
TECHNICAL GUIDELINES ON DETECTION AND CONTROL OF EPIDEMIC YELLOW FEVER

These *Technical Guidelines on the Detection and Control of Epidemic Yellow Fever* were prepared by the Data for Decision Making Project of the International Branch / Epidemiology Program Office of the National Centers for Disease Control and Prevention, 1600 Clifton Road Atlanta, Georgia, 30333, USA.

The goal of the Data for Decision Making Project is to increase the use of epidemiologic, economic, demographic, and other data in formulating and implementing public health policies and programs. The purpose of these Guidelines is to assist public health officials in Africa in preparing for and responding to epidemics of yellow fever. The Guidelines may also be useful to international, bilateral and non-governmental agencies which assist countries in efforts to control yellow fever epidemics.

These Guidelines are meant for district level staff who are responsible for detection and control of epidemics. The Guidelines will help a district health team make their district ready to detect and control an epidemic of yellow fever. District team members who attend a training workshop based on these guidelines, and who work on the follow-up projects in their places of work, should be able to:

- √ detect and investigate an epidemic of yellow fever
- √ arrange for confirmation of a suspected epidemic;
- √ collect and analyze the data needed to make essential decisions

-
-
- √ institute treatment and control measures
 - √ plan for financing the epidemic preparedness strategy and
 - √ make an epidemic preparedness action plan.

Acknowledgments

The Data for Decision Making Project (Project Number 936-5991) was supported by the United States Agency for International Development under a Participating Agency Service Agreement (PASA Number DPE-5991-X-HC). The following people contributed to the development of the Technical Guidelines and training materials¹: Robert Craven, Bradley A. Perkins, James Zingeser, Richard Greene, Karen Wilkins, Anne E. Rodman and Marguerite Pappaioanou.

Additional information may be obtained by contacting the Data for Decision Making Project.

¹ The training materials were developed by the Klemm Analysis Group, Inc. under a contract with the Data for Decision Making Project.

TECHNICAL GUIDELINES ON DETECTION AND CONTROL OF EPIDEMIC YELLOW FEVER

CONTENTS

INTRODUCTION	1
1.0 ABOUT YELLOW FEVER	2
1.1 Magnitude of the Problem in Africa	2
1.2 Urban and Sylvatic Yellow Fever Transmission	2
1.3 Conditions Favoring Yellow Fever Epidemics	3
2.0 THE DISEASE	7
2.1 Carriage, Transmission and Development of Disease	7
2.2 Clinical Presentation of Yellow Fever	7
2.3 Clinical Laboratory Findings	8
3.0 HOW TO DETECT AND CONFIRM AN EPIDEMIC OF YELLOW FEVER	9
3.1 Epidemic Versus Endemic Yellow Fever	9
3.2 Surveillance for Early Detection of Yellow Fever Epidemics	9
3.3 Collecting Information About Patients	10
3.4 Reporting Suspected Cases and Suspected Epidemics	11
3.5 Laboratory Confirmation of Yellow Fever	12
3.6 Investigation of Suspected Yellow Fever Epidemics	13

4.0	HOW TO RESPOND TO AN EPIDEMIC OF YELLOW FEVER	23
4.1	Steps for the Control of an Epidemic	23
4.2	Convene a District Epidemic Committee	24
4.3	Report Cases and Inform Authorities	26
4.4	Inform the Public	26
4.5	Conduct a Mass Vaccination Campaign	27
4.6	Report During an Epidemic	35
4.7	Control Mosquitoes	36
4.8	Documenting the Epidemic	37
4.9	Clinical Management of Patients with Yellow Fever	37
5.0	HOW TO PREPARE FOR A YELLOW FEVER EPIDEMIC	41
5.1	Ensure That the Surveillance System Can Detect Yellow Fever	44
5.2	Ensure the Capability to Get Laboratory Confirmation	44
5.3	Identify and Address Training Needs	45
5.4	Maintain a Reserve Stock of Vaccine and Essential Equipment and Supplies	48
5.5	Organize an Epidemic Committee	49
5.6	Plan Staff and Logistics Needed for Control Measures	50
5.7	Ensure That Financial Support Is Available for Preparation and Response	51
5.8	Organize Vaccination Teams	52
5.9	Make an Emergency Response Plan for Responding to an Epidemic of Yellow Fever	52
5.10	Evaluate Epidemic Preparedness	54
5.11	Plan for Prevention	55

ANNEXES

Annex 1	Resources and Assistance	59
Annex 2	Sample Public Health Education Messages	61
Annex 3	Guidelines on Vaccine Management and Administration	65
Annex 4	Laboratory Confirmation of Yellow fever	67
Annex 5	Roles and Responsibilities at the Health Facility, District, Province and Central Levels	69

INTRODUCTION

Yellow fever is a preventable disease. In the long term, a commitment to immunization will eliminate epidemics.

However, as long as there is a large population that is not immune, the potential for epidemic yellow fever exists. Yellow fever cases, particularly sporadic ones occurring early in an epidemic, are often misdiagnosed. A large epidemic may be underway by the time it is recognized. When an epidemic of yellow fever does occur, many cases and deaths can be prevented if the epidemic is detected *early*, and if a mass vaccination campaign is begun *quickly*. Health authorities are expected to respond quickly and effectively when epidemics occur. To do so, they should have a yellow fever epidemic response plan which:

- √ outlines control measures,
- √ causes minimal disruption of the usual health services, and
- √ provides for adequate resources to treat patients and control the spread of the disease.

Epidemic prevention, preparedness and control all involve decision-making on the part of health officials. To be effective and cost-effective, these decisions must be based on reliable and timely data.



Chapter 1

ABOUT YELLOW FEVER

Yellow fever is an acute mosquito-transmitted viral infection which is endemic and occasionally epidemic in many countries of Africa and South America. The spectrum of clinical yellow fever varies from an undifferentiated febrile illness to death. Patients with classic yellow fever have fever, vomiting, epigastric pain, prostration, dehydration, scleral icterus, gastrointestinal bleeding leading to “black vomitus,” and abnormal kidney function. From 20% to 50% of patients with classic symptoms die, with deepening scleral icterus, hemorrhages, shock, encephalopathy, and renal failure.

The death rates during epidemics, and the consequent social and economic disruption, can be enormous. Yellow fever is preventable — the 17D vaccine is safe, effective, inexpensive and provides protection from 10 years to life. Epidemics can be controlled by the prompt vaccination of people at risk and by efforts to eliminate the mosquito vector. In the long term, the threat of yellow fever can be markedly reduced by routinely vaccinating children against yellow fever.

There is no specific curative treatment for yellow fever, and the inability of modern medicine to intervene in the course of severely ill patients emphasizes the importance of prevention through consistent vaccination of children. Thus, a public health program for yellow fever consists of:

- 1) a prevention program based on the vaccination of children (incorporating yellow fever vaccine into the EPI programme), and
- 2) a management plan for responding to epidemics.

1.1 Magnitude of the Problem in Africa

The historic zone of yellow fever transmission in tropical Africa lies between 15° North and 10° South. Yellow fever epidemics have been documented in Africa since 1778, causing hundreds of thousands of cases and tens of thousands of deaths.

Large scale yellow fever vaccination was first begun in Francophone West Africa, which prevented epidemics there for many years. Yellow fever has re-appeared in countries where vaccination programs were abandoned, and the impact of outbreaks has fallen upon the unimmunized young of the population.

For the past 20 years, West Africa has been the major geographic focus of yellow fever epidemics on the continent, but regional outbreaks returned to East Africa during the 1990's. Countries which have experienced yellow fever outbreaks and epidemics in recent years include Angola, Cameroon, Gabon, Gambia, Ghana, Guinea, Kenya, Liberia, Mali, Nigeria, Sierra Leone, Sudan and Zaire. All of these outbreaks share two characteristics: failure to maintain adequate levels of yellow fever immunization in the population at risk and lack of plans for rapid detection of and response to outbreaks. Countries at risk in the historic yellow fever endemic zone, but where there have not been recent outbreaks are: Benin, Burkina Faso, Burundi, Central African Republic, Chad, Congo, Ethiopia, Guinea-Bissau, Ivory Coast, Niger, Rwanda, Senegal, Somalia, Tanzania, Togo, Uganda, and Zambia. The long history of yellow fever in this classic transmission zone suggests that recurrence of disease may be expected in any of these countries where high levels of vaccine immunity have not been maintained.

1.2 Urban And Sylvatic Yellow Fever Transmission

There are two types of yellow fever transmission, *urban* and *sylvatic*.

1.2.1 Urban Yellow Fever

Urban yellow fever occurs in more populated areas and is usually transmitted by *Aedes aegypti* mosquitoes. It occurs when infected humans or infected mosquitoes are introduced into populated areas where *Aedes aegypti* mosquitoes can perpetuate a mosquito-to-human-to-mosquito transmission cycle. *Aedes aegypti* deposit their eggs in any container which can hold water, in or around houses. These containers include large uncovered jars for drinking water, and refuse such as bottles and food tins. Their ability to rear offspring in household water makes *Aedes aegypti* a threat for yellow fever transmission in areas of very low rainfall, or during the dry season (when water is stored inside houses or very close by). Thus, these mosquitoes complete their life cycle from eggs to adults in very close proximity to humans.

When a female *Aedes aegypti* feeds on blood infected with yellow fever virus, her salivary glands and her ovaries become infected, and she passes this infection into her eggs through her ovaries (transovarial transmission). The infected eggs develop into infected adults, and the adult females are able to transmit yellow fever virus to humans as soon as they begin feeding on humans. This ability of *Aedes* mosquitoes to transmit virus transovarially — and thus to rapidly multiply the numbers of infected adult mosquitoes — is the reason why it is important to use mosquito bednets with yellow fever patients. After several mosquito generations, transovarial transmission ends if yellow fever virus is not consumed naturally in a blood meal.

1.2.2 Sylvatic Yellow Fever

Sylvatic yellow fever is spread to humans by the bites of tree hole breeding mosquitoes. These mosquitoes are infected when they feed on viremic monkeys or because they inherited the infection by transovarial transmission from their mother. Sylvatic yellow fever is usually sporadic, but it is also the ultimate source of urban yellow fever. Sylvatic yellow fever is maintained in a natural enzootic cycle between a number *Aedes* species which breed in tree holes and the monkeys they feed upon. Two species of mosquitoes commonly involved in sylvatic yellow fever transmission in Africa are *Aedes furcifer* and *Aedes luteocephalus*. This cycle occurs quietly in nature, because African monkeys do not become ill when infected with yellow fever virus. Sylvatic mosquitoes (which normally feed on monkeys) will bite humans who enter forested areas, and humans in villages at the forest edge.

1.3 Conditions Favoring Yellow Fever Epidemics

1.3.1 Areas at Risk for Yellow Fever Epidemics:

In general, an area is at risk for an epidemic of yellow fever if:

- √ it has experienced yellow fever epidemics in the past
- √ people visit or work in forested areas where sylvatic yellow fever is likely to occur
- √ people come to the area from places where there is yellow fever
- √ these three factors are present:
 - 1) mosquitoes which transmit yellow fever
 - 2) a long rainy season
 - 3) large forested areas with monkeys

Although a great deal is known about the conditions required for the occurrence of yellow fever epidemics, it is not possible to predict exactly when or where an epidemic will occur. Environmental factors, factors related to the mosquito vector, and factors related to the host are all important.

1.3.2 Environmental Factors

The amount of rainfall and the availability of mosquito breeding sites are both important. Heavy rainfall contributes to the development of large mosquito populations. Conversely, in areas that are continually dry, storing water close to homes may encourage breeding of *Ae. aegypti*, the classic peridomestic vector of yellow fever. Mosquito larvae need relatively still water to grow, whether it is in a tree hole, a water storage jar, or a tin can in a garbage dump. For sylvatic transmission, monkeys must be present at least part of the year.

1.3.3 Mosquito Vector Factors

Not all mosquitoes can transmit the yellow fever virus. Some mosquitoes which can transmit the virus do not seek out humans to bite or do not fly far from the forest — however, they will feed on humans who enter the forest. It is very important to know where *Ae. aegypti* are distributed in the country. This peri-domestic mosquito is an avid human biter and is usually the primary vector in epidemics.

1.3.4 Host Factors

A person's immune status is the most important host factor. People become immune after being vaccinated or after natural infection. In populations where epidemics occurred in the past, or where vaccination has been erratic, the highest attack rates will occur in younger age groups. In populations that have not been exposed to either vaccine or natural virus, the attack rates and the severity of disease are the same for all ages, and males and females are equally affected.

Social and cultural host factors also influence who becomes infected. For example, if transmission is sylvatic and *men* spend more time hunting or working in forested areas, then men may have higher attack rates. If the transmission pattern is urban, women and children spending more time near their houses may have higher attack rates.

1.3.5 Potential for an Epidemic

To sum up, health officials who are trying to decide whether their area is at risk for a epidemic of yellow fever should consider:

- 1) whether their area is at risk historically;
- 2) how long it has been since the last epidemic;
- 3) the geographic areas that are susceptible (rainy vs. desert area);
- 4) the number and location of persons who have been immunized (is yellow fever included in the EPI program?, has there been a mass campaign?); and
- 5) whether a neighboring area has active yellow fever transmission.

CHAPTER 2

THE DISEASE

2.1 Carriage, Transmission And Development Of Disease

There is no protracted carrier stage for yellow fever virus in humans, and there is no direct person-to-person transmission. After a person is bitten by an infected mosquito, there is an incubation period of 3 to 6 days before becoming ill. Once the febrile illness starts, the virus remains in the blood for 3 to 6 days.

During this time, mosquitoes feeding on a viremic patient may become infected with the yellow fever virus. For this reason, patients suspected of having yellow fever should be kept under mosquito nets.

2.2 Clinical Presentation Of Yellow Fever

The clinical spectrum of yellow fever varies from asymptomatic infection, to an undifferentiated moderately severe febrile illness, to classic yellow fever.

2.2.1 Classic Yellow Fever

Patients with classic yellow fever have fever, vomiting, epigastric pain, prostration, dehydration, scleral icterus, gastrointestinal bleeding leading to “black vomitus,” and abnormal kidney function.

From 20% to 50% of patients with classic symptoms die, with deepening scleral icterus, hemorrhages, shock, encephalopathy, and renal failure. It is usually not difficult to recognize a patient with severe yellow fever, but by the time a patient shows severe signs, the virus is usually no longer in the blood. This means such patients are not likely to yield a virus isolate that will provide important laboratory confirmation of an epidemic.

After about a week, most patients with yellow fever begin to improve. Even patients who progress to more severe disease will first have a short (1-3 days) remission of fever.

2.2.2 Physical Signs Suggestive of Yellow Fever in Febrile Patients

Recognizing mild to moderate cases of yellow fever is very useful in giving early warning of epidemic transmission. Clinicians and members of the field investigation team should look for suggestive physical signs in moderately ill patients.

Fever is almost always present, and is frequently accompanied by a relative bradycardia (Faget's sign). Conjunctival congestion and flushing of the face and neck are frequently seen. The tongue is often reddened at the tip and lateral margins and there may be minor gingival hemorrhages. In addition to headache and general malaise, patients often have muscle pains, and pains in the lumbosacral area.

Less common clinical presentations and complications include atypical fulminant cases (dying as soon as 3 days after the onset of illness), suppurative parotitis, bacterial pneumonia, or death during late convalescence due to myocardial damage or cardiac arrhythmia.

2.3 Clinical Laboratory Findings

Clinical laboratory findings include absolute neutropenia and lymphopenia, elevated serum transaminases, albuminuria, and azotemia. Patients with more severe disease have elevated bilirubin levels, coagulation defects, fibrin split products and abnormal electrocardiograms.

CHAPTER 3

HOW TO DETECT AND CONFIRM AN EPIDEMIC OF YELLOW FEVER

3.1 Epidemic Versus Endemic Yellow Fever

Endemic yellow fever occurs when sporadic cases are related to exposure to sylvatic yellow fever. After a large epidemic, endemic yellow fever may occur due to failure to receive vaccine or to receiving bad vaccine.

An epidemic of yellow fever is defined by the *sudden onset of clinically compatible cases*.

3.2 Surveillance For Early Detection Of Yellow Fever Epidemics

The best way to recognize a yellow fever epidemic early is to recognize mild and moderate cases.

Health workers in yellow fever prone areas must be aware of the typical clinical presentations of yellow fever, and must notify of any suspected cases. It will be easier to recognize a yellow fever outbreak if patients with fevers, who have a negative malaria smear and no other obvious cause of the fever, are recorded as pyrexia of unknown origin. These should be reported when their numbers are unusually high.

Active surveillance should be based on these case definitions:

CASE DEFINITIONS
YELLOW FEVER SURVEILLANCE

Suspected Case

Sudden onset of fever, followed by jaundice, AND one or more of:

- ⇒ bleeding in the mouth
- ⇒ black vomitus
- ⇒ death

Confirmed Case

Suspected/probable case and

- ⇒ blood or liver tissue culture positive for yellow fever virus

or

- ⇒ a positive neutralization or IgM capture test done by an experienced laboratory

3.3 Collecting Information About Patients

Health workers should record the following information about suspected yellow fever cases in the permanent consultation register:

- √ diagnosis
- √ date of consultation

-
-
- √ age
 - √ sex
 - √ address
 - √ specimens obtained for confirmation of diagnosis, and where the specimens were sent
 - √ local laboratory results
 - √ treatment and outcome (lived, died, referred)

After a yellow fever outbreak has been identified, health facilities may also list yellow fever patients separately in a special epidemic register. Even when an epidemic register is used, all suspected yellow fever patients should continue to be listed in the permanent register so that a record will always remain at the health facility.

3.4 Reporting Suspected Cases And Suspected Epidemics

Report even a single suspected case of yellow fever immediately.

Do not wait for confirmation.

Report a suspected epidemic of yellow fever immediately.

In an area where there is no recognized yellow fever activity, all suspected yellow fever cases should be considered a potential epidemic and reported immediately. Reports from less formal sources of information, such as travelers, merchants and religious leaders should be taken seriously.

Report the number of cases and deaths, the location of the cases, dates of onset of disease, details of the clinical presentation and any action taken. Report cases by the most rapid and reliable means available. Depending on the circumstances, this might be by telephone, radio, telegram, facsimile, TELEX, courier, or informal messengers such as taxi drivers (if you use an informal method, send the report by an additional means as well).

The flow of information should be from health facilities to district level, and then to the provincial and national level. At each point, information should be forwarded *immediately*. When a qualified laboratory has confirmed that the epidemic is caused by yellow fever, the Ministry of Health notifies the World Health Organization, and may declare a Yellow Fever Emergency.

All reports of suspected yellow fever epidemics should be investigated (see *Section 3.6*). This includes reports from less formal sources such as travelers, merchants or religious leaders. Rapid reporting in the early stages of a yellow fever outbreak may allow the rapid use of emergency vaccine supplies stored in the country and thus contain an outbreak at its beginning.

3.5 Laboratory Confirmation Of Yellow Fever

Controlling a yellow fever epidemic requires the expenditure of extraordinary resources — not only by the affected country, but frequently by groups such as the World Health Organization and donor countries. Before such resources are committed, laboratory confirmation of the epidemic is usually required. Laboratory confirmation of yellow fever is not routine, and when a yellow fever epidemic is suspected, the assistance of a reference laboratory should be sought for the collection and transport of specimens.

Laboratory confirmation will be greatly simplified by identifying a laboratory within each country that is able to isolate the yellow fever virus and able to diagnose cases serologically. In Francophone West Africa, there may be a Center Pasteur or Institute Pasteur with this capability. A university, college or well-equipped medical center may also be able to provide this service. Because laboratory confirmation procedures are complex and specialized, personnel at these centers should be advised as soon as a yellow fever outbreak is suspected. If the capability to confirm yellow fever is not available in country, arrangements for it should be made with the advice and assistance of the World Health Organization Regional or Country Representative.

Yellow fever can be confirmed by isolating the virus from blood or other tissues or by detecting specific antibodies in the blood of infected patients. Both types of test require specialized equipment, facilities, and trained personnel. Serologic tests are available to detect antibodies to yellow fever virus, but they require skilled interpretation. There are antigen detection tests for rapidly identifying virus in blood, but they vary in their sensitivity. Strict attention must be paid to the *proper collection and transportation of specimens*. See *Annex 4* for details on specimen collection, packing and transport.

3.6 Investigation Of Suspected Yellow Fever Epidemics

In a likely area of yellow fever emergence, the probability of yellow fever is high when cases occur that meet the yellow fever case-definition. When the possibility of an outbreak is suggested through formal or informal sources, an investigation team should be sent to the field immediately. Give the highest priority to efforts to investigating the suspected outbreak and to collecting laboratory specimens that are needed to confirm it.

Field investigation teams will have two very different kinds of assignments:

- 1) documentation of the cause and geographic extent of a yellow fever epidemic and/or
- 2) determining the number of cases and deaths associated with the epidemic, where and when they occurred and the effectiveness of the vaccine campaign.

The first type of assignment is crucial to proving that yellow fever virus is the cause of an epidemic, what age groups and areas are involved and where vaccine can be used most successfully to stop the epidemic. This is always the highest priority assignment and at least some teams must be assigned to these types of studies until the epidemic is being contained.

The second types of studies are necessary for determining where future resources need to be spent and what were the costs to the country of the epidemic. They are not as urgent as the first type of investigations, but such studies do yield important information for public health planning and should be done whenever possible. For example, studies of this sort will document the extraordinary costs of dealing with an epidemic compared to a consistent program of childhood immunization with yellow fever vaccine.

Steps in Investigating a Suspected Epidemic of Yellow Fever:

- 1) Review the reports of suspected case(s), and decide whether the signs and symptoms are consistent with yellow fever.

-
-
- 2) Contact health facilities that are near where the first cases were reported. Ask whether the health staff have seen patients who:
 - a) meet the yellow fever case-definition,
 - b) or who have signs and symptoms consistent with yellow fever.

Inquire about cases in surrounding villages and towns within a 20 km radius of the first cases. If no cases are occurring, alert health workers in the area to be vigilant for cases.

- 3) Organize an investigation team and send it to the field. Make every effort to provide reliable transportation and essential resources for this team.
- 4) Send a report to the province or designated level, as soon as the investigation team confirms that there are patients who meet the case-definition for suspected yellow fever.
- 5) Send specimens to a qualified laboratory to obtain laboratory confirmation of yellow fever.

3.6.1 Members of the Investigation Team

The investigation team should include:

- √ a clinician and / or an epidemiologist
- √ an entomologist or hygienist with mosquito training
- √ a microbiologist and / or an laboratory technician from the cooperating reference laboratory
- √ drivers, interpreters, and general helpers will be needed

Every member of the team must be vaccinated against yellow fever.

3.6.2 Responsibilities of the Investigation Team

RESPONSIBILITIES OF THE INVESTIGATION TEAM

- 1) Verify that reported recent yellow fever cases are consistent with case definitions.
- 2) Take steps to establish or confirm the diagnosis by investigating new cases.
- 3) Obtain acute-phase blood and/or postmortem liver biopsy material for laboratory confirmation and quickly deliver specimens to the reference laboratory for testing.
- 4) Collect numerous specimens at the beginning of an epidemic until a diagnosis of yellow fever can be made with certainty; later collect only in newly suspected outbreak areas.
- 5) Get information about cases (date of onset, age, sex, residence and outcome).
- 6) Analyze the information gathered (count the numbers of cases and deaths, calculate the case fatality rate and age-specific case fatality rates).
- 7) Decide whether additional help is needed by assessing the local ability to respond to the epidemic, that is,
 - ⇒ assess the clinical management protocols being used,
 - ⇒ assess local human and material resources for treatment of cases (numbers of doctors and nurses, numbers of beds, mosquito nets, IV fluids, etc.),
 - ⇒ assess ability to reduce mosquitoes and breeding sites,
 - ⇒ assess ability to conduct / cooperate with vaccination campaigns.
- 8) Identify mosquito vector(s) and make recommendations for control.
- 9) Report findings to local, regional and national decision makers.

3.6.3 Supplies Needed by the Investigation Team

The investigation team needs specimen collection materials (needles, syringes, gloves, blood collection tubes, tourniquets, disinfectant sponges, liver biopsy (Menghini) needles, biopsy collection tubes with formalin, insulated transport box with ice or frozen collection packs) and vehicles and fuel. The team should take copies of these *Guidelines*. Investigation teams can also be used to deliver supplies such as intravenous fluids to areas they are investigating.

3.6.4 Additional Case-Definition Used During Epidemics

As soon as the team believes that the outbreak is indeed caused by yellow fever, or the laboratory confirms yellow fever, the team epidemiologist may decide to use an additional less strict case-definition than the ones on page 10. During the field investigation, using the additional case-definition “suspect possible yellow fever” may produce a more accurate case count.

Suspect Possible Yellow Fever

⇒ Fever with scleral icterus.

or

⇒ Fever with scleral icterus, in a patient with a negative malaria smear.

Always use this case-definition when information is available on the malaria smear.

Thus the investigators will classify cases as *Suspect Possible Yellow Fever*, *Suspect Yellow Fever* or *Confirmed Yellow Fever*. Put cases into one of these categories in field investigation reports, and in surveillance reports from the field during the epidemic. At the discretion of District Health Officer, the "suspect possible" category can be incorporated into local reporting, if training in its use can be provided to local data collectors. In usual practice, this case definition has been used only by an epidemiologist in research contexts.

3.6.5 Investigation in Areas Where Weekly Surveillance is Not Reliable

In areas where the weekly surveillance is not reliable, the investigation team should:

- √ visit all surrounding health facilities in a definable population between 30,000 and 100,000;
- √ review the consultation register; and
- √ count the number of cases (meeting the case definition) seen in the current week as well as the three weeks preceding the investigation.

These data should be used to define the geographic extent of a yellow fever epidemic in progress or about to occur.

3.6.6 How to Analyze and Report the Information Collected

It is helpful to organize the analysis into three categories: *person*, *place*, and *time*. In the report, the investigators should try to answer the questions listed below:

Person:

- √ How many cases and deaths have there been?
- √ Which groups are at highest risk?
- √ What is the case fatality rate?
- √ What are the age and sex-specific attack rates?

Place:

- √ Where have the cases occurred? What is the geographic distribution of cases?
- √ Is the outbreak spreading? Are there accessible health facilities in the affected areas?

Making maps helps to follow the progress of the disease, and to plan vaccination campaigns.

Time:

- √ When did the cases occur?
- √ Is the number increasing?

Displaying the number of cases and deaths that occurred each day on a graph can be very helpful. If the outbreak has affected a large area, make separate graphs for different areas or communities affected.

3.6.6.1 Determine the Case Fatality Rate

The Case Fatality Rate (CFR) is the proportion of cases which resulted in death. To find the case fatality rate, divide the number of deaths by the number of cases, and multiply by 100.

$$\frac{\text{Number of Deaths}}{\text{Number of Cases}} \times 100 = \text{Case Fatality Rate}$$

For example, if 100 cases are reported in an area during one week, and 10 of the cases died, the case fatality rate is 10%, or 0.1%

$$\frac{10}{100} = 0.1 \times 100 = 10\%$$

CFRs vary depending on the source of denominators used. Population-based studies will have lower CFRs. Studies using hospital visits as the denominator will have higher CFRs, since those will include a sicker population.

During an epidemic, CFRs are useful in identifying the location of epidemics and defining the population groups at high risk of disease and death. Having this type of information helps in focusing vaccine use where it will have the greatest impact.

A high case fatality rate (>25%) may suggest an established epidemic. Control measures should be begun immediately in order to save lives. Review clinical management with health workers.

If the case fatality rate is low (~5%), it is possible the epidemic is just beginning. It may also be that illnesses not due to yellow fever are being classified as yellow fever (“over-diagnosis”). It is also possible that severely ill patients are not reaching health facilities. To discover why the case fatality rate is low, review the clinical data on cases and discuss the situation with health workers and community leaders. Community-based surveys that include limited autopsies may be useful to define CFRs in an epidemic more clearly if there is evidence suggesting that large numbers of cases are dying outside of health facilities.

After an epidemic, use the case fatality rate to calculate the total number of estimated deaths.

3.6.6.2 Calculate Age-Specific and Sex-Specific ² Attack Rates

Use data from the field investigation to calculate the age-specific attack rates. Identifying the age groups with the highest rates of disease assists in planning the vaccination strategy (see *Section 4.5* for discussion of vaccination strategy). Focusing vaccination campaigns on areas and age groups with the highest rates of disease will prevent the greatest number of cases with the least human and material resources.

If the age distribution of the local population is not available, use the one below, which is typical of sub-Saharan Africa. The attack rates are expressed as a “number of cases per 100,000 population in a given amount of time”.

² Sex-specific attack rates are not often useful during an epidemic since transmission that occurs within villages or towns is a “man-mosquito-man” pattern, which readily infects whomever is in the area. However, calculating the sex-specific attack rates with reference to a specific time frame can be useful later in determining the epidemiology of onset in a given area.

AGE GROUPS (YEARS)	% OF TOTAL POPULATION
0-4	17
5-14	28
15-29	28
30-44	15
45 and older	12

Calculate age-specific attacks rate in this way:

- Step 1:** Calculate the number of persons in the age group in the area under investigation.
- Step 2:** Divide 100,00 by the number of persons in the age-group.
- Step 3:** Tally the number of cases in the age-group for the chosen time period.
- Step 4:** Multiply the result of Step 2 by the number of cases in that age-group.

The result is the age-specific attack rate per 100,000 persons.

EXAMPLE

The health facilities in Bola District have reported 40 cases of suspected yellow fever between the 4th and 10th of December. Their catchment population is 50,000. Fifteen of the cases occurred in children 0 - 4 years, 15 occurred in persons 5 - 14 years of age, and 10 occurred in persons 15 - 29 years of age. The Chief Medical Officer used the table below to keep track of his calculations.

He calculated the age-specific attack rate for the 0 - 4 year olds in this way:

Step 1: He calculated the number of children aged 0 - 4 years in the district.

$$50,000 \times .17 = 8,500$$

Step 2: He divided 100,000 by 8,500

$$100,000 / 8,500 = 11.8$$

Step 3: He knew there were 15 cases reported in that age group

15 cases

Step 4: He multiplied 11.8 by 15

$$11.8 \times 15 = 176$$

The age-specific attack rate for children 0-4 years is 176 cases / 100,000 population/week. The Chief Medical Officer then calculated that the age-specific attack rate for the 5 - 14 year olds was 107, and that for the 15 - 29 year olds it was 71. Because the highest attack rate was in the youngest age group, he realized that, if resources were limited, the first group to vaccinate would be the 1 - 4 year olds.

AGE GROUPS (YEARS)	% OF TOTAL POPULATION	BOLA DISTRICT POPULATIONS	NUMBER OF CASES IN BOLA DISTRICT	BOLA DISTRICT ATTACK RATE
0-4	17	8,500	15	176
5-14	28	14,000	15	107
15-29	28	14,000	10	71
30-44	15	7,500	0	--
45 and older	12	6,000	0	--

3.6.6.3 Use Maps to Show Where Cases have Occurred

Indicate the location of cases on a map, by date of onset of illness, if possible. Ideally, use maps that show the location of settlements and health facilities. This helps identify at-risk areas, and their relation to available health services and to possible sites for vaccination. Use the maps to plan the vaccination campaign and to indicate where vaccination has been completed.

CHAPTER 4

HOW TO RESPOND TO AN EPIDEMIC OF YELLOW FEVER

This section is a guide to responding to a confirmed epidemic of yellow fever. The next chapter explains how to become ready for an outbreak.

Determine Staff Responsibilities

An important step is to determine the responsibilities of district and health facility personnel in detecting and controlling an epidemic of yellow fever. *Annex 5* lists suggested responsibilities for the health facility, district, provincial and national levels — they may be adapted according to local circumstances (provincial and national responsibilities are listed so that the district level will know what to expect from those levels).

At the district and health facility levels, try to assign specific people to specific responsibilities, and be sure that they are trained and prepared to undertake them in the event of an epidemic.

4.1 Steps For The Control Of An Epidemic

Steps for Detection and Confirmation:

- (1) Health facilities report a case of suspected yellow fever.
- (2) Conduct field investigation and report the findings.
- (3) Notify the designated level(s) of suspected and confirmed cases.

Steps to be Taken When an Epidemic of Yellow Fever has been Confirmed:

-
-
- (4) Convene the Epidemic Control Committee.
 - (5) Inform the public.
 - (6) Plan and conduct the vaccination campaign.
 - (7) Implement mosquito control measures.
 - (8) Collect and report data on cases and deaths, and on control activities.
 - (9) Document the epidemic.
 - (10) When the epidemic has ended, evaluate the response and make plans for improving detection and response in the future.

4.2 Convene A District Epidemic Committee

There should be a district epidemic committee to coordinate epidemic preparedness and response activities at district and health facilities. In areas where epidemics of yellow fever are infrequent or where there is no general crisis committee, a yellow fever epidemic committee should be formed as soon as a yellow fever epidemic is suspected. The committee should be given appropriate decision-making powers. A committee may already exist in areas where there was a yellow fever epidemic recently or where the district has prepared itself for an epidemic. While a separate committee for yellow fever is not necessary, a general crisis committee should maintain its competence to respond to yellow fever epidemics.

Similar committees should exist at the provincial and national level.

4.2.1 Members and Responsibilities of the Yellow Fever Epidemic Committee

The responsibilities of the epidemic committee are to:

- √ plan control strategies
- √ define populations at risk of yellow fever
- √ assign specific responsibilities for epidemic detection and response
- √ identify competent laboratory support
- √ establish procedures to rapidly mobilize mass vaccination campaigns
- √ identify resources needed for rapid epidemic response
- √ estimate resources needed to control epidemic
- √ establish procedure for accessing funds
- √ coordinate education of the health care community and the general public
- √ coordinate and monitor the implementation of control measures
- √ report on epidemic
- √ evaluate impact of control measures, adjust strategy, and review performance after the epidemic

The epidemic committee may include representatives from:

- √ the Ministry of Public Health (including communicable diseases, the EPI programme, administration, and drug supply and distribution) and other ministries, as appropriate
- √ the armed forces and / or police
- √ non-governmental organizations involved in health care
- √ the reference laboratory
- √ referral hospitals for treatment of fever cases and hospitals in the affected area(s)
- √ community health programs

√ technical experts (entomologists, vector control specialists)

During an epidemic, the committee should meet every day, if possible. The committee can meet less frequently (weekly) when response efforts have begun and surveillance data suggest that additional areas are not having increased numbers of cases. At each meeting, the members (or designated subcommittees) should review each of the responsibilities listed above, and be certain that there is progress in controlling the outbreak.

An epidemic has ended when there has been a decrease in weekly incidence rates to usual endemic disease levels for at least two weeks and no new cases have been recognized. At that point, the committee should produce a report and evaluate the response to the epidemic.

4.3 Report Cases And Inform Authorities

Suspected cases and suspected epidemics must be reported immediately (see *Section 3.4*). When an epidemic has been confirmed or is strongly suspected to be yellow fever, health authorities in neighboring provinces, departments, or cities should be informed so that spread of epidemic disease to other areas can be monitored. Health care personnel within the region should be kept informed of the extent of the epidemic, appropriate case management, changes in reporting procedures, and vaccination plans.

4.4 Inform The Public

When a yellow fever epidemic has been recognized, there is likely to be widespread public concern and media attention. Therefore, efforts to inform the community about the outbreak must begin as early as possible and continue throughout the epidemic. The public should know when and where to go for vaccination, when and where to seek medical attention, how yellow fever is spread, and how to reduce mosquitoes and their breeding sites.

Explore local beliefs about disease transmission or treatment before an epidemic occurs and prepare educational messages. Correct any misconceptions. Reach the public through radio, town criers, meetings with community, religious and political leaders, presentations at markets, health centers, schools, religious centers and house-to-house visits. Posters and fliers, newspapers and television may be used. There are sample Health Education Messages in *Annex 2*. Take advantage of meetings to demonstrate how to reduce mosquito breeding sites at or near the place the meeting is being held.

4.5 Conduct A Mass Vaccination Campaign

4.5.1 Principles of Vaccination During Epidemics

A mass vaccination campaign can control a yellow fever epidemic if the campaign is begun before peak transmission. The earlier a vaccination campaign is begun, the more cases of disease will be prevented. Based on epidemiologic studies in the field, vaccination should be started in areas with the highest rates of disease and then extended to include all surrounding areas to create a *cordon sanitaire* as large as possible around the affected area (a *cordon sanitaire* is effective in yellow fever, but not for cholera). When the affected area has been covered by the vaccination campaign, vaccination should expand outward into adjacent areas, to include all areas in the historic transmission zone, if possible. If resources are limited and the entire population cannot be vaccinated, target the age groups with the highest attack rates in the affected area.

Use of an Emergency Store of Vaccine

If an emergency store of vaccine is maintained in the country, careful use of this vaccine until a larger supply becomes available can be very helpful in the early stages of an epidemic. A frequent error made with emergency stores of vaccine is to squander them in large, low-risk urban areas hundreds of kilometers from the epidemic. News bulletins about a suspected epidemic should clearly state where the outbreaks are occurring and should discourage panic and demand for vaccine in low risk areas. Health care workers in the high risk areas of the country should be immunized as soon as they arrive in such areas before epidemics occur. If this has not been done, health care providers in the outbreak area, including nurses and all other critical staff, as well as Investigation Teams and Vaccination Teams entering the outbreak area, should be immunized first.

A target population should be identified in the outbreak area and in nearby villages. Vaccine should be administered to this target population in ever widening areas from the epidemic center, until all emergency vaccine has been utilized. Someone must be identified as being in control of stored vaccine and only that person or someone designated by that person should approve release of vaccine for use under the targeted population method of administration. (*See 4.5.2.1 for ways to choose a targeted population.*)

Yellow Fever Vaccine

There are three types of vaccine available.³ 17-D vaccine is very effective, is safe and is the least expensive. A single dose of properly maintained and administered vaccine protects adults for life. Children vaccinated when they are less than 4 years of age are protected for 10 years, and perhaps for longer. 17D vaccine is not recommended for infants less than nine months of age.

During epidemics, vaccinate infants 9 months of age and older. If an epidemic recurs in the same area the next year, re-vaccinate all children younger than 5 years of age, if they do not have written proof of vaccination. Pregnant women should be vaccinated during an epidemic of yellow fever. Theoretically, there is a risk of the live yellow fever vaccine virus to the fetus, but it has not been proven. During an epidemic, this theoretic risk is outweighed by the very real risk of death to the pregnant woman.

Guidelines on vaccine management and administration are found in *Annex 3*.

4.5.2 Plan the Mass Vaccination Campaign

Determine the geographic areas affected and select the target population, taking into account the amount of vaccine available and the resources available to deliver the vaccine.

4.5.2.1 Select the Target Population for Vaccination

When Age-specific Attack Rates Are Available

Ideally, everyone who is at risk of yellow fever should be vaccinated. If resources are limited, vaccination should always be targeted at the highest risk group (i.e., the group with the highest attack rates). Whenever possible, use age-specific attack rates to select the target vaccination age-range. When the age groups have been selected, determine how many people there are in those age groups (use the age distribution table in *Section 3.6.2.2*, or the known age distribution in the area).

When Age-specific Attack Rates Are Not Available

³ There are three types of vaccine: 1) 17-D vaccine, 2) thermostable vaccine, and 3) certified avian leucosis-free vaccine. 17-D vaccine is very effective, is safe and is the least expensive. The other 2 types are 20-100 fold more expensive per dose. If the vaccine will be stockpiled the thermostable vaccine is preferred.

Children and young adults are usually at highest risk for disease in yellow fever endemic areas. If age-specific attack rates cannot be calculated, first vaccinate children 9 months - 14 years old, followed by the remaining population up to 30 years of age, using the percentage estimates given in *Section 3.6.6.2* .

To estimate the population 9 months to 14 years old, multiply the total population by 45% .

To estimate the population 9 months up to 30 years old, multiply the total population by 73%

In addition, early in the campaign, vaccinate all the personnel who are involved in controlling the epidemic and their immediate families regardless of age (so long as they are at least 9 months old).

4.5.2.2 Calculate the Number of Vaccine Doses Needed

Step 1: Determine the number of people to be vaccinated (see Section 4.5.2.1)

Step 2: Multiply the population at risk by 1.17

(This assumes a vaccine wastage factor of 17% — if you know the actual wastage factor in your district, use it instead of 17%)

Step 3: Multiply the result by 1.25

(This assumes the number of reserve doses of vaccine is 25% — if you have reasons to use another factor for the number of reserve doses, substitute it in this calculation).

This gives the number of doses of vaccine needed. Order the same number of syringes and needles.

EXAMPLE

The Yellow Fever Epidemic Committee of District G. needs to request yellow fever vaccine to respond to an epidemic in the district. They do not have age-specific attack rates. The last epidemic of yellow fever in the area was 10 years ago, and yellow fever vaccine is not given in the EPI programme. For these reasons, the committee decided that younger age groups would likely be most at risk in this outbreak and chose their target population as persons 1-29 years of age. They referred to the age distribution table, and found that age group is about 73% of the total population. The population of the district is 49,633, which they rounded up to 50,000.

Step 1: *Multiply the total population by 0.73*
 $50,000 \times 0.73 = 36,500$

Step 2: *Multiply the result by 1.17*
 $36,500 \times 1.17 = 42,705$

Step 3: *Multiply the result by 1.25*
 $53,381 \times 1.25 = 53,381$

The district will need 53,381 doses of yellow fever vaccine. Since there are 50 doses in each vial of 17D vaccine, the committee divided 53,381 by 50, to get the number of vials to order.

$$53,381 / 50 = 1068 \text{ vials}$$

They requested 1068 vials of vaccine and 53,400 needles and syringes.

REQUEST FOR YELLOW FEVER VACCINE

Person To Sign Request:

Information To Include In Request:

- a) Number of cases and deaths
- b) Geographic location of cases (names of affected areas)
- c) Estimated size of population at risk (use age-specific attack rate if possible)
- d) Amount of vaccine and supplies on hand
- e) Amount of vaccine and supplies needed
- f) Measures taken so far
- g) Report of investigation, if available

Person To Whom Request Should Be Sent:

How The Request Should Be Sent:

4.5.4 Assemble and Train Vaccination Teams

A suitable composition for a team is:

- √ one supervisor,
- √ two vaccinators or nurses,
- √ two clerks, and
- √ one technician responsible for the cold chain.

In addition, there should be a driver (who may act as general help) and one or more community representatives and/or translators. Two more people, who would fill syringes, may be added to the team. This team should be able to administer 1,000 doses a day. Everyone on the team must be vaccinated against yellow fever. A smaller four-person team would consist of four individuals who rotate preparing and administering vaccine, a recorder/general helper, a driver and translator if needed.

4.5.5 Set Up Vaccination Sites

Vaccine can be administered by mobile teams or at fixed stations.

A vaccine site should have the following stations:

Waiting Area

- √ This should be shaded, if possible.
- √ Some health education and information about vaccination could be given here.

Vaccine Card Station

- √ Issue cards at this station (but mark the cards only after the vaccine has been given).

Vaccination Administration Station(s)

- √ Administer vaccine at these stations (dispose of all needles in a safe container).

-
-
- √ Stamp or write on the cards after the vaccine has been given.
 - √ Maintain a tally sheet which indicates age group and sex of those vaccinated.

Position table(s) for loading syringes behind the vaccination station(s). Workers there will pass loaded syringes to the vaccinators.

For efficiency:

- √ Have only one entrance and one exit to the site. The flow of people should be one-way.
- √ Guide persons waiting for vaccination into a single line as they approach the first station. It will be easier to maintain the line if there are some barriers to indicate where the line is.
- √ Allow only one person (or one family) at each station at a time.

4.5.6 Document the Vaccinations

Record the dose and date on a vaccine card, such as an E.P.I. card, a woman's Tetanus Toxoid card, or a special yellow fever vaccination card. Report the number of persons vaccinated daily, by age group. Careful documentation is important to estimate coverage and to revise the amount of personnel and time needed for completing the vaccination campaign.

4.6 Report During An Epidemic

During an epidemic, diagnosis and reporting of new cases should be based on standard case definitions. Health facilities should send a daily report which gives the number of cases and deaths. However, if communications are difficult, a health facility might report twice weekly, or weekly.

Every day during the epidemic, the district should prepare a summary report of health facility data and submit it to the provincial level. This report should include:

- √ the period of time covered by the report ("epidemiologic week" or the dates);

-
-
- √ number of health facilities that reported (include health facilities that reported no cases of suspected yellow fever);
 - √ total number of health facilities in the district;
 - √ total number of suspected yellow fever cases and deaths during the reporting period; and
 - √ number of vaccinations planned and the number given.

4.6.1 Zero Reporting

During epidemics, health facilities must send a report, even if there were no cases or deaths during the reporting period. This “zero reporting” lets the district tell the difference between an area which actually had no cases, an area which did not send a report, and an area from which communication failed. In addition, it helps the crisis committee measure the effectiveness of the vaccination campaign.

4.7 Control Mosquitoes

Eliminating adult and larval mosquito populations and potential mosquito breeding sites reduces the vector that carries yellow fever. Vector control specialists are best qualified to determine the approach to control mosquitoes in any area. Large aerial spraying campaigns are very expensive and often only marginally effective. Specialists should evaluate the effectiveness as well as the toxicity to humans and the environment of locally used insecticides (e.g., DDT is largely ineffective and is very toxic to the environment.)

Mosquito control efforts are most effective when the major vector is a peridomestic mosquito such as *Ae. aegypti*. In such cases, both management of individual homes (using insecticide sprays and protecting water containers) and community-based programs can have significant impact on the size of infected mosquito populations.

4.7.1 Eliminate Mosquito Breeding Sites

The first priority is to protect stored household water. Water stored in large open earthenware containers, steel barrels, or masonry cisterns can provide ideal mosquito larval breeding sites. Remove larvae from these containers, then be sure the containers are covered, to prevent female mosquitoes from depositing eggs inside. Next, look at other containers such as

gourds, small tin cans, and glass or plastic bottles discarded around premises or in village refuse piles. Make sure these are properly disposed of to avoid collection of water in these containers.

4.7.2 Use Mosquito Bed Nets

Encourage community members to use mosquito nets — especially on the beds of ill patients — and to spray insecticide in their homes to kill mosquitoes. The use of bed nets also reduces other mosquito-transmitted diseases, such as malaria.

Conduct a public education program to inform the community about these measures. There are sample Health Education messages in *Annex 2*.

4.8 Documenting The Epidemic

The crisis committee should prepare a summary report on disease activity and the emergency response. This report should be distributed to local personnel to provide feedback, as well as to international organizations and other donors. This is important for training purposes and planning future responses. If the response was not optimal, evaluation is needed to assure that management will be more effective in the future.

4.9 Clinical Management Of Patients With Yellow Fever

The spectrum of clinical illness is described in Chapter 2. Although there is no specific curative therapy for yellow fever, such as antiviral drugs, good supportive care is very important. During an epidemic, simplify case management as much as possible.

CLINICAL MANAGEMENT OF PATIENTS WITH YELLOW FEVER

- ⇒ Prevent or correct dehydration and electrolyte imbalance.
- ⇒ Look for and treat other unrelated infections, such as malaria.
- ⇒ Reduce high fevers with paracetamol (acetaminophen).
 - ◆ Do not give aspirin, since it may aggravate bleeding in severe cases.
- ⇒ Do not transfuse anaemic patients routinely. Blood transfusions are only rarely indicated.
 - ◆ Use the hematocrit level — in an adequately hydrated patient — to judge the degree of anemia.
 - ◆ Seriously ill patients in shock, with severe liver damage, will not be improved by blood transfusion.
 - ◆ Moderately ill patients with mild mucosal bleeding often will not require transfusion.
 - ◆ Use clinical judgment to identify the very few candidates for transfusion, in whom there is brisk blood loss without fatal liver damage.
- ⇒ Give anti-emetics and anti-convulsants if indicated.
- ⇒ Use bed nets for suspected yellow fever patients.
- ⇒ Order complete bed rest for ill patients.

There is no need to isolate patients, but all suspected yellow fever patients should have bednets which prevent mosquitoes from carrying the virus from viremic patients to uninfected persons.

Blood from viremic yellow fever patients is infectious, so health workers should always employ the same universal precautions they use to prevent infection with other blood-borne diseases, such as HIV or hepatitis B. Health workers and all health facility personnel must be vaccinated against yellow fever. There are no other special precautions needed.

4.9.1 Temporary Treatment Centers

Temporary Treatment Centers may be needed to handle overflow from established health facilities. A Temporary Treatment Center should be a roofed and screened building as near to the hospital as possible. There should be 2 nurses for each 50 moderately ill patients per shift, and the number of nurses should increase as the number of severely ill patients increases. One doctor per Temporary Treatment Center is usually enough, once the Temporary Treatment Center has been set up and is running well. There should be a mosquito bed net for every suspected case.

CHAPTER 5

HOW TO PREPARE FOR A YELLOW FEVER EPIDEMIC

Being well prepared is the best way to guarantee a rapid and effective response to an epidemic of yellow fever. This chapter describes the components of preparedness and provides a guide so that districts can evaluate their level of preparedness.

The second part of the workshop Exercise Book outlines projects that will guide your efforts to make your district ready for an epidemic.

PREPAREDNESS COMPONENTS

- (1) Ensure that the surveillance system can detect yellow fever;
- (2) Ensure the capability to get laboratory confirmation;
- (3) Identify and address training needs;
- (4) Maintain a reserve stock of vaccine and essential equipment and supplies;
- (5) Organize an epidemic committee;
- (6) Plan logistics and staff needed for control measures;
- (7) Ensure that financial support is available for preparation and response;
- (8) Organize vaccination teams;
- (9) Make an emergency response plan;
- (10) Evaluate epidemic preparedness; and
- (11) Plan for prevention.

Many of these components include activities that also must be done *during* an epidemic - their implementation was covered in earlier chapters. This chapter focuses on how to *prepare for* a possible epidemic. For each preparedness component, you will find a box with questions about the state of readiness of your district. Your district will be well prepared when you can answer “yes” to each of the questions.

These preparedness components should be considered:

- √ *before* an epidemic, so that the district will be ready to respond,
- √ *during* an epidemic, so that the response will be effective, and
- √ *after* an epidemic, so that the district will be better prepared in the future.

Assign Responsibilities for Detection and Control Activities

The detection and control of epidemics of yellow fever will be more rapid and more effective when the roles and responsibilities of all involved health staff are clear. *Annex 5* lists suggested responsibilities for staff at the health facility, district and national levels. In any country, the precise assignment of activities to different levels of the system and to certain individuals will differ. The figure on the next page provides an example of how one country assigned responsibilities to different levels.

EXAMPLE

Figure
Data-based Decisions and Actions in Epidemic Preparedness and Response
Ministry of Public Health, Cameroon

This chart illustrates the responsibilities of different levels of the health care system in Cameroon. On the right hand side (next to the upward arrows), are listed the information and requests that lower levels send to higher levels. On the left hand side, (next to the downward arrows) are listed the responsibilities that flow from higher to lower levels.

5.1 Ensure That The Surveillance System Can Detect Yellow Fever

The detection and confirmation of epidemic yellow fever is discussed in detail in Chapter 3.

ENSURE THAT THE SURVEILLANCE SYSTEM CAN DETECT YELLOW FEVER

Routine Reporting and Emergency Notification

- ⇒ Can health workers recognize cases of yellow fever?
- ⇒ Do health workers know the surveillance case-definition of yellow fever?
- ⇒ Do health workers know how to report suspected cases by the most rapid and reliable means?
- ⇒ Do health workers know what to report?
- ⇒ Are routine reports complete, sent regularly, and on time?

Investigation Team

- ⇒ Have possible members of an Investigation Team been identified?
- ⇒ Have they been trained or briefed on their duties?
- ⇒ Has funding for an investigation been provided for?
- ⇒ Have the necessary supplies and resources been provided for?

5.2 Ensure The Capability To Get Laboratory Confirmation

Laboratory confirmation of yellow fever is discussed in Chapter 3. There are details are in *Annex 4*.

ENSURE THE CAPABILITY TO GET LABORATORY CONFIRMATION

If the district will rely on a reference laboratory to collect and transport the specimens:

- ⇒ Has a cooperating reference laboratory been identified?
- ⇒ Have any funds needed been allocated?

If district personnel will collect and transport the specimens:

- ⇒ Is there a person trained in collection of specimens from yellow fever patients?
- ⇒ Are the supplies needed for collection and transport of specimens available?
- ⇒ Is there a plan for keeping the specimens cold during transport?
- ⇒ Have any funds needed been allocated?

5.3 Identify And Address Training Needs

As a district health officer, one of your responsibilities is to make sure that district health personnel have the knowledge and skills to detect and respond to epidemics of yellow fever. However, because yellow fever epidemics are unpredictable and not common, (perhaps once in every ten years), it may be difficult to ensure that all health workers are up-to-date at all times.

In order to *detect* an epidemic, clinical staff should know how to recognize and report possible cases of yellow fever. If they cannot, then they should be trained as soon as possible. However, a district may decide to delay training on how to *respond* to an epidemic, until an epidemic threatens. The threat of an epidemic is present whenever yellow fever activity is occurring in a neighboring country. The closer yellow fever is to border areas the higher the risk is that outbreaks will reach your country. District health offices should make a detailed training plan that will be put into effect when an epidemic is detected.

Decide who needs to be trained, and what they need to learn

Assess the training needs of the district's personnel, based on their roles and responsibilities. Table 3 lists suggested topics — you may modify it according to the roles and responsibilities of your own district. Health workers should be trained in the starred (*) topics *before* an epidemic. Decide whether you will train health workers in the other topics before an epidemic, or will teach them quickly when an epidemic occurs.

TABLE 3. TOPICS FOR TRAINING DISTRICT AND HEALTH FACILITY STAFF

TARGET GROUP	TOPICS
Health Facility Personnel	<ul style="list-style-type: none"> * basic epidemiology of yellow fever * how to recognize yellow fever * yellow fever case definitions * how to report suspected yellow fever ⇒ case management ⇒ collection of data on patients and record keeping ⇒ reporting during epidemics ⇒ taking inventory of treatment and control supplies ⇒ mosquito control measures ⇒ health education of the public
District-level Personnel	<ul style="list-style-type: none"> * epidemiology of yellow fever * passive and active surveillance for yellow fever * how to report suspected yellow fever ⇒ field investigation, including data collection and analysis ⇒ specimen collection and laboratory confirmation ⇒ reporting during an epidemic ⇒ taking inventory, estimating and ordering supplies ⇒ planning vaccination strategy ⇒ conducting mass vaccination campaign ⇒ mosquito control measures ⇒ health education of the public

When making the training plan, consider the educational level of personnel, the resources available (either locally or from donors), and the amount of time and travel involved. If possible, adapt standard curricula to the needs of the district. Training should include plenty of practice of the skills that health workers would be expected to do. Plan for regular supervisory and follow-up activities to ensure that trainees are practicing what they learned, to correct mistakes, and to get feedback from trainees. In addition to formal courses and workshops, supervisors may teach health workers during regular supervisory visits.

During an outbreak, simplified on-the-job training may be needed to rapidly bring health workers up-to-date.

IDENTIFY AND ADDRESS TRAINING NEEDS

- ⇒ What percentage of the district's health workers are up-to-date on yellow fever?
- ⇒ Is there a plan to train health workers (or at least their local supervisors) in advance of an epidemic?
- ⇒ Is there a plan to quickly train health workers at the time of an epidemic?
- ⇒ Are health workers being trained according to the plan(s)?

5.4 Maintain A Reserve Stock Of Vaccine And Essential Equipment And Supplies

The World Health Organization maintains an emergency stock of yellow fever vaccine in West Africa which can be delivered in 24 hours, so if countries do keep a reserve stock themselves, it is usually only at the central level. The central or provincial level usually maintains a stock of materials needed to confirm epidemics, although certain districts may as well.

The district (or Province) should maintain a reserve stock of the supplies needed to provide supportive care to patients. Although it is difficult to predict exactly how much will be needed, a

district should maintain a reserve stock of 1,000 litres of IV fluids, in 500 cc bags⁴, and of infusion sets for infants, children and adults. These supplies should be rotated with the usual supplies, so that they are used well before the expiry date. Insecticide should not be stocked in advance, because a vector control expert should make specific recommendations at the time of an outbreak.

**MAINTAIN A RESERVE STOCK OF ESSENTIAL
EQUIPMENT AND SUPPLIES**

- ⇒ Is there a reserve stock of treatment supplies needed for yellow fever?
- ⇒ If so, are the supplies being rotated with usual supplies?
- ⇒ If district personnel will collect and transport specimens for confirmation, is there a stock of the materials that would be needed?
- ⇒ Has funding been found for the reserve supplies?

5.5 Organize An Epidemic Committee

The membership and responsibilities of Epidemic Committees are described in *Section 4.2*.

Although an epidemic committee may not focus on yellow fever until an epidemic has begun, a district that is working to become prepared should consider forming a committee (or sub-committee) well before an outbreak. Ideally, committee members should work as a group on the preparedness components. An Action Plan made by the group that would eventually implement it may be more realistic than one made by a few individuals, and the committee may function more smoothly during an epidemic if members have worked together before.

⁴ Being prepared for cholera also requires maintaining a reserve stock of IV fluids. Ringer's lactate is recommended for treatment of cholera, and normal saline may be used if it is not available. Other IV fluids are not acceptable for the treatment of cholera. The reserve stock for the two diseases might be combined if Ringer's lactate is stocked for yellow fever. Discuss your order with Control of Diarrhoeal Diseases Programme manager.

ORGANIZE AN EPIDEMIC COMMITTEE

- ⇒ Is there a yellow fever epidemic committee (or a yellow fever subcommittee of another crisis type committee)?
- ⇒ If so, do the members meet regularly?
- ⇒ If so, are the members working to prepare the district for a possible epidemic?

5.6 Plan Staff And Logistics Needed For Control Measures

The major responses to an epidemic of yellow fever — public education, patient care and mass immunization — all require extraordinary efforts by health personnel. The number of very sick patients and the number of people eager for vaccine may overwhelm health services, if there is not a plan or if resources are not available. To avoid confusion and panic, district health officials should plan how to make the best use of staff and of available resources *before* an epidemic occurs.

Although the central Ministry of Health may provide vaccine and some vaccine supplies, the district or province is often expected to provide logistical support (e.g., transport, fuel, communications, use of buildings) and to assign staff to control efforts. *Annex 5* lists suggested responsibilities of health facility and district-level staff. Review them before an epidemic and consider who among your staff would be responsible for each task.

PLAN STAFF AND LOGISTICS NEEDED FOR CONTROL MEASURES

- ⇒ Have the roles and responsibilities for district personnel been decided?
- ⇒ Is there a plan for re-assigning staff during an epidemic?
- ⇒ Has funding been identified for extra staff costs during an epidemic?
- ⇒ Is there a plan for setting up Temporary Treatment Centers?
- ⇒ Have logistics needs during an epidemic been identified?
- ⇒ Has funding for extra costs related to logistics been identified?

5.7 Ensure That Financial Support Is Available For Preparation And Response

ENSURE THAT FINANCIAL SUPPORT IS AVAILABLE FOR PREPARATION AND RESPONSE

- ⇒ Have the costs related to preparation for an epidemic been identified?
- ⇒ Have the costs for investigation of suspected epidemics been identified?
- ⇒ Have the costs related to the response to an epidemic been identified?
- ⇒ Has a source of funding or support been found for each expense?

5.8 Organize Vaccination Teams

ORGANIZE VACCINATION TEAMS

- ⇒ Have potential members of vaccination teams been identified?
- ⇒ If so, have they been trained?
- ⇒ Has a source of supplies (other than vaccine itself) been identified?
- ⇒ Is the cold-chain prepared?
- ⇒ Has transport been identified?
- ⇒ Have possible vaccination sites been identified?
- ⇒ Has funding for mass vaccination (other than for vaccine itself) been identified?

5.9 Make An Emergency Response Plan For Responding To An Epidemic Of Yellow Fever

Filling in the Emergency Response Plan Matrix in Self-Study Exercise Number 9 will give you the outline of a plan. If a crisis committee exists, it should be involved in making the plan.

A district with a Yellow Fever Emergency Response Plan can respond quickly and effectively to a suspected or confirmed epidemic. Planning an emergency response means that you have a "road map" or procedure guide to follow during an epidemic. It also means you have adequate resources and have identified sources of support. The action plan should specify:

- √ *what* should be done,
- √ *when* it should be done,
- √ *who* should do it, and
- √ what *resources* are needed.

The Action Plan Matrix in Self-Study Exercise Number 9 includes the activities listed below - you may add others.

Activities to be Done When the First Report of Suspected Yellow Fever is Received

- (1) Report the suspected cases to the designated authorities;
- (2) Convene the epidemic committee;
- (3) Identify (or review) roles and responsibilities of staff;
- (4) Send investigation team to the field;
- (5) Inventory essential supplies; and
- (6) Inform health facilities to be alert for cases (inform the public when you are more certain it is yellow fever).

Activities to be Done When a Yellow Fever Epidemic is Confirmed, or Strongly Suspected

- (7) Inform neighboring districts;
- (8) Regularly obtain health facility reports, summarize them, and forward them to the designated level;
- (9) Conduct training, if needed;
- (10) Plan vaccination strategy, train and field vaccination teams;
- (11) Obtain vaccination, treatment and mosquito reduction supplies;
- (12) Regularly inventory vaccination, treatment and mosquito reductions supplies;
- (13) Set up Temporary Treatment Centers, if needed;
- (14) Implement other control measures;
- (15) Monitor and evaluate control measures; and
- (16) Educate the public.

Assign a person to monitor and document control activities, costs and results throughout the epidemic. This will be useful if the strategy needs to be changed and to improve your district's epidemic preparedness in the future.

**MAKE AN EMERGENCY RESPONSE PLAN FOR RESPONDING TO AN
EPIDEMIC OF YELLOW FEVER**

- ⇒ Is there a written Emergency Response Plan for responding to yellow fever?
- ⇒ Are members of a yellow fever epidemic committee, and other persons who are involved, aware of the plan?

5.10 Evaluate Epidemic Preparedness

You should regularly assess your district's epidemic preparedness:

- √ *before* an epidemic (to be sure the district will be ready),
- √ periodically *during* an epidemic (to be sure that the response is effective), and
- √ *after* an epidemic (to be sure the district will be better prepared in the future).

Systematically review all the questions in the boxes in this chapter (they are summarized in Self-Study Project 10 in the *Exercise Book*). Decide whether there are other indicators of preparedness that you want to add. When you can answer “yes” to all the questions, your district will be ready to respond to an epidemic of yellow fever.

EVALUATE EPIDEMIC PREPAREDNESS

- Has the preparedness of the district been evaluated?
- If so, were the results of the evaluation acted on?
- Are regular, periodic evaluations scheduled?

5.11 Plan For Prevention

Yellow fever is a preventable disease. The core of a prevention program should be a commitment to vaccination. In many countries, yellow fever vaccine has been added to the EPI programme.

Another method of prevention is eliminating breeding sites of peridomestic mosquitoes — this is effective only where the primary vector of yellow fever is a peridomestic mosquito.

PLAN FOR PREVENTION

Yellow Fever Vaccine in EPI

- ⇒ Is yellow fever vaccine included in the Expanded Programme on Immunization?
- ⇒ Is it being regularly given in the district as part of the Expanded Programme on Immunization?
 - ◆ If so, is vaccination recorded on EPI cards?
- ⇒ If yellow fever vaccine is not being routinely and regularly given, is there a determined effort to:
 - (a) obtain enough vaccine, and
 - (b) provide it to all eligible children?

Reduction of Peridomestic Mosquitoes

- ⇒ Are common peridomestic mosquitoes in the district possible vectors of yellow fever?*
- ⇒ Do people know how to store household water safely, and how to reduce mosquito breeding sites?
 - ◆ If not, have health education materials been prepared?
- ⇒ Have all health facilities been inspected to be sure that:
 - (a) all water is stored safely, and
 - (b) there are no potential mosquito breeding sites nearby?

* If the local mosquitoes have not been identified, you may not know whether or not they might be vectors of yellow fever. Nonetheless, reducing mosquito populations may be of benefit in reducing other mosquito-borne diseases.

ANNEXES

Annex 1 Resources and Assistance

Possible National Resources:

Pasteur Institutes, Pasteur Centers, Medical Schools or Universities

International Resources:

World Health Organization, Geneva, Switzerland.

(contact your in-country WHO Representative)

Centers for Disease Control and Prevention, Atlanta, GA., 30333 USA

Annex 2 Sample Public Health Education Messages

Use these health education messages when there is a suspected or confirmed yellow fever epidemic in the district, or in a neighboring district.

- √ Review the messages
- √ Adapt them to local conditions, if needed
- √ Translate them into local languages, if needed
- √ Decide the best methods to communicate them to the public
- √ Consult with vector control specialists to be certain the messages about mosquito control are appropriate for the outbreak — specialists will have very specific recommendations about how to best eliminate local mosquitoes and about which insecticides are safe and effective.
- √ In the message about vaccination, fill in the blank lines with the times and places that yellow fever vaccine will be available.

**YELLOW FEVER IS SPREAD BY MOSQUITOES
FOLLOW THESE RULES TO PROTECT YOURSELF FROM
YELLOW FEVER**

1. Get vaccinated against yellow fever
2. Rid your homes of mosquitoes
3. Use mosquito bed nets
4. Go to a health facility when you suspect yellow fever

**PROTECT YOURSELF FROM YELLOW FEVER:
GET VACCINATED AGAINST YELLOW FEVER**

- ⇒ Vaccination prevents yellow fever
- ⇒ Children vaccinated when they are under 5 years old are protected for 10 years
- ⇒ Children older than 5 years and adults are protected for life
- ⇒ Go to (place) _____ for vaccination
- ⇒ Vaccination will be offered on _____ (date) from _____ o'clock until _____ o'clock
- ⇒ Bring your vaccine card, if you have one (EPI cards, TT cards or other vaccination cards)
- ⇒ Vaccination is free

**PROTECT YOURSELF FROM YELLOW FEVER :
RID YOUR HOMES OF MOSQUITOES**

- ⇒ Cover all your water containers so mosquitoes cannot breed in them.
- ⇒ Spray _____ insecticide inside your home.
(Get advice from vector control specialists)
- ⇒ Search the inside and the outside of the buildings for places where there is standing water. Eliminate all places where mosquitoes can breed, such as tins, tires, gourds and bottles.

PROTECT YOURSELF FROM YELLOW FEVER :

USE MOSQUITO NETS

- ⇒ Use mosquito nets to avoid mosquito bites.
- ⇒ People who are ill with fever should always use a mosquito bed-net.
- ⇒ This helps prevent diseases like yellow fever and malaria from spreading to others.

GO TO A HEALTH FACILITY WHEN YOU SUSPECT YELLOW FEVER

1. Suspect yellow fever when someone has a sudden fever, followed by yellowing of the white part of the eyes.
2. Take the person to a health facility to be checked. The health workers will decide if the illness is due to yellow fever and will see if there are other diseases that can be treated.

A person who has a fever followed by yellowing of the eyes is seriously ill. Take them to a health facility immediately.

3. There is no medicine that can cure yellow fever, but there are medicines that will make the person feel better and may save their life.
4. Give the sick person plenty of fluids, and offer them food to eat.

Annex 3 Guidelines On Vaccine Management And Administration

Vaccine Storage and Transport

- 1) Vaccine storage, cold chain and transport can usually be accomplished in conjunction with the Expanded Programme on Immunizations. Freezer space and a cold chain must be available. Prepare storage space for the vaccine *before* it arrives. Each fifty-dose vial requires approximately 144 cm³ of space for storage of ampules, solvent and packing.

17-D vaccine should be frozen on arrival. Discard any dry vaccine that has not been kept frozen. Store frozen yellow fever vaccine at 0^c or lower. Frozen dry vaccine stored at these temperatures remains stable for at least two years. Keep the vaccine frozen until it is reconstituted for administration. If using thermostable vaccine, consult the package directions for temperature recommendations.

- 2) Transport vaccine in well-sealed insulated boxes with adequate dry ice or frozen cold packs. Once diluent has been added to a vial of yellow fever vaccine, use all the vaccine in one hour. Avoid mixing more vaccine and diluent than can be used in an hour. Yellow Fever vaccine deteriorates in light, so keep vials of vaccine shaded when ready to administer.

Vaccine Administration Guidelines

- 1) Give vaccine according to priorities for age groups as determined by Ministry of Health authorities.
- 2) During an epidemic:
 - √ immunize pregnant women - the risk of the women dying of yellow fever outweighs any potential danger to the fetus.
 - √ do not vaccinate persons with AIDS in the later stages of their disease since the vaccine may cause them to develop encephalitis
 - √ do not give yellow fever vaccine to anyone who is allergic to eggs or chickens.

-
-
- 3) Add diluent to vaccine using sterile needles, syringes and technique. A sterile needle and syringe must be used for each vaccine recipient. The injection site should be cleaned with alcohol or other disinfectant prior to injection.

 - 4) Adverse reactions to yellow fever vaccine are rare. Anaphylactic reactions are very rare, but may occur and require emergency care with epinephrine and steroids. Moderate soreness and swelling at the injection site are not uncommon. Rare severe local reactions at the injection site have been reported in some African yellow fever vaccine campaigns. The cause of these reactions is not clear but may be related to insufficient cleaning of the injection site.

Annex 4 Laboratory Confirmation Of Yellow Fever

Background

The laboratory confirmation of yellow fever requires specialized equipment, facilities, and trained personnel. It is strongly recommended that personnel from the cooperating reference laboratory be involved in the collection and transport of specimens. Yellow Fever can be confirmed by isolating the virus from blood or other tissues (postmortem liver biopsies), or by detecting specific antibodies in the blood of infected patients. For timely confirmation of an epidemic, strict attention must be paid to the *proper collection of specimens and transportation of specimens*.

Virus isolation can be done by inoculating suckling mice or inoculating special mosquitoes or mosquito cell cultures or other cell culture lines. Once a viral isolate is obtained, a variety of specialized techniques are available to identify the virus with certainty. Antigen detection tests to identify viruses directly and rapidly in blood are available in some laboratories, but vary in their sensitivity. A number of serologic tests are available to detect antibodies to yellow fever virus, but they require skilled interpretation in some instances.

Virus Isolation from Blood

Yellow fever virus is usually in the blood during the first 3-4 days of acute clinical illness, before jaundice is noticeable. This frequently means that, by the time jaundice is noticeable, virus can no longer be recovered. In addition, patients who develop severe disease with bleeding may have virus present again, and blood from them should be cultured for yellow fever virus.

The failure to isolate virus from the blood after the first 3-4 days may be due to the fact that virus particles are present in the blood but are bound up in complexes with antibodies. Some laboratories may be able to treat such specimens to split the virus from these complexes and thus make it possible to isolate the virus.

Blood from viremic patients is infectious and should be collected and handled with gloves. It is not known to be infectious by aerosol.

Collect blood in a sterile tube, using aseptic technique and seal the tube tightly.

Virus Isolation from Postmortem Liver Biopsy

Tissue from a postmortem liver biopsy from fatal cases can also yield a virus isolate. In almost all situations, the assistance of the cooperating diagnostic reference laboratory should be obtained to collect liver tissue. Because of the danger of severe, uncontrollable intra-abdominal bleeding, **liver biopsy must not be attempted while the patient is alive.** A Menghini biopsy needle can obtain an adequate biopsy specimen percutaneously, which avoids the need for an autopsy. If a biopsy needle is not available, a small abdominal incision can adequately expose the liver to obtain a small piece of tissue. Gloves should be worn when collecting and handling the tissue. Place the tissue in a sterile tube, using aseptic technique, and seal the tube tightly. The tube should be chilled as soon as possible and transported cold to the laboratory. The family of the deceased usually will agree to either procedure, if you explain why the information to be gained is important.

Confirmation by Detecting Antibody

IgM antibodies will usually appear by the fourth day of clinical illness and will persist for 2-4 weeks. IgG antibodies appear by 7-14 days after onset of illness and may persist many years.

Labeling, Packing and Transporting Specimens

Label each specimen with a number, the patient's name, location, date of onset of illness, if possible, date of collection of specimen, and a brief clinical description. The specimens must reach the laboratory promptly and must be kept cold during transport. Maintain a cold temperature using wet ice, frozen cold packs, dry ice or liquid nitrogen. Insulated carrying containers are mandatory. Access to cold transportation methods will be facilitated by involving personnel from the cooperating reference laboratory.

Annex 5 Roles And Responsibilities At The Health Facility, District, Province
And Central Levels

Health Facility Level

1. Surveillance and Reporting
 - √ recognize cases of yellow fever
 - √ report suspected cases of yellow fever immediately to the district level
 - √ collect information on patients
 - √ report daily during epidemics
2. Treatment of Patients
3. Inventory of supplies needed for case management
4. Public Education
 - √ conduct health education and support health education efforts of the district and province

District Level

1. Surveillance
 - √ Collect data from health facilities and through investigations
 - √ Analyze data
 - √ Review the clinical signs and symptoms of reported suspected yellow fever cases
 - √ Arrange for laboratory confirmation
 - √ Contact neighboring health facilities to search for additional evidence of yellow fever activity and to alert them to be vigilant for cases in their area.
2. Reporting

-
-
- √ Forward reports about suspected yellow fever to the province or designated level immediately.
 - √ When a field investigation confirms that there are cases meeting the case definition for suspected yellow fever, immediately report this to the province of designated level.
 - √ During Epidemics, send daily reports of cases and deaths.
 - √ Notify neighboring areas and designated officials and agencies when an epidemic has been confirmed.
3. Investigation of Suspected Epidemics
- √ Send an investigation team to the field whenever a suspected case of yellow fever is reported.
4. Planning
- √ Collect inventories of vaccination and treatment supplies from health facilities. Combine estimates and report the district needs to the province or designated level.
 - √ Get results of tests for laboratory confirmation and communicate them to the designated person (crisis committee).
5. Vaccination
- √ Define the high risk populations.
 - √ Calculate the number of vaccine doses and other supplies needed.
 - √ Organize vaccination teams and arrange cold chain.
6. Monitor course of epidemic and control measures
- √ Monitor the inventory of diagnostic, treatment and vaccination supplies in health facilities and in national stores.
 - √ Maintain close communications with Provincial/National level crisis committee to:
 - a) Review epidemiology, results of epidemiologic investigations and laboratory results;

-
-
- b) Agree on appropriate vaccination strategy;
 - c) Assess district and Provincial resources available for vaccination campaign;
 - d) Assess Provincial capacity to address projected needs; and
 - e) Determine need for support or assistance.

Provincial Level

1. Surveillance

Data Collection

- √ Receive reports from districts. If daily reports are not being received, contact the District Chief of Health to find out why the report was not received and to collect the number of suspected yellow fever cases and deaths.

2. Data Analysis

- √ Tabulate total daily numbers of suspected yellow fever cases reported by each district.
- √ Prepare a summary of the number of health facilities reporting (including health facilities that reported but did not have suspected yellow fever cases) and the total health facilities in each District.

3. Review of Data

- √ Compare the total daily or weekly number of cases reported from each health sub-district to monitor the progress of the epidemic.

4. Investigate Suspected Epidemics

- √ Provide support to districts to conduct a field investigation.

5. Reporting

- √ Send a daily summary of surveillance data to the Central level and to adjacent provincial officials.

-
-
- √ Send weekly summaries of epidemic surveillance data to districts, health facilities, NGOs & the MOH while an epidemic is in progress.
 - √ Continue to send weekly reports until there are no cases for two weeks.

6. Assess and Obtain Resources

- √ Immediately contact the WHO in-country representative when laboratory confirmation of yellow fever is obtained;
- √ Assess human & other resources available for mass vaccination campaigns, and for diagnosis and treatment of cases; and
- √ Maintain a provincial stock of enough intravenous solutions and giving sets to meet the needs of one average-size district having a yellow fever epidemic.

7. Epidemic Response

- √ Convene epidemic committee and monitor response activities.

National Level

1. Notification
 - √ Report suspected yellow fever cases to the World Health Organization (WHO).
 - √ Notify WHO when laboratory confirmation is obtained.

2. Convene National Epidemic Coordinating Committee
 - √ Alert committee members when a yellow fever outbreak is confirmed.
 - √ Convene the committee to coordinate resources, technical expertise, and emergency supplies.

3. Planning and Policy Formulation
 - √ Define roles and responsibilities of level of health care system, in conjunction with other levels
 - √ Support inclusion of yellow fever vaccine in routine childhood immunization
 - √ Arrange for laboratory support from laboratories competent to confirm yellow fever
 - √ Arrange for, or support efforts, to provide funding for epidemic detection and control
 - √ Decide whether to maintain a reserve stock of yellow fever vaccine for use in epidemics, and where it should be held
 - √ Support training which will increase competence to detect and respond to yellow fever epidemics

3. Analyze Data
 - √ Receive weekly collated reports of suspected yellow fever cases, deaths, and their locations from the provinces. Analyze the data to:
 - a) monitor provincial and district attack rates;
 - b) monitor case fatality rates;

-
-
- c) map the location of outbreaks by district;
 - d) determine geographic spread; and
 - e) graph the number of new outbreaks and new cases over time.
4. Assist in Field Investigations
- √ Consult with the province regarding on-site investigations via telephone or on-site visits.
 - √ Review investigations, advise the provinces regarding data collection, methodology, analysis, and actions to take.
5. Provide Assistance
- √ Review surveillance data to determine needs for emergency supplies, technical, and personal assistance.
 - √ Provide on-site technical support to the provinces as needed. Factors suggesting the need for national support include:
 - a) requests from the province for assistance;
 - b) attack rates greater than 10% in a provincial population;
 - c) case fatality rates greater than 15%; and
 - d) confirmed yellow fever outbreaks in multiple locations.
6. Mobilize Additional Supplies
- √ Request resources and assistance from WHO, non-governmental organizations and other donors.
7. Conduct Epidemiologic Studies
- √ Discuss with the province the need for additional epidemiological studies, such as case control studies to identify risk factors for yellow fever, and to guide control efforts. If needed, provide the technical training and assistance.

-
-
- √ Conduct ongoing and retrospective studies to determine:
 - a) the probable source of the epidemic;
 - b) related morbidity and mortality by time, location and age groups;
 - c) effectiveness of the vaccination and mosquito source reduction campaigns; and
 - d) costs of the epidemic.

 - √ Analyze and use these data for future planning and crisis responses.

NOTES

NOTES

NOTES