modes of transmission, laboratory results and Interpretation.

– **Control Measures**: Detailed strategy, constraints, costs analysis considerations and Evaluation of preventive measures.
• Thank you