Chapter 6

OUTBREAK INVESTIGATION, RESPONSE & CONTROL

This section covers

- Defining an outbreak/epidemic
- Detecting an outbreak
- Investigation of an outbreak
- Response to an outbreak and control measures
WHY AN OUTBREAK HAS TO BE INVESTIGATED?
Analysis of the data may reveal potential or actual outbreaks. These need to be investigated and if verified, needs to be controlled. This is the basic essence of this chapter. The purpose of an investigation is to

- Verify the outbreak
- Recognise the magnitude of the outbreak.
- Diagnose the etiological agent, identify the source and the route of transmission as well as the people at risk
- Recommend measures so that the outbreak can be controlled as well as prevented in the future.

DEFINITION OF AN OUTBREAK:

An outbreak or epidemic is defined as the occurrence in a community of cases of an illness clearly in excess of expected numbers. While an outbreak is usually limited to a small focal area, an epidemic covers large geographic areas and has more than one focal point.

There is yet another definition of an outbreak – occurrence of two or more epidemiologically linked cases of a disease of outbreak potential (e.g. measles, cholera, dengue, JE, AFP or plague).

DETECTING AN OUTBREAK:
There are various ways in which outbreaks can be detected. Some of these are:

Rumour register

The rumour register (sample in Annex 6.1) is to be maintained in each public health institution. Source of information from the community should be verified to identify outbreaks. It is an important source of information and should not be neglected. On the other hand, key informants in the community should be assiduously cultivated, so they become the eyes and ears of the health services in the community.

Review of routine data

The first step in investigating an outbreak is to detect it. One of the common ways of early detection is to review the data from the routine surveillance and check if it crosses threshold levels. Details of this are provided in the previous chapter. If the cases are approaching the threshold level or has crossed it, then an outbreak should be suspected. Remember to review the lab data also.
One another method is to be alert for any unusual events that maybe reflected in the routine data. Some examples are given below

**Warning signs of an impending outbreak**

- Clustering of cases or deaths in time and/or space
- Unusual increase in cases or deaths
- Even a single case of measles, AFP, Cholera, Plague, dengue or JE
- Acute febrile illness of unknown aetiology
- Occurrence of two or more epidemiologically linked cases of meningitis, measles
- Unusual isolate
- Shifting in age distribution of cases
- High vector density
- Natural disasters

**Media**

The media is an effective source of information on any unusual health event in the community. This important source is unfortunately neglected and ignored by the health services. It may help to tap this source.

**Trigger events**

Some times trigger events indicate a potential outbreak. Details of these are given below.

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<tr>
<th><strong>CHOLERA</strong></th>
<th><strong>DYSENTERY</strong></th>
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<td>If a single suspect case is confirmed</td>
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<th><strong>MEASLES</strong></th>
<th><strong>ACUTE DIARRHOEAL DISEASES</strong></th>
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<td>If a single suspect case is confirmed.</td>
<td>If the number of new cases exceeds the upper limit of cases seen in a previous non-epidemic period in previous years.</td>
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<th><strong>DENGUE/ DHF/ DSS</strong></th>
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<th><strong>JAPANESE ENCEPHALITIS</strong></th>
<th><strong>VIRAL HEPATITIS</strong></th>
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WHO SHOULD RESPOND TO AN OUTBREAK

At the PHC and CHC level, the MO of the concerned institution will be the nodal officer who will respond to an outbreak. At the district, the Corporation, the State and the Central level special Rapid Response Teams need to be formed whose prime responsibility is to investigate outbreaks. If an outbreak is suspected, the local health team should verify the same. Once this is done and if there is a need to investigate, the RRT should take over and do the needful.

The Rapid Response Teams (RRT):

The RRT is a multi faceted team that looks into the various aspects of an outbreak. A suggested composition of this team is an epidemiologist, a clinician and a microbiologist. Further details of the RRT are given in Annex 6.8

The main role of the RRT will be to investigate and confirm outbreaks. It is to be noted that the RRT is not a permanent team who is waiting for an outbreak. They are individuals who are normally performing their usual roles, but in the event of an outbreak come together to undertake a special function. They should work in close coordination with the local health staff in the event of an outbreak. While they will help and support the local staff in the management and control of the outbreak, the prime responsibility for implementing control measures rests with the local health staff (with additional support from the district health authorities).

The names, addresses and telephone numbers of the RRT members should be available with the District and State surveillance officer at all times, so that they can be activated as soon as possible. Members who have been transferred etc should be replaced with competent people as soon as possible.

Epidemic preparedness

<table>
<thead>
<tr>
<th>Preparatory action before an outbreak</th>
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<tr>
<td>• Formation of the RRT</td>
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<td>• Training for the RRT</td>
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<tr>
<td>• Regular review of the data</td>
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<td>• Identifying ‘outbreak seasons’</td>
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<td>• Identifying ‘outbreak regions’</td>
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<tr>
<td>• Ensuring that these regions have the necessary drugs and materials (including transport media) prior to the ‘outbreak season’</td>
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<td>• Identifying and strengthening the appropriate labs</td>
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<tr>
<td>• Designating vehicles for outbreak investigation and ensuring that it is in working condition</td>
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<tr>
<td>• Ensuring that communication channels like telephones are in working condition.</td>
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INVESTIGATING AN OUTBREAK

1. Unusual health event
   - Is this an outbreak?
     - YES: Institute control measures
     - NO: Continue
   - YES: Institute control measures
   - NO: Further Investigation (Clinical, Laboratory, Epidemiological)

2. Etiology, source and transmission known?
   - YES: Institute control measures
   - NO: Further Investigation (Clinical, Laboratory, Epidemiological)

3. Describe outbreak in terms of Place, time and Person
   - Develop Hypothesis regarding source, transmission, etiology and people at risk
   - Does the Hypothesis fit with the Facts?
     - YES: Institute control measure
     - NO: Special studies
Remember that an outbreak is a sudden and unexpected event usually. There is a need to act quickly. So a SYSTEMATIC APPROACH needs to be adopted.

When the DSO suspects an outbreak, he/she should initiate the following steps immediately.

**Step 1 - Verification of the outbreak**

The preliminary step of the outbreak investigation would be to verify the outbreak. Much time may be wasted due to a false alarm. Even if the outbreak is suspected from the routine surveillance data, it must be verified (lest it may be a data entry error). The fastest way to verify is to contact the MO nearest to the location of the outbreak and request him/her for confirmation. This may be done telephonically or through a special messenger. The MO should check

- if there is an abnormal increase in the number of cases or
- if there is a clustering of cases or
- if the cases are Epidemiologically linked or
- if some trigger events have occurred (see above) or
- if many deaths have occurred

If there is evidence of an outbreak, and if the etiology, the source and the route of transmission is known, then the specific control measures need to be immediately instituted. If however, any one of the above is unknown, then the outbreak must be investigated to identify the specific cause. The RRT should be alerted and requested to investigate the outbreak. At the same time, general control measures should be instituted.

**Step 2 – Sending the RRT**

A RRT should be immediately formed with those readily available. As stated above, it should have the minimum 4 categories of professionals. Resources (vehicles, drugs, reagents and forms) should be made available to the RRT and they should proceed to the location. At the location the RRT members along with the local health staff should initiate a Medical / Epidemiological / Laboratory investigation simultaneously.

- **Medical investigation** - The physician / paediatrician will clinically examine the available cases (in the hospital or the community) and make a clinical diagnosis. The history will include questions that will identify the possible source, routes of transmission and contacts. He will also review the case management (as per the recommended protocol) and recommend suitable amendments to the therapy if required.

- **Laboratory investigation** - The microbiologist will perform the appropriate lab investigations. He will advise on what samples are required, mode of collection and method of transportation and also to which lab it has to be sent. He will be
responsible for the lab confirmation of the outbreak. If the outbreak warrants entomological investigation should also be done.

It is not necessary to collect specimens from ALL cases; just enough to confirm the diagnosis.

- **Epidemiological investigation** - The epidemiologist will carry out a detailed epidemiological investigation that will look into the epidemiological and environmental aspects of the outbreak. The basic aim of the epidemiological investigation is to identify the source of the problem and the routes of transmission. For this he may ask for further tests like water analysis, entomological survey, etc. The detailed steps in the epidemiological investigation are given in Annex 6.3:

- **Formulation of hypothesis**: The RRT will then review all the various investigative findings and reports/results received and formulate a provisional hypothesis to explain the cause of the outbreak. This will answer the following questions:
  - What was the causal agent
  - What was the source of infection
  - What was the transmission pattern
  - Who are the people at risk

If this hypothesis fits with the facts, then specific response measures can be instituted. If however, the hypothesis does not fit with the facts, then further analytical investigation in terms of case control studies will need to be carried out. In the meantime, general control measures may be instituted.

- **Specific response measures**: Based on the above hypothesis, the RRT will recommend suitable control measures to be immediately implemented by the local PHC staff to curtail the epidemic. If the team feels that the PHC staff needs any support, then they will request the District to provide the necessary help. Similarly if the district team needs support, then they need to call the State team.

Call the State or Centre if:
- the outbreak is unusual, or
- the CFR is high, or
- if the aetiology cannot be determined

- **Special studies if necessary**: Following the institution of control measures, if the epidemic is under control and tapers off, the hypothesis of causation could be considered as correct. If the epidemic continues unabated then the Hypothesis would have to be reviewed. In such cases analytical studies like a case control study might have to be conducted to confirm the hypothesis. The decision to
investigate further or to institute control measures are dependent on whether the source and the transmission are known or not. See Fig 6.1

- **Interim report**: The RRT should file an interim report, giving details of the investigation and the diagnosis and also the control measures initiated. A format is given in Annex 6.5

- **Follow-up Visits**: Once the outbreak is coming under control, the RRT can leave but should make follow up visits to ensure that the control measures are being implemented adequately. Also these follow up visits help to identify any new information that may have been missed in the first visit.

![Fig 6.1: Investigate or control?](image)

<table>
<thead>
<tr>
<th>SOURCE / TRANSMISSION</th>
<th>Known</th>
<th>Unknown</th>
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<tbody>
<tr>
<td><strong>ETIOLOGY</strong></td>
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<tr>
<td>Known</td>
<td>Control +++ Investigate +</td>
<td>Control + Investigate +++</td>
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<tr>
<td>Unknown</td>
<td>Control +++ Investigate +++</td>
<td>Control + Investigate +++</td>
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**Step 3: Monitoring the situation**

The DSO / MHO should monitor the situation on a regular basis. Ideally they should review the status on a daily basis and give feedback to the RRT as well as feed forward to the State. The main points to monitor are:

- The trends in the cases and deaths.
- The containment measures that are being implemented
- Drugs / vaccine stock
- Logistic issues – communications, vehicles,
- Community involvement
- Media response

This should continue till the outbreak is officially declared to be over.

**Step 4: Declaring the outbreak to be over**

The DSO / MHO should declare the outbreak to be over only when there have been no new cases for a period of 2 incubation periods since the onset of the last case. This implies that a very active case search should continue during this period to ensure that cases are not missed.
**Step 5: Review of the final report**

The DSO / MHO should receive the final report from the PHC MO within 10 days of the outbreak being declared to be over. The Technical committee should review the report basically to understand why the outbreak occurred. Based on this review the Committee should make recommendations – immediate and medium term, so that similar outbreaks do not occur. Most important, they should try and identify deficiencies in the system that needs to be rectified.

**RESPONSE TO AN OUTBREAK**

Even as the outbreak is detected, and is being investigated, control measures need to be instituted. These may be divided into

1. General measures - till the specific source and route of transmission is identified. For example, if one is suspecting a water borne disease, then one should start a campaign requesting people to use safe drinking water.

2. Specific measures – depending on the causative agent. The broad steps would include
   - Identification and nullification of the source of the outbreak e.g. chlorinating wells.
   - Minimising transmission and so further exposure e.g. vector control
   - Protection of the host e.g. immunisation or chemoprophylaxis.
   - Effective case management

Fig 6.2 Specific measures

![Diagram showing nullification of source, minimising transmission, and protecting the host.](image)
General measures:

- Logistic support to the field teams: This would start immediately when the outbreak is reported without waiting for verification, etc. The emphasis should be on saving lives. Some of the resources that would be necessary are:
  - Human resources - Additional MO’s, lab technicians and nursing staff (depending on the number of cases/deaths reported) may be sent from the block/district hospital to strengthen in-patient treatment facilities in the nearest health facility, like the PHC. They will assist the MO health facility in providing emergency health care to the patients. Assistance from local practitioners/specialists should also be sought for better on the spot management of cases. If situation demands ‘camp hospitals’ should be established in school buildings or similar structures.
  - Drugs – In the event of an outbreak, there should be an uninterrupted flow of medicines to the area. Emergency medicine stocks should be mobilised and if necessary medicines should be relocated from unaffected regions for the use of the affected region.
  - Equipment and supplies – this is also important and the district health manager should ensure that this takes place.
  - Vehicles and mobility – this is of utmost importance as the teams need to move as fast as possible to the affected areas.
  - 24-hour Communication channels to be established between the District and the team leader at the outbreak location.

- IEC to sensitise the community about the problem, give them the correct messages and enrol their help in containing the outbreak. More details are given in Annex 6.6

- Handling of the media – this is an important task and needs the appointment of a special officer whose main responsibility is to update the press on a daily basis. This will reduce the stress for the district managers and will go a long way in communicating the right message to the community.

WATER BORNE OUTBREAK

- If one is suspecting a water borne outbreak – then one has to ensure:
  - Access to safe drinking water: Ideally it would be best to communicate to the people not to use any of the local sources for drinking purposes and to supply safe water in sachets or through water tankers for the duration of the epidemic. All wells in the area should be cleaned by frequent emptying out of water by portable pump sets and then chlorinated with fresh bleaching powder.
  - Sanitary disposal of human waste: This is a major source for water contamination and a major cause for outbreaks. Sanitary disposal of faeces
and other human waste during an outbreak is a major task and must be well planned out.

- Frequent hand washing.
- Adopting safe practices in food handling.

VECTOR BORNE OUTBREAK
- If one is suspecting a vector borne outbreak, then one has to ensure
  - **Vector control:** Integrated vector control i.e. use of environmental methods (draining of water collections/ stagnation, filling, etc), biological (use of larvivorous fish, Bacillus thuringensis, etc) and chemical (larvicidal – abate/ baytex, anti-adult-space sprays, fogging only if absolutely essential, and indoor residual spray with appropriate chemicals) should be implemented on priority under guidance by the entomologist (if available).
  - **Personal protective measures:** Prevention of exposure to mosquito bites by using repellents (including neem oil) and use of mosquito nets at night (plain or impregnated) would significantly reduce risk of infection during an outbreak.

VACCINE PREVENTABLE OUTBREAK
- If one is suspecting an outbreak due to VPD, then one has to ensure
  - Adequate supply of vaccines, syringes and needles
  - Adequate staff who are able to administer the vaccines.
  - Ring immunisation where applicable.

**Specific measures:**

This depends on the causative agent, the source of the agent, the method of transmission, the host response, the local conditions including the environment, the effectiveness of the health services etc. A framework for specific intervention is given in Annex 6.7 and each individual disease is tackled separately.

**What is important is to nullify the source as soon as possible, stop (or minimise) transmission and effectively manage the existing cases.**

To summarise, general measures should instituted immediately and specific measures on confirmation. The DSO / MHO should also make a decision as soon as possible whether they need the support of others e.g. the nearby medical colleges, the State or the Centre.

REPORTS

It is important for the concerned officials to make appropriate and timely reports to higher authorities. This has two main uses
1. It keep the authorities at the higher level informed so that they can make the appropriate decisions.

2. It helps to review the outbreak and response, identify system failures and take corrective measures so that similar events are not repeated.

Thus reports are an important learning tool and should not be seen as a mindless chore. But for this to happen, the authorities at the appropriate level should read the reports and take the necessary action.

Some of the reports recommended are:

Preliminary report by nodal MO:

The nodal MO of the peripheral health facility who first reports the outbreak should submit a preliminary report to the next level. The report should cover briefly about how the outbreak came to his attention, verification of the outbreak, total number of affected cases/deaths, time, person, place analysis, management of the patients, likely suspected source, immediate control measures implemented, etc. A sample report form from Maharashtra is shown in Annex 6.2

Daily situation updates:

During the period of the outbreak the nodal MO should continue to give daily situation updates of the outbreak to the next level. This should continue even when the EIT has started its investigation and should include the list of new cases, lab results received, any new findings, any containment measures taken etc. This daily report should continue till the end of the outbreak (i.e. no suspect case during a period which is double the incubation period). However it is important that these updates are kept as simple as possible – thereby sparing the MO unnecessary work.

Interim report by RRT:

The RRT will submit an interim report within one week of starting their investigation, response and control activities. The report should cover verification of the outbreak, total number of affected cases/deaths, time, person, place analysis, management of the patients, likely suspected source, immediate control measures implemented, etc. The report will include reports by the physician and microbiologist, and entomologist (where applicable). The lab results received during that period, environmental factors, etc. It will also have a provisional hypothesis of the causation of the outbreak and comments/recommendations, if any, including whether any further outside help is necessary.

Final report:

Within 10 days after the outbreak has ceased, a final outbreak investigation report must be submitted by the local health authorities. This report must be comprehensive and give a complete picture of the multi-factorial causes of the outbreak, the precipitating factors, the evolution of the epidemic, description of the persons affected, time trends, areas affected and direction of spread of the epidemic. It should have complete details of lab results including regional lab (cross verification and
strain identification), confirmation of the provisional diagnosis and other relevant information.

It is important that feedback from the report is shared with the lower levels and also other districts. Publication in a journal will ensure wider circulation of the lessons learnt.

CONCLUSION

Surveillance has no meaning if there is no action taken. So the response mechanism is necessary to ensure an effective surveillance system. Response has two objectives, one is to contain the outbreak, while the other is identify problems with the health systems so that repetitions of the outbreaks do not occur. There are certain principles of outbreak response that is common to most outbreaks and if applied will be effective in most situations. Fig 6.2 depicts graphically the benefit of a timely response.

In the case of Non-communicable diseases, the response is usually in the form of IEC and patient education so that there are behavioral changes. This IEC may be done by the concerned department in the Ministry of Health, based on the findings of the surveys.

Fig 6.2: Natural history of an outbreak in the event of an effective response