POLIO ERADICATION

FIELD GUIDE

Second Edition

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FOREWORD

The primary aim of the first *Polio Eradication Field Guide*, originally published in 1987 and revised in 1988, was to provide epidemiologists, medical officers, and other health personnel involved in polio eradication efforts at national, state, and local levels with a step-by-step guide for setting up and carrying out polio eradication activities. The present guide incorporates knowledge acquired over the past 6 years and can be used by any country working toward eradication. It emphasizes issues related to evaluating surveillance systems, improving specimen collection for cases and contacts, and developing specially targeted vaccination strategies. Some of the measures it describes may need to be adapted according to local conditions. Prototype forms are included in the appendices and may be copied or modified to meet particular needs.

By the time this version of the *Field Guide* is published, over 2 years will have elapsed since the last case of paralytic disease due to the transmission of indigenous wild poliovirus was detected. That case occurred in Junín, Peru, on 23 August 1991. Nevertheless, surveillance must be maintained until eradication has been accomplished worldwide, as was demonstrated by the importation of wild poliovirus into Canada from the Netherlands in late 1992.

The Pan American Health Organization/World Health Organization wishes to acknowledge the outstanding accomplishment of all the health workers in the Americas involved in the polio eradication program. Despite often trying and even hazardous conditions, they persevered and continued to learn from their experiences. The lessons they have learned in conducting the program so successfully are contained herein.

1 INTRODUCTION

1.1 Background

On 14 May 1985, the Director of the Pan American Health Organization (PAHO) announced the goal of eradicating wild poliovirus in the Americas. At the XXXI Meeting of the PAHO Directing Council in September 1985, PAHO Member Governments unanimously adopted a resolution setting this goal for the Americas. By the third quarter of 1993, no poliovirus had been detected within the Americas for over 2 years, despite intensive surveillance from over 21,000 weekly reporting units and investigation of over 3,500 suspected polio cases, which on close study were discarded as not being polio. The eradication effort has also dramatically strengthened immunization services for the other vaccine-preventable diseases included in the Expanded Program on Immunization (EPI).

To achieve the goal of eradication, public and private agencies—including UNICEF, the Inter-American Development Bank (IDB), the United States Agency for International Development (USAID), the Canadian Public Health Association (CPHA), Rotary International, and others—have joined forces with PAHO.

1.2 Program Strategy

The strategies used in the polio eradication program are based on knowledge about the disease, the vaccine, and effective methods for the control of polio.

Natural history of the disease: The ratio of inapparent infections of poliomyelitis to paralytic cases is high, somewhere between 100 and 1,000 to 1. Despite the large number of subclinical cases of poliomyelitis, if the wild virus continues to circulate in a community, a paralytic case is likely to appear. Surveillance techniques are therefore useful to identify high-risk areas.

Properties of the vaccine: The oral poliomyelitis vaccine (OPV) contains live poliovirus whose virulence has been reduced, or attenuated. Since the virus in the vaccine is live and is administered orally, mimicking the natural route of infection, it also can be transmitted from a vaccinated person to close contacts who have not been immunized. Its circulation interrupts transmission of the wild virus by displacing it. This effect is enhanced if the vaccine is administered to entire communities by means of national vaccination days.

Effective control methods: After mass vaccination campaigns with OPV, developed and developing countries alike have experienced a dramatic decrease in the number of cases of poliomyelitis. Many approached or achieved zero incidence within a few years of initiating mass campaigns (see Figure 1). In several countries success has been achieved despite large gaps in vaccination coverage in the under-5-year age group. This success is due primarily to the emphasis on mass vaccination for community protection rather than on individual immunity alone.

The six components of the eradication strategy are as follows:

- Intensification of immunization activities, in the form of national vaccination days and house-to-house "mop-up" campaigns in high-risk areas.
- Monitoring of coverage levels in the smallest geopolitical units.
- Enhanced surveillance of acute flaccid paralysis (AFP).
- Rapid case investigation, including the collection of appropriate stool samples from cases and contacts of cases.
- Aggressive outbreak control whenever necessary to stop transmission.
- Community monitoring to ensure absence of the virus in both human populations and the environment.

1.3 Program Management

A well-coordinated and managed approach is critical if eradication is to succeed. This approach requires centralized responsibility for overseeing all surveillance and control activities. At the same time decentralization of

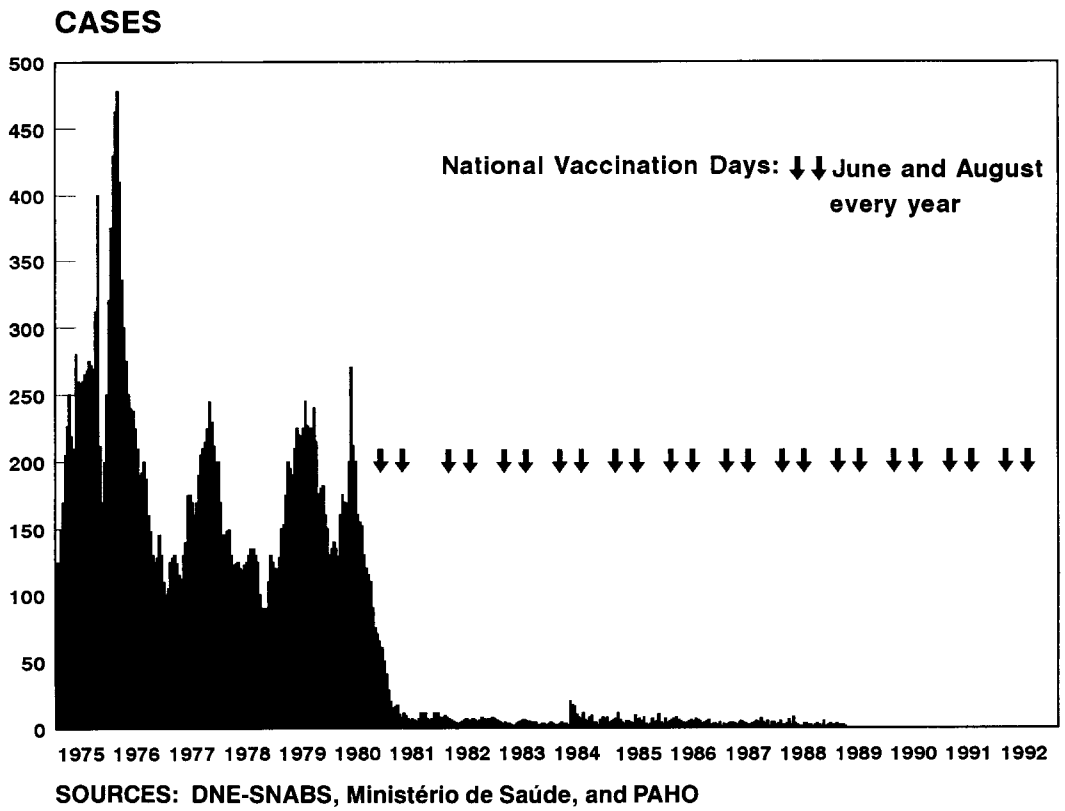


FIGURE 1
Polio Cases by 4-week Period in Brazil, 1975–1992

management functions is critical, so that health workers have enough authority and flexibility at the local level to conduct program activities in the areas of greatest need. The program manager needs to use epidemiologic data to direct the program and to supervise and evaluate activities. A standardized information system is therefore critical.

The development of training programs is an equally important component of successful eradication. Health staff at every level should attend seminars on polio eradication. Such "classroom" training efforts should be followed up with field visits to ensure that the approaches and materials are relevant and are successfully implemented.

All activities should be detailed in a national plan of action that should form the basis for local plans of action.

An Interagency Coordinating Committee (ICC) should be established so that the public and private agencies involved will have a clear idea of each agency's commitment to the program. Such a committee is important for pooling and reassigning resources, setting priorities, and decentralizing funding.

2 EPIDEMIOLOGY

2.1 Infectious Agent

The poliovirus is an enterovirus. There are three antigenic types, called types 1, 2, and 3. All three can cause paralysis, although type 1 causes paralysis most often, type 3 less frequently, and type 2 rarely. Most epidemics are due to type 1. Cases associated with the vaccine, which contains all three types, are usually caused by types 3 and 2.

2.2 Occurrence

Poliomyelitis exists worldwide. It is seasonal, occurring more commonly in summer and early autumn in temperate climates. In tropical countries seasonality is less clearly defined; however, some areas experience increases during the rainy season. In developing countries with low immunization coverage, poliomyelitis produces a significant amount of illness, death, and disability. Where poliomyelitis is common, 3 to 10 of every 1,000 young children will develop paralytic disease. During 1991, over 16,000 cases of poliomyelitis were reported worldwide to the World Health Organization (WHO). However, lameness surveys have previously shown that official reporting in developing countries usually identifies less than 10% of the actual number of paralytic cases. Thus, it is likely that the true global incidence is at least 160,000 cases annually.

In the Americas between 1975 and 1980, approximately 4,000 total cases were reported per year from 19 countries. In 1986, 963 cases of polio were reported from 13 countries in the Americas. In 1991 only 9 culture-positive cases from 2 countries were reported. All 9 were wild-type 1, with 8 occurring in Colombia and 1 in Peru. In addition to these 9 confirmed polio cases, there were 45 cases compatible with polio and 5 vaccine-related cases. By the end of 1992, no culture-positive cases were reported (see Figure 2). Given that the countries of the Region have mounted an efficient surveillance system, data from the Americas are considered far more reliable than those from other parts of the world.

2.3 Transmission

Fecal-oral transmission is most common in developing countries where sanitation is poor, while oral-pharyngeal transmission is likely to be more common in industrialized countries and during outbreaks. One week after onset, little virus remains in the throat, but it continues to be excreted in stools for 6 to 8 weeks. Cases are probably most infectious during the first few days before and after the onset of symptoms.

2.4 Reservoir

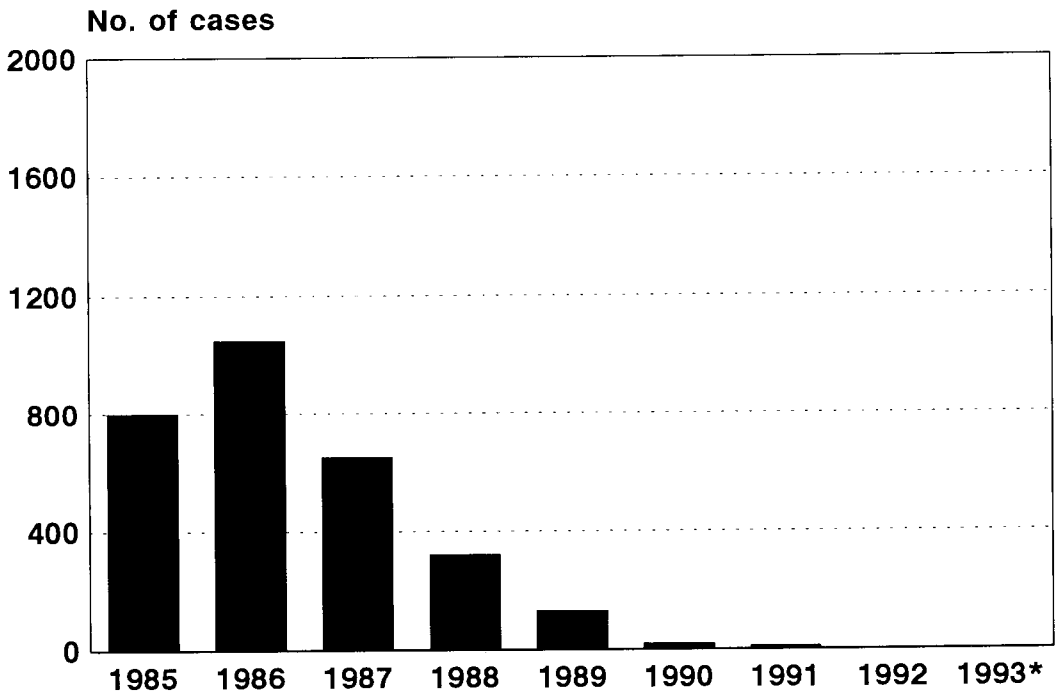
Man is the only reservoir, and infection is spread from person to person. Given the large number of inapparent infections it is difficult to find the source of a case. A long-term carrier state is not known to occur.

2.5 Incubation

On average, the incubation period from exposure to the virus to the onset of first symptoms is 7–10 days (range of 4–30 days). The initial illness is followed by a few days relatively free of symptoms before the onset of paralysis.

2.6 Immunity

All unimmunized persons are susceptible to poliomyelitis. Epidemiologic evidence shows that infants born to mothers with antibodies are protected naturally against paralytic disease for a few weeks. Immunity is obtained through infection with the wild virus and through immunization. Immunity following natural infection (including inapparent and mild infections) or a completed series of immunizations with live oral polio vaccine (OPV) results in both humoral and local intestinal cellular responses. Such immunity is thought to be lifelong and can serve to block infection with subsequent wild viruses, thereby helping to break chains of transmission. Vaccination with the inactivated poliovirus vaccine (IPV) confers humoral immunity, but relatively less intestinal immunity; thus, vaccination with IPV does



* DATA AS OF DECEMBER
SOURCE: PAHO

FIGURE 2
Confirmed Polio Cases in the Americas, 1985–1993

not provide resistance to carriage and spread of wild virus in the community. There is thought to be little, if any, cross-immunity between poliovirus types.

2.7 Molecular Epidemiology

The molecular epidemiologic studies of wild poliovirus have recently proved useful in helping to identify whether different virus isolates originate from a common ancestral source of infection. With this information, geographic foci or reservoirs of transmission can be defined and sources of outbreaks traced across large geographic areas. For example, the eight culture positive cases reported from Colombia in 1991 were evaluated by genomic sequencing; results indicated that all were indigenous to Colombia. Similarly, of the 14 wild-type 1 isolates in 1990, the genomic sequencing results indicated that all were indigenous Andean genotypes and not importations from other areas in Latin America or from other endemic countries around the world.

3 CLINICAL ASPECTS

The polio eradication program places emphasis on surveillance of all cases of acute flaccid paralysis (AFP), whatever the cause, in children under the age of 15 years. Any case of AFP thus identified is investigated immediately (within 48 hours) to rule out or confirm wild poliovirus as the cause of the paralysis.

3.1 Pathogenesis

The mouth is the usual site of entry, and the virus first multiplies in the lymph nodes in the pharynx and gastrointestinal tract. The virus is usually present in the pharynx and in the stools before the onset of paralytic illness. Once the virus has entered the body, it invades local lymphoid tissue, enters the bloodstream, and then may invade certain types of nerve cells. As it multiplies intracellularly, the virus may damage or completely destroy these nerve cells.

3.2 Clinical Features

For purposes of reporting, surveillance is chiefly concerned with paralytic disease. Many persons who are infected with the wild poliovirus exhibit minor illnesses, but these cannot be distinguished clinically from illnesses with many other etiologies. Symptoms associated with these minor illnesses include mild fever, muscle pains, headache, nausea, vomiting, stiffness of the neck and back, and, less frequently, signs of aseptic (nonbacterial) meningitis. Inapparent (subclinical) infections are common: depending upon the strain of the polio virus, the estimated ratios of inapparent to apparent infections range between 100:1 and 1,000:1 (Figure 3).

Susceptible older children and adults run a greater risk of developing paralytic illness. The case-fatality rate varies between 2% and 20% among persons who do develop the paralytic form of the disease. However, if there is bulbar or respiratory involvement the case-fatality rate may be as high as 40%. Most deaths occur within the first week following the onset of paralysis.

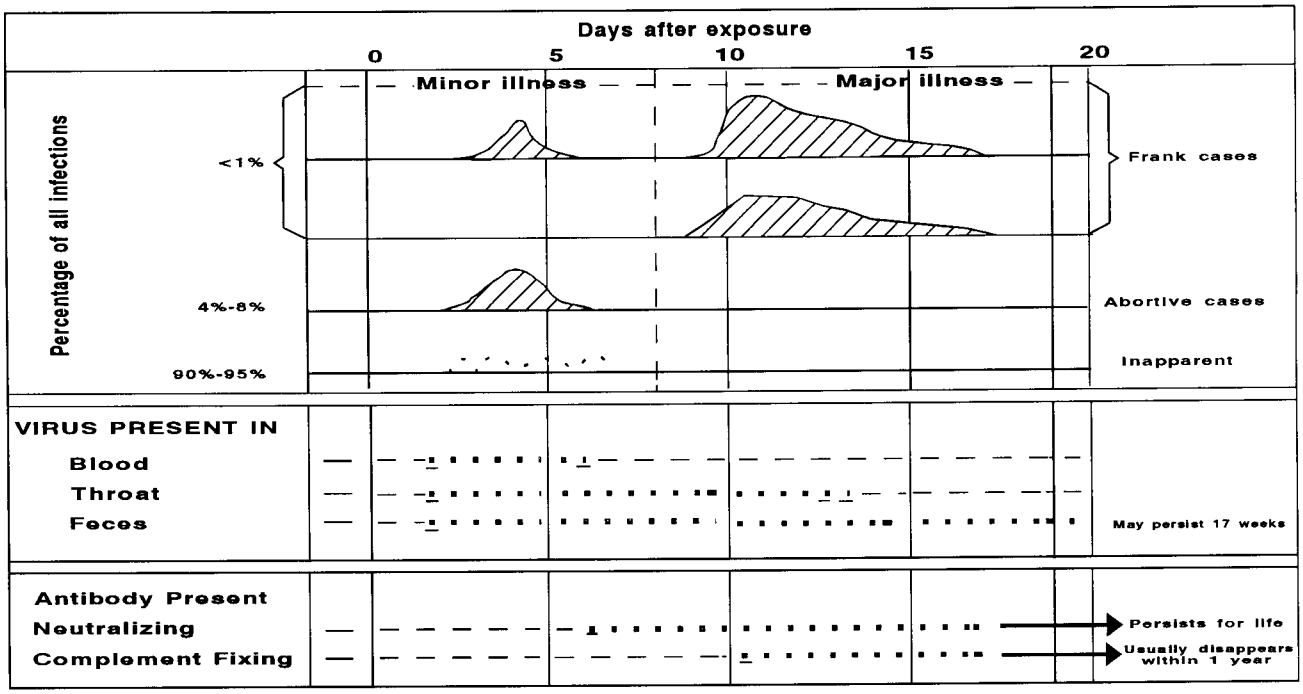
3.3 Differential Diagnosis

Every case of acute flaccid paralysis in persons under 15 years old that is clearly not due to severe trauma should be investigated. If there is strong suspicion of polio in persons over 15 years of age, these cases should also be thoroughly investigated.

It is difficult to confirm paralytic poliomyelitis in the acute phase based on clinical signs and symptoms alone, as a large number of other diseases and conditions may cause similar symptoms. Laboratory confirmation is therefore critical to the final diagnosis. The two diseases most frequently confused with polio are Guillain-Barré syndrome and transverse myelitis (see Table 1).

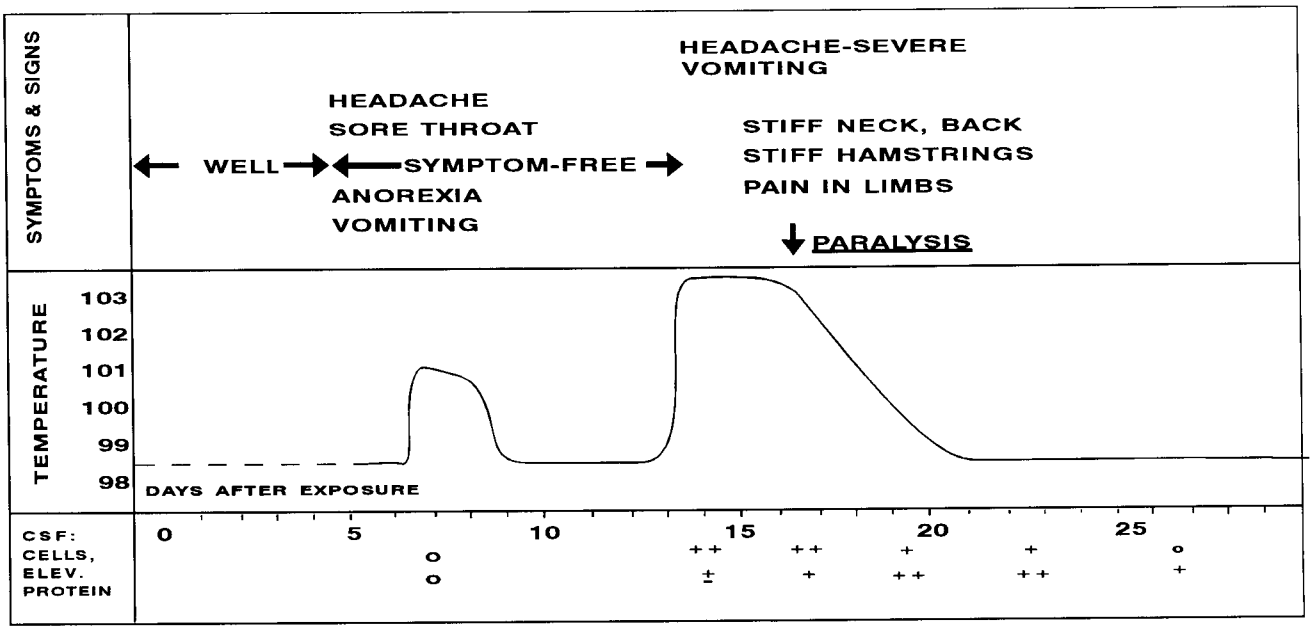
Other conditions that may present symptoms similar to those of paralytic poliomyelitis include traumatic neuritis and tumors and, less frequently, meningitis/encephalitis, as well as illnesses produced by a variety of toxins. The most prominent difference between poliomyelitis and other causes of acute flaccid paralysis is that for polio the paralytic sequelae are generally severe and permanent, while for many other causes of AFP paralysis tends to resolve or improve within 60 days of onset. All discarded cases should be recorded, along with the final differential diagnoses (Appendix A). For a more detailed discussion of the differential diagnosis of poliomyelitis, see Appendix B.

PATHOGENESIS



SOURCE: ADAPTED FROM PAUL JR, EPIDEMIOLOGY OF POLIOMYELITIS, WHO MONOGRAPH NO. 26, 1955.

CLINICAL COURSE



SOURCE: HORSTMANN DM, CLINICAL ASPECTS OF ACUTE POLIOMYELITIS, AMERICAN JOURNAL OF MEDICINE 1949;6:598.

FIGURE 3
Pathogenesis of Poliomyelitis Infection and Clinical Course of Acute Poliomyelitis

TABLE 1. CRITERIA FOR THE DIFFERENTIAL DIAGNOSIS OF POLIOMYELITIS

	POLIO	GUILLAIN-BARRÉ SYNDROME	TRAUMATIC NEURITIS	TRANSVERSE MYELITIS
TIME FROM ONSET OF PARALYSIS TO FULL PROGRESSION	usually from 2 to 3 days	from hours to 10 days	from hours to 4 days	from hours to 4 days
FEVER	fever with onset of paralysis, usually disappearing within 3 to 4 days	not common	commonly present before, during, and after flaccid paralysis	rarely present
FLACCID PARALYSIS	acute, asymmetrical, principally proximal (upper part of arms and legs)	generally acute, symmetrical, and distal (lower part of arms and legs)	asymmetrical, acute, and usually affecting only one limb	acute, lower limbs affected symmetrically
MUSCLE TONE	reduced or absent in the affected limb	reduced or absent	reduced or absent in the affected limb	reduced in lower limbs
DEEP-TENDON REFLEXES	decreased to absent	absent	decreased to absent	absent in lower limbs
SENSATION, PAIN	sensation usually normal, severe myalgia, backache	cramps, tingling, reduced sensation on palms and soles	pain in buttocks, reduced sensation to cold and heat	anesthesia of lower limbs with sensory perception
CRANIAL NERVE INVOLVEMENT	only when bulbar involvement is present	often present, low and high: Miller-Fisher variant	absent	absent
RESPIRATORY INSUFFICIENCY	only when bulbar involvement is present	in severe cases, enhanced by bacterial pneumonia	absent	often thoracic paralysis, without sensory loss
AUTONOMIC SIGNS & SYMPTOMS	general motor incoordination, weakening of the reflexes	rare	frequent blood pressure alterations, sweating, blushing, body temperature fluctuations	hypothermia in affected limb
CEREBROSPINAL FLUID	inflammatory	high protein with relatively low cells	normal	normal or mild elevation in cells
BLADDER DYSFUNCTION	absent	sometimes	transient	always
NERVE CONDUCTION VELOCITY AT 3 WEEKS	abnormal: anterior horn cell disease (normal during the first 2 weeks)	abnormal: demyelinization	abnormal: axonal damage	normal or abnormal, no diagnostic value
SEQUELAE AT 3 MONTHS UP TO A YEAR	severe, asymmetrical atrophy; skeletal deformities develop later	mild	symmetrical atrophy of peroneal muscles (outer side of leg)	moderate atrophy, only in affected lower limb

Source: Alcalá H, Olivé J-M, de Quadros C. The Diagnosis of Polio and Other Acute Flaccid Paralyses: A Neurological Approach. Document presented at the Ninth Meeting of the Technical Advisory Group on Vaccine-preventable Diseases, held in Guatemala City, Guatemala, 12–15 March 1991. (Doc. no. EPI/TAG/91-10.)

WHEN PARALYSIS DUE TO POLIOMYELITIS OCCURS:

- *It is typically flaccid (the muscles are not stiff or spastic).*
- *Patients usually have problems with standing and walking.*
- *It is commonly preceded by symptoms of minor illness such as sore throat, headache, backache, fever, vomiting, etc.*
- *Paralysis develops rapidly, usually within 4 days.*
- *Fever is usually present at onset of paralysis.*
- *Most patients have little or no sensory loss (for example, patients will feel a needle stick). This sign may be difficult to determine in children.*
- *The legs are more commonly involved than the arms, and the large muscle groups of the hand are at greater risk than the small ones. Proximal muscles of the extremities tend to be more involved than distal.*
- *It is usually asymmetric (not affecting both sides equally). Although any combination of limbs may be paralyzed, the most common pattern is involvement of one leg only, followed by one arm only. Less common is to have both legs or both arms affected. Quadriplegia is rarely observed in infants.*
- *Sequelae are usually present at 60 days after onset.*

4 CASE DEFINITIONS

The polio eradication program should use the following standardized case definitions. It should be stressed that surveillance is carried out for all cases of acute flaccid paralysis and not just for poliomyelitis. The terms "probable case" and "acute flaccid paralysis" are synonymous in an eradication program. Special effort should be made to obtain stool samples from probable cases and from their contacts, and intensified "mop-up" vaccination efforts should be started promptly. All cases that are classified as "discarded" (see Figure 4) require thorough justification.

4.1 Suspected Case

- A suspected case is any case of acute-onset paralysis in a person under 15 years of age for any reason other than severe trauma

  OR

  paralytic illness in a person of any age in which polio is suspected.

The classification "suspected case" is temporary. It should be reclassified as "probable" or "discarded" within 48 hours of notification.

4.2 Probable Case (Acute Flaccid Paralysis)

- A suspected case is classified as "probable" if acute ***flaccid*** paralysis (AFP) is found

  AND

  no other cause for the paralysis can be identified immediately.

The classification of "probable case" is also temporary; within 10 weeks of onset the case should be reclassified as "confirmed," "compatible," "vaccine-associated," or "discarded."

4.3 Confirmed Case

- Acute paralytic illness with or without residual paralysis,

  AND

  isolation of wild poliovirus from the stools of either the case or its contacts.

4.4 Polio-compatible Case

- Cases are classified as "polio-compatible" when two adequate stool specimens were not collected from a probable case within 2 weeks of the onset of paralysis,

  AND

  there is either an acute paralytic illness with polio-compatible residual paralysis at 60 days,

  OR

  death takes place within 60 days,

  OR

  the case is lost to follow-up.

4.5 Vaccine-associated Paralytic Poliomyelitis

- Acute paralytic illness in which vaccine-like poliovirus is isolated from stool samples,

  AND

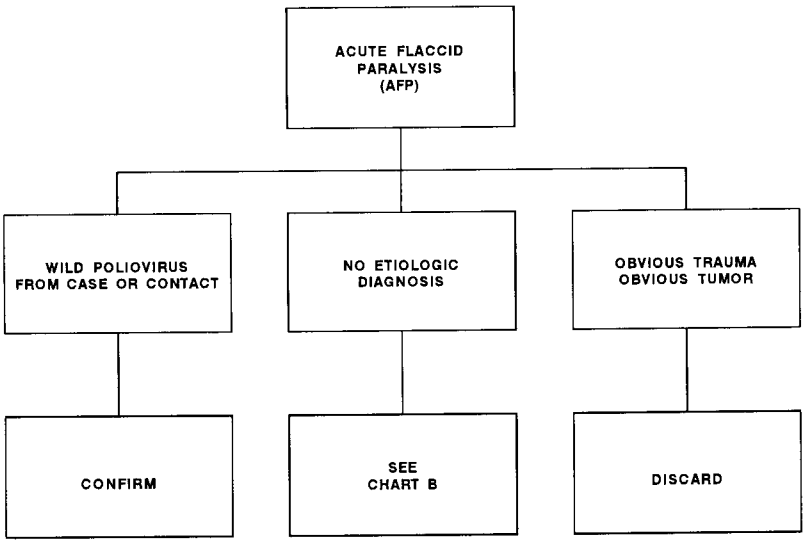
  the virus is believed to be the cause of the disease.

There are two possible types of vaccine-associated paralytic poliomyelitis (VAPP): recipient and contact.

A case is classified as *recipient* vaccine-associated paralytic poliomyelitis when any person has onset of AFP 4 to 40 days after receiving OPV and has neurologic sequelae compatible with polio 60 days after the paralysis began. (It generally takes somewhere between 4 and 30 days from the time of exposure to develop signs of illness such as diarrhea or myalgia. Paralysis usually occurs up to 10 days after the other symptoms appear. Since paralysis is the surveillance reference, PAHO/WHO uses a 4–40 day criterion.)

A case is classified as *contact* VAAP when a person who has residual paralysis 60 days after the onset of AFP had contact 4 to 40 days before the paralysis began with a

(Chart A)



(Chart B)

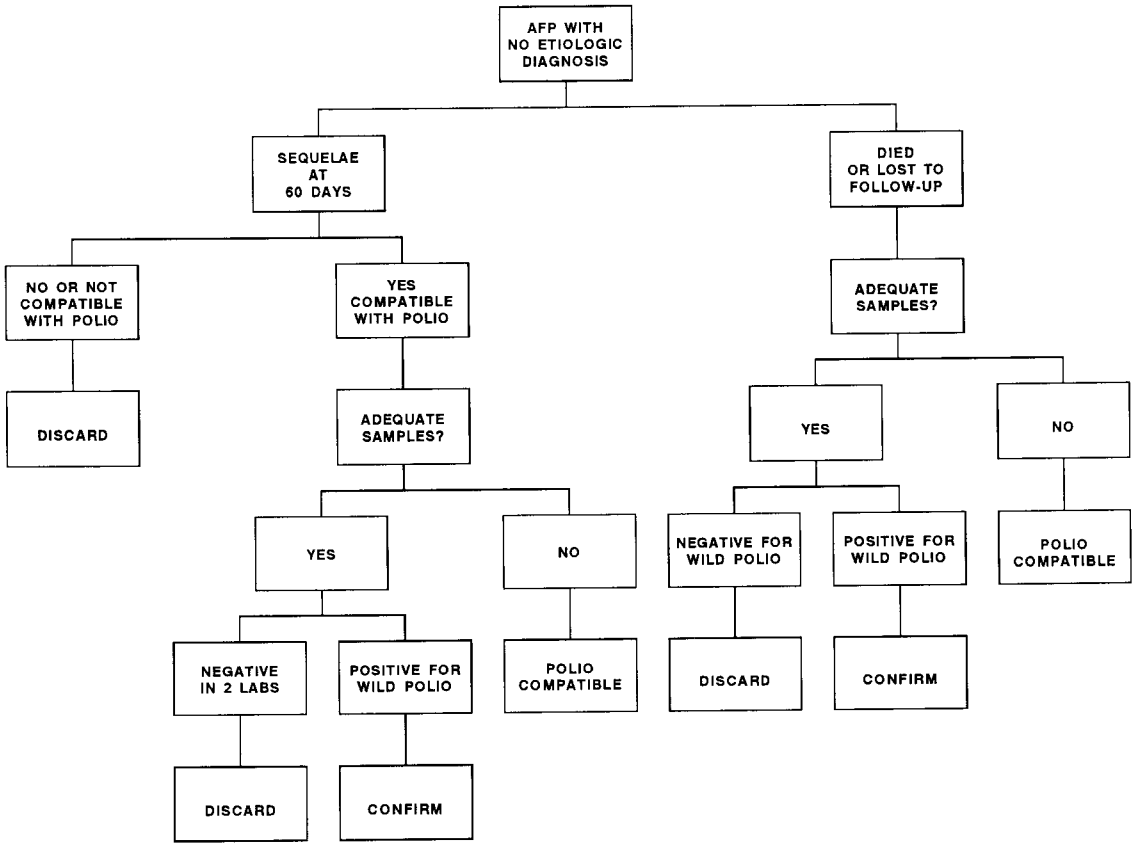


FIGURE 4
Classification of Acute Flaccid Paralysis

NOTE ON CASE DEFINITIONS FOR ENDEMIC COUNTRIES

In the initial stages of polio eradication, especially in those countries that are endemic for polio, it is necessary to concentrate on cases of paralytic illness that have residual paralysis at 60 days. In addition, a high priority should be given to investigating AFP (a probable case) in children who:

- *are under 6 years of age;*
- *experience fever at onset of paralysis;*
- *develop paralysis in less than 4 days.*

In outbreak situations, after the first few cases are laboratory-confirmed, additional cases may be confirmed based on epidemiologic association, that is, on a clinical basis alone. At the initial stages of eradication, obtaining stools from contacts is usually not called for and will tend to overburden laboratory resources. Contact stools become more important in the later stages of eradication.

person who received OPV somewhere between 4 and 85 days before the contact's paralysis began.

Given that contact exposure history is often missing or difficult to interpret, surveillance of VAPP in Latin America has focused almost exclusively on recipient VAPP.

4.6 Discarded (Not Poliomyelitis)

- Acute paralytic illness for which two adequate stool specimens were obtained within 2 weeks after onset of paralysis and were negative for poliovirus;

  AND

  stools from five contacts < 5 years of age who had not been vaccinated within the past 30 days were negative for poliovirus. Aliquots of the original samples should be held at the laboratory for future study.

Any probable case who dies, is lost to follow-up, or has residual paralysis at 60 days should have aliquots of the original specimens examined in two other laboratories in the network. If all specimens were adequate and negative, the case should be considered as "not polio" and discarded, or a committee of experts may decide the final outcome (see section 4.8, below).

4.7 Sensitivity and Specificity

It is important to use risk factor information to identify cases of AFP most likely to be polio.

Based on a review comparing culture-confirmed polio cases with other cases of AFP in the Americas, it was observed that findings present early in the course of disease are good predictors of culture-confirmed polio cases. These findings include age < 6 years and fever. In addition, paralysis develops completely in under 4 days in 90% of confirmed cases, according to available data. Various combinations of these characteristics can be used on first encounter to identify patients who are most likely to be confirmed by culture as having poliomyelitis.

Using solely age < 6 years as a criterion has yielded a sensitivity of 93% and a specificity of 43%. The combination of age < 6 years and either fever or paralytic progression in less than 4 days resulted in a sensitivity of 96% and an increase in specificity to 49%. The presence of age < 6 years and fever at paralysis onset yielded a sensitivity of 75% and a specificity of 73%.

Those areas that report compatible cases who are < 6 years of age and have fever at paralysis onset should be considered ***high-risk areas***, and special attention should be given to augmenting immunization activities through such measures as "mop-up" campaigns.

4.8 National Review Committees

After the incidence of polio has decreased, each country should organize a National Review Committee. Such committees should be composed of epidemiologists, neurologists, virologists, and pediatricians. The function of such a committee is to analyze problematic cases of AFP by considering the clinical summary, neurological examination, neurophysiology, and laboratory findings, in order to establish a final diagnostic classification. Such committees should also organize seminars where the theoretical and practical aspects of neurological examination of children with AFP are presented.

5 LABORATORY SUPPORT

The laboratory plays a critical surveillance role in the polio eradication program, since eradication focuses on elimination of the wild poliovirus itself and not just the clinically apparent disease. Virus culture of stool specimens collected from both cases of AFP and their contacts is the most sensitive and effective way to rule out wild poliovirus transmission (see Table 2). It is impossible to determine whether a patient will be available for follow-up, so clinical information and specimen collection should take place during the first encounter with the patient.

To ensure that stools of cases and contacts are tested without delay and to solve other problems, a high degree of communication and coordination between the epidemiologist and the virologist must take place. For all probable cases, all available specimens from both the cases and their contacts should be examined.

5.1 Type of Specimen

Stool: Virus usually can be found in the feces from 72 hours to up to 6 weeks after infection, with the highest probability during the first 2 weeks.

Cerebrospinal fluid (CSF): Not likely to yield virus and therefore its collection is *not recommended.*

Throat: Not likely to yield virus and therefore specimen collection from this site is *not recommended.*

Blood: Not likely to yield virus, and current serologic tests cannot differentiate between wild and vaccine virus strains. Experience has shown that, for polio, interpretation of serologic data can often be misleading. Collection of blood specimens is therefore *not recommended.*

If a probable case dies, a definite diagnosis of polio can be made or rejected by examining the spinal cord. It is important that a qualified and experienced pathologist do the examination and that a specimen be sent directly to a reference laboratory, so that efforts can be made to culture poliovirus.

5.2 Collection

Probable case: Two stool specimens should be obtained within 14 days of paralysis onset from all cases. The specimens should be collected 24–48 hours apart.

Probable case that has died: Intestinal contents or nearly formed stools should be collected; tissue (medulla, spinal cord) and serum may also be obtained as soon as possible after death. These specimens should be cultured, investigated by polymerase chain reaction (PCR), and subjected to histopathologic analysis. A section of the nerve of the affected limb should also be obtained.

Contacts: Stools should be collected from five contacts who are under 5 years of age and who have not received oral polio vaccine within the last 30 days.

If the case is seen later than 14 days after the onset of paralysis, and if it is clinically compatible with polio, then in addition to the two stool samples from the case and from five of its contacts, special studies need to be conducted. Such studies may include community surveys to obtain stool samples from 50 to 100 contacts and neighbors of the case who are < 5 years of age and have not been vaccinated within the previous 30 days.

Stools should be collected by the cup technique. ***A minimum of 8 grams should be collected*** (8 g is approximately the volume of two "thumbs"). Rectal swabs are not recommended, although rectal tubes may be used in special studies.

5.3 Storage and Shipment

Stool samples must be kept cold if they are to remain in adequate condition for reliable testing when they arrive at the laboratory.

The best source of cold is dry ice; it should be used whenever possible. As a second choice, ice packs are recommended. Dry ice requires special handling, so it should be ensured that any box containing dry ice is sealed hermetically (see Figure 5).

TABLE 2. SPECIMENS FOR DETECTION OF POLIOVIRUS		
	FECES	AUTOPSY MATERIAL (TISSUE & INTESTINAL CONTENTS)
WHEN TO COLLECT	As early as possible in the course of the illness; two specimens taken at least 24 hours apart from cases or a single specimen from contacts.	Within 24 hours of death.
COLLECTION TECHNIQUE	Use a clean, empty container to collect 8 g of feces (approximately the size of two thumbs).	Avoid contamination of nervous system tissue with intestinal contents. Tissues should be collected using sterile instruments and placed in individual sterile containers. Use separate instruments and containers for different tissue types.
STORAGE	If possible keep refrigerated from the time of collection.	Keep refrigerated from the time of collection.
LABELING	Label all specimens clearly with case or contact's name, case ID number, date of collection, date of onset of paralysis.	Label all specimens clearly with case's name, case ID number, date of collection, date of onset of paralysis.
SHIPPING OF SPECIMENS	Ship wrapped in a well-sealed plastic sack in a thermos or cooler with ice. Use dry ice if available. Include appropriate laboratory slips, and inform laboratory when sample will arrive.	Ship wrapped in a well-sealed plastic sack in a thermos or cooler with ice. Dry ice strongly recommended. Include appropriate laboratory slips, and inform laboratory when sample will arrive.
TYPE OF EXAM	Virus isolation and characterization.	Virus isolation.
INTERPRETATION OF RESULTS	If poliovirus is isolated it must be characterized as being either a "wild" or "vaccine" strain. Absence of virus does not exclude the possibility of polio.	Isolation of poliovirus from the central nervous system tissue confirms poliovirus infection.

The person responsible for shipping should make sure that there is a sufficient quantity of stool and ice. In addition, the shipper should make a telephone call and send a facsimile (fax) to alert the receiver. The shipper should also make sure that the appropriate forms are included with the shipment. Upon delivery, the receiver should inform the shipper of the day and time the specimens were received and their condition. This verification should take place within 48 hours if possible, so that arrangements may be made to collect new samples if needed.

When samples are sent by messenger service or personal delivery, the carrier should be advised of the contents and special handling requirements of the package and should be instructed to make it a top priority to deliver the samples directly and immediately. The delivery service should inform the shipper when delivery has been successfully completed.

The following information should be provided for all specimens:

- date taken
- case identification number
- health jurisdiction
- hospital/clinic
- key clinical information
- vaccine history, date of last OPV dose
- adequacy of sample container
- type of samples
- whether sufficient stool (8 g) was collected
- whether ice was present upon arrival at the laboratory
- correct identification on package.

5.4 Quality Control

Continuous evaluation of the quality of stool specimen collection, transport, and storage is a critical component

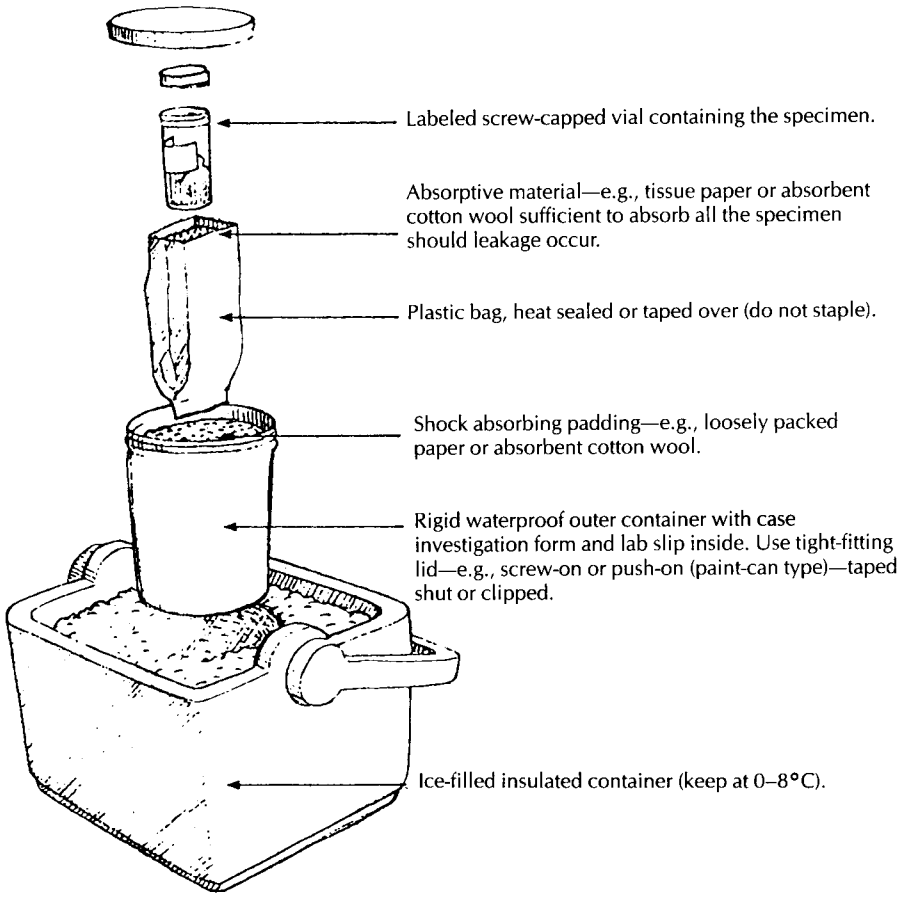


FIGURE 5
Packaging for Virological Specimens

of the program. Specific forms should accompany every specimen to assist in the collection of critical monitoring information (Appendix C).

5.5 Results

It is important that the status and results of tests on the stool samples be conveyed back to the individuals requesting such testing as soon as possible.

Isolation: Failure to isolate a poliovirus from a fecal specimen does not exclude the diagnosis of poliomyelitis, since many factors can influence isolation results, including intermittent excretion of the virus in the stool, insufficient material collected, collection too late in the course of the illness, inadequate storage and shipping procedures of specimens, and laboratory technique. The proportion of specimens for which enteroviruses are isolated should be reported, as this serves as an indirect indicator of the quality of the specimens. In tropical areas enteroviruses should be isolated from at least 15% to 20% of specimens.

Characterization of poliovirus: All polioviruses isolated from the stools of patients with acute flaccid paralysis or from their contacts are characterized by hybridization with strain-specific nucleic acid probes. This characterization determines whether the virus is "wild" or "vaccine-like." The initial identifications are confirmed by polymerase chain reaction (PCR) analyses using primer sets specific to each vaccine strain and to the predominant wild polioviruses indigenous to the Region. Wild viruses identified by these procedures are further characterized by partial nucleotide sequencing of the virus genomes, which reveals the genetic relationships among virus isolates. Given that poliovirus genomes evolve rapidly during replication in humans, the proximity of epidemiologic links among cases may be estimated by the extent of nucleotide sequence rela-

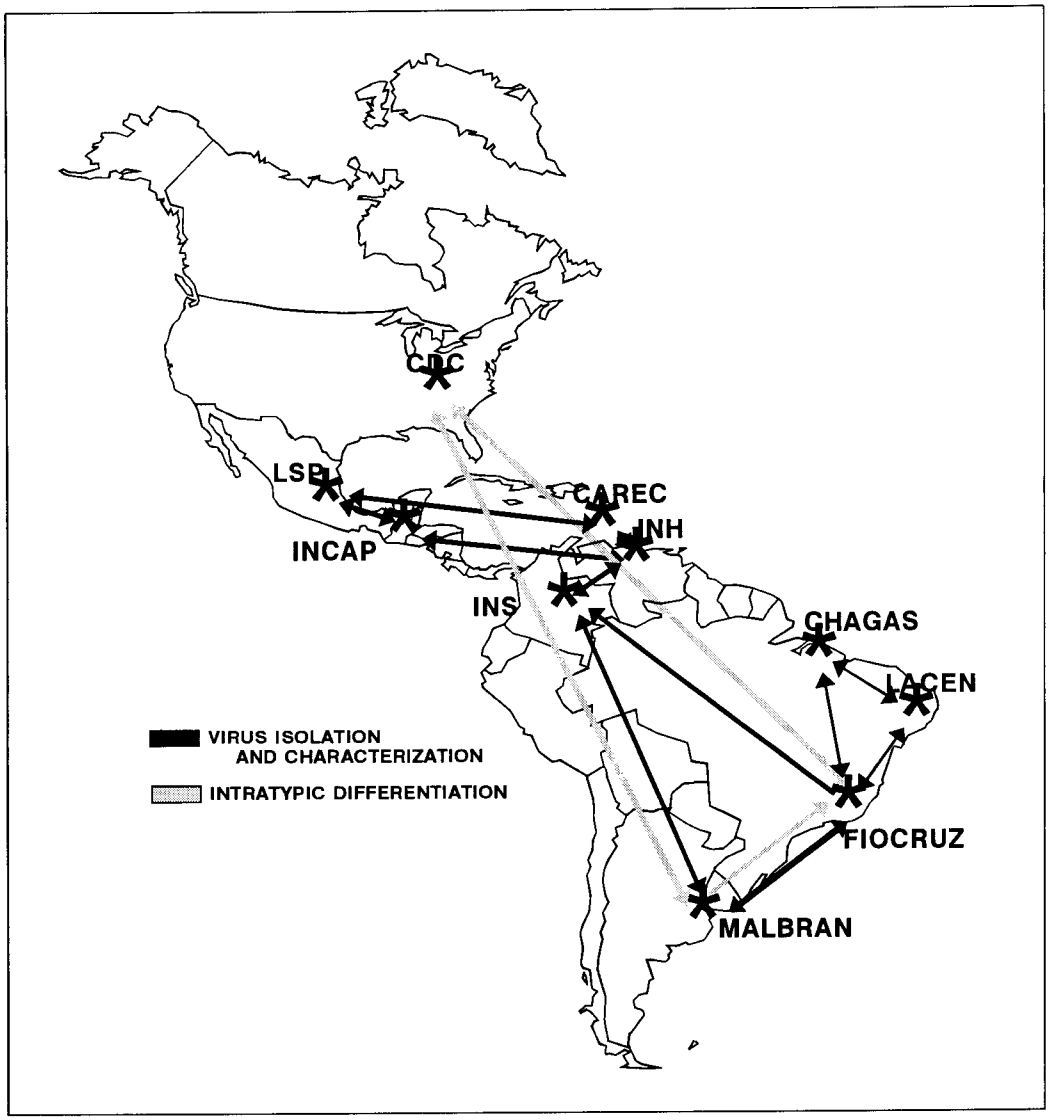


FIGURE 6
Polio Reference laboratory Network for the Region of the Americas

tionships among isolate genomes. Sequence information is also used to aid systematic design of nucleic acid probes and PCR primers.

5.6 Laboratory Network

Poliomyelitis is not clinically distinctive and may be confused with other causes of flaccid paralysis. Extensive laboratory support is therefore required to confirm or rule out poliovirus as the cause of a case of acute flaccid paralysis. Techniques to process stool samples, isolate poliovirus, and differentiate between vaccine and wild virus have to be standardized, and the quality of the process needs to be monitored. PAHO has sponsored the formation of a network of laboratories with this process in mind (see Figure 6). All of the labs perform stool sample analysis to detect poliovirus. Several of the more sophisticated (Level 3) labs perform intratypic differentiation tests for polioviruses (see Figure 7). It is important for the laboratories to provide regular updates of their findings so that the epidemiologic surveillance system can monitor the status of all stool specimens collected from AFP patients.

The network serves to enhance laboratory performance by developing new technologies and analytic approach-

Pan American Health Organization
Pan American Sanitary Bureau, Regional Office of the World Health Organization

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Poliovirus Surveillance

NO INDIGENOUS WILD POLIO VIRUS HAS BEEN DETECTED FOR THE LAST 84 WEEKS
Last wild poliovirus was detected on 5 September 1991, in Peru

Table No. 1a
Status of Case Stool Sample Analysis
Last 52 Weeks (92/18 - 93/16)

LAB.	CNTRY	TOTAL *	WITHOUT RESULTS			ENTEROVIRUS ISOLATION					
			Not yet in Lab	<10 wks	>10 wks	% ISOLATION	NEG.	OTHER ENTERO-VIRUS	Poliovirus Pending	Poliovirus Vaccine	Poliovirus Wild
BEL	BRA	80	3	3	0	13.5	64	10	0	0	0
CAR	DOR	34	0	1	0	24.2	25	8	0	0	0
	HAI	11	1	3	1	16.7	5	1	0	0	0
	JAM	4	0	0	0	0.0	4	0	0	0	0
	SUR	1	0	0	0	0.0	1	0	0	0	0
	TRT	9	1	0	1	14.3	6	1	0	0	0
CDC	COL	5	0	0	0	80.0	1	1	0	3	0
	ECU	4	0	0	0	100.0	0	1	2	1	0
	ELS	7	0	0	0	100.0	0	0	0	7	0
	GUT	2	0	0	0	100.0	0	0	0	2	0
	MEX	32	0	0	0	100.0	0	15	1	16	0
	VEN	1	0	0	0	100.0	0	0	0	1	0
FIO	BOL	55	8	3	7	43.2	21	10	0	6	0
	BRA	253	11	30	5	30.9	143	43	1	20	0
	PER	100	13	25	4	41.4	34	16	1	7	0
INC	COR	4	0	0	0	50.0	2	2	0	0	0
	ELS	56	7	4	0	37.8	28	17	0	0	0
	GUT	93	0	11	0	41.5	48	34	0	0	0
	HON	48	2	4	1	46.3	22	19	0	0	0
	NIC	17	6	0	0	36.4	7	3	0	1	0
	PAN	6	1	0	0	0.0	5	0	0	0	0
INDRE	MEX	397	0	22	6	20.6	293	72	4	0	0
INH	VEN	81	2	5	0	32.4	50	20	0	4	0
INS	ARG	1	0	0	0	100.0	0	1	0	0	0
	COL	153	3	5	0	36.6	92	52	1	0	0
	ECU	69	7	4	0	17.2	48	9	1	0	0
	VEN	1	0	1	0	0.0	0	0	0	0	0
MAL	ARG	64	1	0	1	54.8	28	33	0	1	0
	BRA	2	0	0	0	50.0	1	1	0	0	0
	CHI	25	0	0	0	56.0	11	11	0	3	0
	COL	2	0	0	0	100.0	0	2	0	0	0
	ECU	3	0	0	0	100.0	0	3	0	0	0
	PAR	27	14	1	4	37.5	5	3	0	0	0
	URU	7	0	0	2	80.0	1	4	0	0	0
REC	BRA	77	4	6	0	31.3	46	21	0	0	0
TOTAL		1731	84	128	32	33.4	991	413	11	72	0

* Each sample relates to an individual

Case samples only

Table No. 1b
Status of Contact Stool Sample Analysis
Last 52 Weeks (92/18 - 93/16)

LAB.	CNTRY	POLIOVIRUS ISOLATION Poliovirus Pending	Poliovirus Vaccine	Poliovirus Wild
BEL	BRA	0	0	0
CAR	DOR	0	0	0
	HAI	0	0	0
	JAM	0	0	0
	SUR	0	0	0
	TRT	0	0	0
			0	0
	COL	4	3	0
	ECU	0	0	0
	ELS	0	2	0
	GUT	7	2	0
	HON	6	2	0
	TRT	0	1	0
	VEN	0	4	0
FIO	BOL	5	0	0
	BRA	26	127	0
	PER	30	23	0
INC	COR	0	0	0
	ELS	0	0	0
	GUT	1	0	0
	HON	1	0	0
	NIC	0	0	0
	PAN	0	0	0
INDRE	MEX	0	0	0
INH	VEN	4	2	0
INS	COL	0	1	0
	ECU	4	0	0
MAL	ARG	1	1	0
	CHI	0	0	0
	COL	0	0	0
	PAR	0	0	0
REC	BRA	1	0	0
TOTAL		90	168	0

Contact samples only

Table No. 2
Status of Poliovirus Pending Intratypic Differentiation
Last 52 Weeks (92/18 - 93/16)

LAB	COUNTRY	POLIOVIRUS NOT YET IN LAB				IN LAB < 4 Wks				IN LAB > 4 Wks				TOTAL
		P1	P2	P3	MIX	P1	P2	P3	MIX	P1	P2	P3	MIX	
	COL	0	0	1	0	0	0	0	0	0	0	0	0	1
	ECU	0	0	1	0	0	0	0	0	0	0	0	0	1
	MEX	1	0	2	1	0	0	0	0	0	0	0	0	4
	PER	1	0	0	0	0	0	0	0	0	0	0	0	1
CDC	ECU	0	0	0	0	0	0	2	0	0	0	0	0	2
	MEX	0	0	0	0	0	0	1	0	0	0	0	0	1
FIO	BRA	1	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL		3	0	4	1	0	0	3	0	0	0	0	0	11

Case samples only

FIGURE 7
Results of Stool Sample Analyses, as Reported in the PAHO/EPI Weekly Surveillance Bulletin

es, by providing training, and by maintaining strong collaboration among laboratories (see Appendix D). Representatives of the network should be encouraged to meet regularly to discuss the evaluation of testing methods, interpretation of findings, ways to improve network performance, implementation of new technologies, further collaborative research activities, and network resource and training needs. The laboratories need to communicate their requirements regarding the timely collection, proper storage, and safe shipment of the appropriate clinical specimens. Maintenance of a central data bank that summarizes the laboratory information on each case and contact (see Appendix E) is critical, as is the dissemination of such information to all interested participants.

6 POLIO VACCINE

There are currently two effective polio vaccines: inactivated poliovirus vaccine (IPV), which first became available in 1955, and live attenuated trivalent oral polio vaccine (OPV), first used in mass campaigns in 1959. In developing countries OPV is the vaccine of choice, not only because of ease of application but because it simulates natural infection, induces both circulating antibody and intestinal resistance, and, by secondary spread, protects susceptible contacts. Successful eradication depends upon the manner in which OPV is used.

A number of key points favor the choice of OPV over IPV for use in an eradication program. Besides ease of administration in both routine and mass campaigns, other factors include duration of immunity and low cost. Probably the most critical factor relates to the vaccine's ability to reduce the intestinal spread of wild poliovirus.

It has been well documented that the use of OPV can successfully interrupt wild poliovirus transmission in both developed and developing countries. IPV protects against clinical disease and suppresses pharyngeal excretion of the virus, but has less of an effect on intestinal excretion. Vaccinating children with IPV would reduce the number of paralytic cases attributable to the vaccine, but comparatively, would have relatively little effect on the transmission of the wild poliovirus, which in developing countries is primarily by the fecal-oral route. The overall risk in the United States for paralytic polio associated with OPV in vaccine recipients is 1 case per 5.2 million doses distributed. The risk of vaccine-associated paralytic polio in recipients of the first dose is 1 case per 1.3 million doses. The experience in the rest of the Americas has been similar. The overall risk in vaccine recipients in Latin America is 1 case per 4.2 million doses administered, while the risk for recipients of the first dose is 1 per 1.5 million doses distributed.

To assess the effects of each vaccine, the United States Centers of Disease Control and Prevention developed a mathematical model to estimate the risks and benefits over a 30–year period for two hypothetical cohorts of 3.5 million children each: one cohort would have received OPV, and the other IPV. The model assumed periodic importations of wild poliovirus, a coverage rate of 95%, and an efficacy of 98% for both vaccines. The model predicted seven times as many cases of paralytic disease among the cohort if IPV, rather than OPV, were used.

The experience in the Americas shows that the present OPV provides the most likely means to stop transmission if used properly. Polio can be eradicated by carrying out mass campaigns to supplement routine vaccine delivery and by placing added emphasis on reducing missed opportunities to a minimum. Mass vaccination campaigns will interrupt transmission in areas where routine immunization programs have failed.

6.1 Immunity

Under ideal conditions in temperate countries a primary series of three doses of OPV produces seroconversion to all three virus types in over 95% of vaccine recipients and is thought to have a clinical efficacy of nearly 100%. Three properly spaced doses of OPV should confer lifelong immunity. In tropical developing countries, the serologic response to OPV may be only 85%. This decrease may be due to breaks in the cold chain, interference with the vaccine's ability to produce intestinal infection because of the presence of other enteroviruses, presence of diarrhea that causes excretion of the virus before it can attach to the mucosal cells, and other factors. Breaks in the cold chain continue to be a major problem in the provision of viable vaccine.

6.2 Schedule, Contraindications, and Adverse Events

Recommended schedule: Although the schedule may vary in some countries, for routine services it is recommended to give three doses of trivalent OPV at 4 to 8 week intervals, beginning at 6 weeks of age. (The vaccine may be given to children and adolescents up to 18 years of age.)

A dose at birth is highly recommended in endemic areas, although it is not counted as part of the primary series and is referred to as "OPV Zero." Longer intervals

than the recommended 4–8 weeks between doses do not require restarting the schedule. Polio vaccine may be given simultaneously with any other childhood immunization.

Contraindications: For purposes of the polio eradication program there are virtually no contraindications to vaccination with OPV. Although diarrhea is not a contraindication, a dose administered to a child with diarrhea should not be counted as part of the series. Another dose should be given at the first opportunity 4 weeks later (if diarrhea is no longer present).

In countries where human immunodeficiency virus (HIV) infection is widespread, individuals should be immunized with the appropriate antigens according to standard schedules. This recommendation applies to individuals with asymptomatic HIV infection as well as those with clinical (symptomatic) AIDS.

Adverse reactions: Other than the rare instances in which OPV is associated with paralysis in vaccine recipients or their contacts (see above), there are virtually no adverse reactions to the vaccine.

6.3 Dosage, Administration, Formulation

OPV should be administered orally, that is, directly into the mouth. Each single dose consists of two or three drops (approximately 0.1 ml) of live oral poliovirus vaccine or the dosage recommended by the manufacturer.

PAHO/WHO recommends that the OPV formulation be 1,000,000, 100,000, and 600,000 median tissue culture-infecting doses for types 1, 2, and 3, respectively. This formulation was adopted after a randomized trial of alternative formulations of OPV in the Americas revealed that children who received a single dose of this vaccine had higher seroconversion rates than those who received the previous vaccine formulation of 1,000,000, 100,000, 300,000.

The importance of careful monitoring of vaccine potency is well illustrated by the fact that a substantial number of the cases that occurred in the Americas between 1990 and 1991 could be attributed to the use of a substandard vaccine formulation.

6.4 Storage and Supply

Polio vaccine (OPV) is one of the most heat-sensitive vaccines in common use. The vaccine can be stored for up to 1 year, and should be kept at 0°C to 8°C at all times. Unopened vials of polio vaccine may be kept in the refrigerator for up to 6 months at temperatures between 0°C and 8°C, and the vaccine may be thawed and refrozen without damage (see Appendix F). Vaccines should be stored a maximum of 3–6 months at the regional or provincial level, and 1–3 months at the local level.

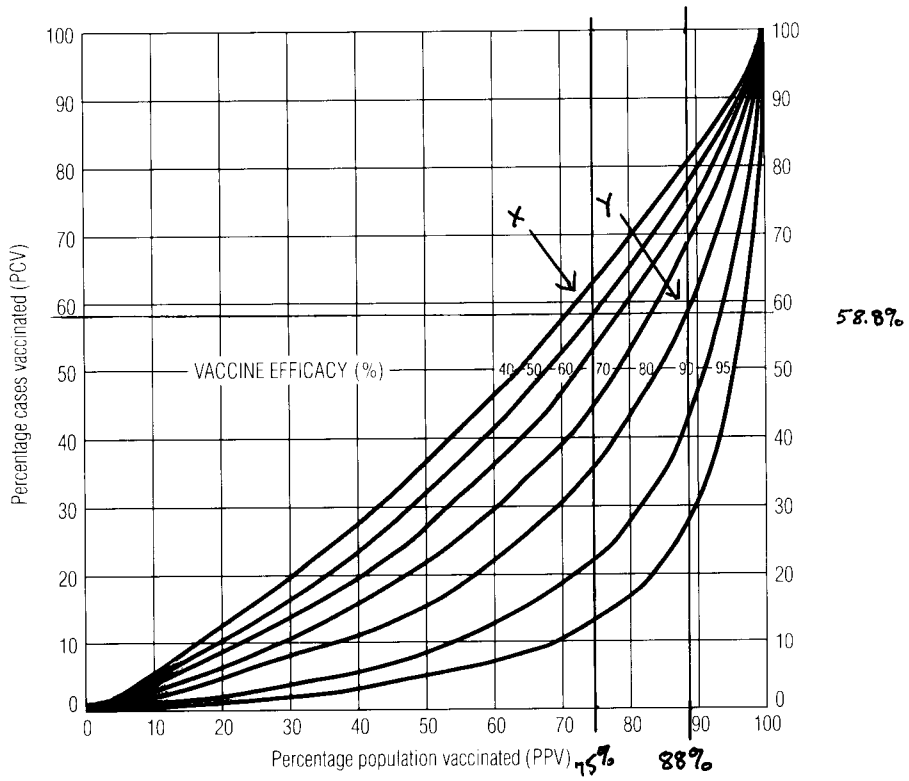
Vials of polio vaccine that have been transferred from the refrigerator to a vaccine carrier for use in local outreach activities (such as at mobile clinics or in house-to-house vaccination) should be discarded at the end of the working day, whether or not they have been opened. When vaccine supply is low, one additional day's use can be added for opened or unopened vials, provided that the vials have been stored properly.

All locations that provide immunization should have a vaccine supply on hand that is sufficient to last until the next shipment is likely to be received: at the local level, 1–3 months' supply; at the regional and state level, 3–6 months'; and at the national level, 6–12 months'. Order and supply dates should be checked to determine whether past vaccine shipments were received before the vaccine supply was exhausted. No expired vaccine should be kept. Recent monthly usage rates should be compared with the amount of vaccine remaining to determine if the vaccine on hand can be used up prior to its expiration date.

6.5 Vaccine Efficacy

Not all persons given polio vaccine are necessarily protected against polio, since no vaccine is 100% effective. There are several approaches to calculating vaccine efficacy. They include (1) use of coverage data, and (2) outbreak investigation by such means as case-control studies. These methods are too detailed to describe in this guide. Low efficacy (for example, below 80%) may indicate that there are problems either with the cold chain or with the manufacturing process that affect the vaccine's ability to produce protection. A preliminary assessment can be made to quickly determine whether efficacy is within expected limits.

Vaccine efficacy can be estimated if the following two variables are known: (1) the proportion of cases occurring in vaccinated individuals (PCV), and (2) the proportion of the at-risk population that is vaccinated (PPV). The curves in Figure 8 indicate theoretical vaccine efficacy levels based on the two variables PCV and PPV. In the example in Figure 8, the percentage of cases with



Source: Orenstein WA et al. Field evaluation of vaccine efficacy. *Bull WHO* 1985; 63(6): 1055-1068.

FIGURE 8
Sample of Graph Used to Estimate Vaccine Efficacy

EXAMPLE: Consider an outbreak of 49 cases of paralytic poliomyelitis in children less than 5 years of age; 20 of these cases have received 3 or more doses of OPV:

Vaccination history of children < 5 years of age with confirmed cases of polio

# of doses of OPV	# Polio cases < 5 yrs of age
0	14 (41.2%)
3 or more	20 (58.8%)
SUBTOTAL	34 (100%)
1, 2, or unknown	15
TOTAL	49

Vaccination coverage in children < 5 years of age

# of doses of OPV	# Children < 5 yrs of age
0	2,800 (25%)
3 or more	8,400 (75%)
SUBTOTAL	11,200 (100%)
1, 2, or unknown	3,380
TOTAL	14,580

CALCULATIONS:

$$PCV = \frac{\text{Polio cases with } \geq 3 \text{ doses OPV}}{\text{Polio cases with } \geq 3 \text{ doses OPV + polio cases with 0 doses OPV}} = \frac{20}{20 + 14} = \frac{20}{34} = 58.8\%$$

$$PPV = \frac{\text{Children with } \geq 3 \text{ doses OPV}}{\text{Children with } \geq 3 \text{ doses OPV + children with 0 doses OPV}} = \frac{8,400}{8,400 + 2,800} = \frac{8,400}{11,200} = 75\%$$

three or more doses of polio vaccine (PCV) is 58.8%, and from prior coverage assessments the percentage of the population at risk (< 5 yrs of age) that was vaccinated (PPV) was 75%. The intersection of these two values is plotted on the graph in Figure 8 (point x). Since the x is to the left of the 60% curve, the vaccine efficacy in this case is estimated to be less than 60%. In a second example (calculations not shown), using the same proportion of cases with three or more vaccinations (PCV = 58.8%) but a higher proportion of individuals vaccinated (PPV = 88%) and then plotting the intersection of these values on the graph (point y), the point is to the right of the 80% curve, indicating a vaccine efficacy higher than 80%. Such a screening does not give precise estimates of vaccine efficacy, but does provide a rough guide as to whether further evaluation is necessary.

The efficiency of routine immunization activities can be monitored by monthly reviews of the immunization records of the 1–year-old population (12–23 months of age) to determine whether or not children were fully immunized by the end of their first year of life. Reasons for noncompliance should be identified, and strategies altered accordingly (Appendix G).

7 IMMUNIZATION ACTIVITIES

High immunization coverage is key to the success of the polio eradication program. Vaccination coverage rates among 1–year-olds of 90% or higher with three or more doses of OPV must be maintained at the national level, as well as the county and district levels within each country. Immunization activities at the local level should be evaluated as to: (1) the availability of routine immunizations, (2) the extent of infant and pre-school-age immunization programs, and (3) the availability of vaccination coverage data. If vaccination coverage is low, routine and outreach immunization activities require improvement, and it should be determined whether mass immunization campaigns are needed to boost rates substantially.

7.1 Routine Immunization

Routine immunization involves activities that are conducted on a continuous basis through the permanent health services. The objective is to ensure that all new cohorts entering the population are immunized as early as possible to prevent pockets of susceptibles from forming. The success of routine immunization activities depends on the following:

- Integration of immunization within routine health services delivery.
- Activities aimed at reducing missed opportunities.
- Improved outreach activities conducted by the health services.
- A high level of cooperation between the health services and the community in order to find the most efficient means of reaching those population groups that are farthest away or least receptive to immunization.

7.2 Missed Opportunities

An opportunity for immunization is missed when a person who is eligible for it and who has no contraindication to immunization visits a health service and does not receive all the needed vaccines. Missed opportunities occur in two major settings: during visits for immunization and other preventive services, and during visits for curative services. In both settings, eliminating missed opportunities can raise coverage levels in a population.

Studies of "missed opportunities" for immunization indicate a continuing need to ensure that health personnel are fully aware of the limited contraindications for administering vaccines and do not impose unwarranted barriers to immunization. Necessary steps to ensure that vaccine is offered to all women and children at every contact with the health care system should be taken. Rates of missed opportunities are generally highest in children under 1 year of age, who are the primary target of vaccination programs. The causes of missed opportunities for immunization are divided into four categories:

(1) False contraindications are the major cause of missed opportunities. These include fever, diarrhea, vomiting, colds, and coughs. Despite the fact that national program standards are clear on the definition of contraindications, health workers often fail to vaccinate because of mistaken beliefs. Among the rationales sometimes given are that vaccination would produce adverse reactions or exacerbate the problem, would be inappropriate, or would not be absorbed by the body. Contrary to common belief, malnutrition is not a contraindication to vaccination.

(2) The second most important cause is the attitude of health care providers, many of whom do not think about vaccination during routine patient visits, do not offer it, and do not ask patients about their vaccination status. Some health care providers fail to offer vaccination in order to economize on biologicals and are reluctant to open a multidose vial of vaccine for a single child.

(3) An important cause of missed opportunities is the inadequate supply and distribution of vaccines.

(4) Other causes of failure to vaccinate are related to the lack of organization and availability of services. Problems often cited include waiting for a large number of children before beginning vaccination, providing services during limited hours or on limited days, or scheduling only specific days of the week or month for vaccinations.

The following are some approaches to reducing missed opportunities:

- Develop in-service training programs for all professional and technical health personnel to ensure that they are up to date on national immunization standards and help change attitudes about "false contraindications."
- Arrange for meetings and visit operations and personnel on-site to discuss missed opportunities and examine alternatives that will allow health personnel to take advantage of every vaccination opportunity.

Health services should:

- Check the vaccination status of all persons seeking services at health establishments, no matter what their reason for attendance. Patients should be encouraged to bring their vaccination card every time they visit a health establishment, and any vaccination that is missing should be given immediately.
- Carry out routine education and vaccination activities in waiting rooms, during hospitalization, and in emergency rooms.
- Offer all vaccines on a daily basis. Do not hesitate to open a vial even when only a few children will be vaccinated. Vaccinate all children in need of vaccination, whether or not they are ill.
- Set up convenient vaccination posts staffed during extended hours.

Program managers should:

- Ensure an adequate stock of biologicals and supplies.
- Decentralize immunizations to the health units or areas.
- Evaluate activities being carried out to reduce missed opportunities.

Within the community, it is important to:

- Create awareness and inform parents about the need for vaccination.
- Get private health providers involved.
- Develop a training program for leaders of the community.
- Carry out activities with the mass media to promote immunization.
- Link the provision of other services (such as milk or food supplements) to the presentation of an up-to-date vaccination record.

7.3 Vaccine Coverage

Immunization coverage can be monitored through two methods:

- the routine reporting system.
- coverage surveys.

Vaccination coverage should be analyzed regularly at the municipality, county, or district level. Where possible, birth cohorts should be closely monitored on a monthly basis (see Appendix G).

Coverage surveys are helpful in places where a significant number of immunizations are given through the private sector or when tracking or reporting systems are not sufficient to provide coverage data. Special vaccination cycles or campaigns should be planned to increase coverage in areas where it is lower than 80% (see Figure 9 and Appendix H).

7.4 Mass Campaigns

Conducting vaccination days is an integral part of the strategy, and without such campaigns polio cannot be eradicated. Widespread vaccination produces extensive dissemination of the vaccine virus, which competes with the wild virus and can abruptly interrupt its transmission. Such campaigns are intended to supplement routine immunization programs and can be held at the local or national level.

Countries that have failed to interrupt transmission, that are still experiencing coverage deficits, or that are facing a reduction in coverage should consider holding vaccinations days. The aim is to vaccinate as many children under 5 years of age (down to birth) as possible, regardless of their previous vaccination status. The simultaneous delivery of multiple antigens, including tetanus toxoid for women of childbearing age who live in risk areas, is encouraged.

National level: Immunization campaigns are best organized at the national level, allowing many resources (educational, military, religious, private enterprise, and community) to be mobilized nationwide for 1 to 3 days (in remote areas the campaign may need to last as long as a week). Such campaigns should be conducted at least two times each year and held not less then 4 to 6 weeks apart or more than 3 months apart. This approach aims at 100% coverage in the under-5–year population of the target area in a single designated period of time. Such national campaigns should be conducted every year.

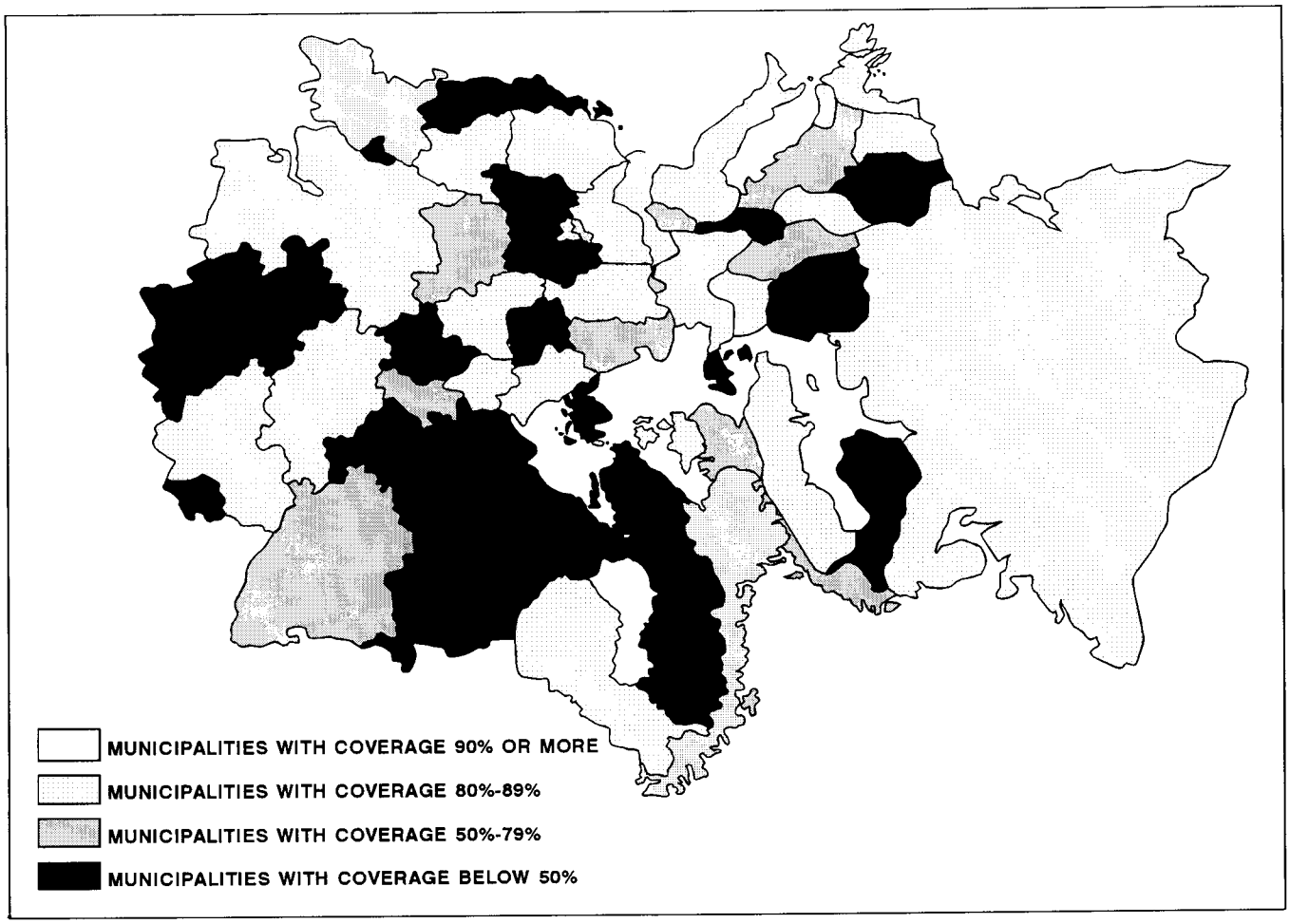


FIGURE 9
Map Displaying OPV Coverage by Municipality, Ficticia

Participation of local community leaders will be essential for success. Mass media attention needs to be focused on the event. The decentralization of financial resources for direct administration by health officials at the lowest level of the health system is essential, so that the funds are closest to where the expenditures will take place.

Local level: Due to logistics, geography, or population size, some countries may decide to conduct vaccination days in geopolitical units smaller than the entire country, such as a single province or group of provinces.

High-risk areas: During the organization of these vaccination days, special attention needs to be paid to those municipalities in which coverage rates are below the national average. This is particularly true in areas with deficient health services. Additional human and logistical resources should be allocated to such areas. Furthermore, in the periods between vaccination days, special programs should be organized in those municipalities that continue to have low coverage (see Mop-up Efforts, below).

7.5 Mop-up Efforts

Not all endemic countries can successfully reach all high-risk populations with routine immunization delivery and national vaccination days. In such cases, special efforts are required to reach pockets of children in areas where wild poliovirus may be circulating or where health resources are not available.

Mop-up efforts are intensive house-to-house vaccination campaigns designed to reach and immunize children that are at a special risk of infection. Such efforts should

be started after the first year of mass campaigns has been completed (see Appendices I and J).

The following is a description of the elements of mop-up campaigns.

Target age group: All children under 5 years of age.

Target area: Municipalities or counties defined as "at risk" by surveillance and other indicators. Within these areas a specific number of households should be targeted for visits. The following criteria are generally used to define areas in need of mop-up vaccination campaigns:

- the presence of polio cases within the last 3 years
- poor surveillance information
- poor vaccination coverage
- low economic status
- poor access to health services
- urban areas with a large poor population, particularly where the population moves frequently
- areas of heavy migration across borders.

Vaccine and timing: A single dose of trivalent OPV, given regardless of immunization status. Two rounds of immunization should be carried out, at least 4 weeks and no more than 8 weeks apart. Children deficient in other immunizations, such as against measles, should be referred to the closest health center for additional vaccination.

Method of delivery: House-to-house visits to find children < 5 years of age. When necessary, this activity is done during weekends and evenings.

Mobilization of the Community: Community leaders at all levels need to be contacted as soon as possible after a case of polio has been classified as "probable," or when there is a threat of polio due to poor coverage. The leaders should understand that by quickly implementing vaccination activities for an entire district or a larger geopolitical unit, many polio cases can be prevented. The briefing should be simple and to the point, keeping the following specific objectives in mind:

- Alert the community to the possible existence of a polio case or that low vaccine coverage places the community at risk of polio. Inform them of the need to protect quickly all children in the community.
- Mobilize resources within the community to complement resources available from the health sector, especially volunteers to assist in house-to-house vaccinations.
- Request assistance from leaders to detect other possible cases of polio.
- Discuss the proposed areas to be covered, when house-to-house vaccination will begin, and when and where training of community volunteers will be held. Since two vaccination rounds will need to be conducted, the dates for the second round should also be established.
- Obtain local assistance in gaining access to community equipment for freezing or storing ice packs or vaccine.

Simple messages need to be developed regarding the appearance of a case of polio, the need to improve coverage, and the importance of vaccinating children quickly on certain specified dates. Television and radio stations should be contacted and requested to provide public service announcements. In addition, the following media have been useful in communicating the necessary messages to the public:

- flyers distributed at market places, pharmacies, bus terminals, and house-to-house
- street banners
- mobile public service announcements (vehicles mounted with loudspeakers driven through neighborhoods and markets)
- badges, buttons, and arm bands with campaign information.

Key community groups to contact include:

- all schools and preschools
- religious organizations
- local organizations, mothers' groups, parent-teacher associations
- volunteer groups
- Rotary and Lions clubs
- municipal and provincial government offices
- private sector health providers, doctors, clinics, pharmacies.

Vaccination approaches and logistics: Although there are differences in the approaches and logistics employed in urban, periurban, and rural areas, the overall principles are similar. The following basic information should be obtained as quickly as possible:

- population data (by age group)
- estimated number of households
- maps (as recent as possible) that show the urban, rural, or other geographic divisions in detail, thus providing the number of households per block or other geopolitical unit
- OPV coverage by health center.

When the number of houses, distance between houses, and the population are known, it is possible to calculate the number of vaccinators required to visit every house, as well as the number of supervisors needed. Other quantities that need to be estimated include the number of vaccine carriers, amount of ice, number of vehicles to transport staff and vaccine, and amounts of other supplies such as forms, pencils, and chalk for marking houses. In calculating such needs it is important to take into consideration the following:

- the number of children that can be vaccinated per day by one person (the average for a well-planned campaign in an urban area is 80, ranging from 50 to 100; the average varies widely in rural areas)
- the topography of the area (hills, mountains, or rivers to contend with)
- the dispersion or concentration of houses or large apartment buildings
- the number of days in which each round of the mop-up operation should be completed (in the Americas a maximum of two days was used to complete each round).

KEY PROBLEMS ENCOUNTERED DURING A MOP-UP CAMPAIGN:

- *insufficient ice-making capabilities*
- *lack of adequate transportation*
- *poor knowledge of area on part of supervisor(s)*
- *poor communication with the community on the need for mop-up*
- *too few vaccinators*
- *lack of sufficient supplies, including vaccines*
- *poor selection of days for carrying out the mop-up*
- *poor weather conditions and lack of protective clothing*
- *poor training of personnel (vaccinators and/or supervisors)*
- *poor distribution of personnel*
- *lack of decentralization of planning and/or operations*
- *insufficient budget*
- *poor community support or lack of volunteer support*

Supervision: The role of the supervisor (one per 10–15 vaccinators) is to ensure that no areas or blocks of houses are left unvisited, that all individual houses are visited, and that all children 0–5 years of age are vaccinated. In addition, the supervisor has to ensure that the movement of vaccinators and supplies is well planned. All supervisors should have a method of performing quality control checks to ensure that each child is being vaccinated. Experience has shown that a supervisor is most effective when accompanying vaccinators rather than covering large areas in a vehicle. At the end of the day, all supervisors should meet with the campaign coordinator(s) to review and discuss accomplishments and problems and make any necessary adjustments for the next day's work. In rural areas, methods of supervision need to be adjusted to the topography and the area covered. It is not always cost effective, or logistically possible, to support many supervisors. The selection of motivated and energetic vaccinators for such rural areas is critical to success.

Evaluation: At the end of each day the supervisors can estimate accomplishments by reviewing the tally worksheets of each vaccinator and comparing the number of children vaccinated with the target established (Appendix I). At the end of the two rounds, tallies should be made of the number of children vaccinated within the area of each health center/post or other geopolitical division. The total number of children vaccinated should be compared to the goals established. Anything less than 85% requires that the supervisors determine the reasons for the poor performance. If there are sufficient pockets of unvaccinated children, teams of vaccinators accompanied by supervisors should return to the pockets to vaccinate the children at a time when the missed children would likely be at home (such as in the evenings).

The results of the mop-up vaccination should be disseminated to the community at all levels as soon as available. The health team should contact community leaders and provide them with the results and any other information that may be useful. All community leaders, volunteers, and other helpful individuals should be congratulated. The local radio station should be contacted and requested to provide the results of the mop-up to the community and to thank the community for its support on behalf of the health sector.

The next important task for the health team is to review the logistical and operational problems that may have impeded the vaccination efforts (see box). Well-executed mop-ups should also be reviewed so that the successes can be documented and the lessons applied toward planning future mop-ups. All problems and successes should be discussed with health staff. Health workers should be congratulated for their efforts, and the results of the campaign should be used as a motivational

tool to show health workers what can be accomplished with good planning and hard work.

Experience in the Americas has shown:

(1) To properly plan the distribution of personnel, supervisors must be familiar with the areas to be covered, that is, which areas are more commercial and contain less family housing and which neighborhoods have a higher concentration of children.
(2) In urban areas one vaccinator can generally vaccinate between 50 to 80 children per day going house-to-house (vaccinators generally do not fill out vaccination card histories during mop-up efforts).
(3) Because of possible fatigue and logistical considerations, many vaccinators should be assigned to cover hilly areas so that they may be covered quickly and in the early morning hours, to permit vaccinators to descend to less hilly areas in the afternoon. In very warm climates, water must be provided to vaccinators.
(4) Perhaps the most underestimated task, and one which is sometimes difficult to organize, is the freezing of thousands of pounds of ice overnight so that it is ready for the vaccine carriers on the day of the campaign. This task requires careful advanced planning.
(5) Training of both health workers and community volunteers needs to be quickly carried out. Training of community volunteers should be done 1 or 2 days in advance of the date of start of vaccination activities to reduce volunteer drop-out.
(6) On the first morning of house-to-house vaccination, it is advisable that operations be decentralized, that is, vaccinators and supervisors start work immediately at designated locations, so that critical time is not wasted transporting personnel to their respective vaccination sites.

8 SURVEILLANCE

Surveillance systems vary from country to country and within countries. Nevertheless, in the effort to eradicate polio, some common principles apply.

8.1 Reporting

In each area, all centers where paralytic cases might be brought for diagnosis, treatment, or rehabilitation should be the focus of the surveillance efforts. In addition, at least one reporting source should be identified in each county or district (or comparable small geopolitical unit). This network of centers will comprise the basic surveillance system. As a standard, when laboratory-confirmed cases are no longer occurring, there should be a minimum of five reporting units per 100,000 population <15 years of age. However, the number of reporting units may vary widely; for example, some areas may have one reporting unit consisting of a hospital that adequately covers a large population, while other areas may require 10–15 units for adequate coverage. Each unit should be requested to report immediately if a case of AFP is seen.

Each facility should identify one individual (and one or two alternates) who will be responsible for identifying and immediately reporting cases of AFP (including febrile paralytic disease, Guillain-Barré syndrome, and transverse myelitis) to public health authorities. This procedure differs from the usual reporting of "poliomyelitis" cases, and therefore requires a clear understanding of the concept of AFP reporting by all health staff involved. Such changes in usual reporting practices require special training and supporting documentation.

Repeated visits to reporting units by state or national program staff involved in surveillance will undoubtedly be required to establish and monitor the system.

All reported cases should be investigated by a specially trained epidemiologist from the central level or state within 48 hours after notification, in order to confirm clinical diagnosis and to obtain laboratory specimens of AFP cases and contacts.

Regular reports should be made each week to state, departmental, provincial, and national levels, and national authorities should report weekly by telex to the corresponding WHO Regional Office.

Reporting should take place even when no cases of AFP have been identified (see Figure 10 and Appendices K and L). Sometimes a special form can facilitate the reporting (and negative reporting) of AFP and help fulfill any other special reporting requirements (see Figure 11).

Hospitals: One of the most critical units in the reporting system is the hospital. Case-finding through the emergency department and pediatric and neurology wards, as well as through outpatient clinics, is critical to success of any surveillance system. Some hospitals may serve as sentinels when they follow special reporting procedures established by the central surveillance program. Such procedures may include a weekly telephone call, telex, or facsimile (fax) to ensure that no new cases of AFP have been seen or admitted.

KEYS FOR A SUCCESSFUL SURVEILLANCE PROGRAM

- *The reporting system must cover key hospitals and clinics and have at least one reporting source for every geopolitical unit.*
- *The concept of reporting all AFP cases rather than only poliomyelitis cases must be emphasized.*
- *Weekly reporting of AFP is critical.*
- *The concept of negative reporting of AFP must be included in the weekly reporting system.*
- *The reporting system for AFP must continually be monitored and revitalized.*
- *Immediate response to reports in the surveillance system by trained epidemiologists must occur for every suspected case within 48 hours.*
- *Cooperation from the private medical community is essential for all surveillance efforts.*
- *The public needs to be informed about the importance of and procedure for reporting AFP.*
- *Feedback to all participants of the surveillance system is essential.*

CONTROL OF WEEKLY REPORTS FORM

Instructions: 1) Mark with a (✓) each report received by the end of the reporting week.

2) Calculate percentage of sites reporting on time.

$$\left(= \frac{\text{Number of sites reporting on time}}{\text{Total number of sites}} \right)$$

Reporting Sites	Wk. 1	Wk. 2	Wk. 3	Wk. 4	Wk. 5	Wk. 6	Wk. 7	Wk. 8	Wk. 9	Wk. 10	Wk. 11	Wk. 12	Wk. 13	Wk. 14	Wk. 15	Wk. 16	Wk. 17	Wk. 18	Wk. 19	Wk. 20	Wk. 21	Wk. 22	Wk. 23	Wk. 24	Wk. 25	Wk. 26	Wk. 27	Wk. 28	Wk. 29	Wk. 30	Wk. 31	Wk. 32	Wk. 33	Wk. 34	Wk. 35	Wk. 36	Wk. 37	Wk. 38	Wk. 39	Wk. 40	Wk. 41	Wk. 42	Wk. 43	Wk. 44	Wk. 45	Wk. 46	Wk. 47	Wk. 48	Wk. 49	Wk. 50	Wk. 51	Wk. 52
site 1	✓		✓	✓	✓			✓	✓																																										
site 2	✓	✓	✓	✓	✓		✓	✓	✓																																									
site 3		✓	✓	✓	✓	✓	✓	✓	✓																																									
site 4	✓	✓	✓	✓	✓		✓	✓	✓																																									
site 5	✓	✓	✓	✓	✓	✓	✓	✓	✓																																									
site 6	✓	✓	✓	✓	✓	✓	✓	✓	✓																																									
site 7	✓		✓	✓	✓	✓		✓	✓																																									
site 8		✓	✓	✓	✓			✓	✓																																								
site 9																																																		
site 10	✓	✓	✓	✓	✓	✓	✓	✓	✓																																								
site 11	✓	✓		✓	✓			✓	✓																																								
site 12	✓	✓	✓	✓	✓	✓	✓	✓	✓																																								
No. reporting on time	9	9	10	11	11	6	7	11	11																																								
% reporting on time	75	75	83	92	92	50	58	92	92																																								

FIGURE 10
Sample of the Control of Weekly Reports Form

WEEKLY SPECIAL SURVEILLANCE REPORT

REPORT UNIT _____

DATES: FROM _____ TO _____

1. NUMBER OF ACUTE FLACCID PARALYSIS CASES: _____
   (ATTACH FORM ON ANY CASE(S); IF NO CASES TO REPORT, INDICATE 0).

2. NUMBER OF DIARRHEAL DISEASES: _____
   (ATTACH LINE LISTING OF DIARRHEAL DISEASES IN CHILDREN < 1 YR OF AGE; IF NO CASES TO REPORT, INDICATE 0).

3. NUMBER OF MEASLES CASES: _____
   (ATTACH FORMS ON ANY CASE(S); IF NO CASES TO REPORT, INDICATE 0).

4. OTHER _____:_____
   (Other designated special reportable disease or condition)

PERSON FILLING OUT REPORT _____ DATE _____

PLEASE SEND BY MESSENGER, TELEPHONE, OR FAX BY TUESDAY.

FIGURE 11
Sample of the Weekly Special Surveillance Report

Surveillance officers will need to make special efforts to meet personally with busy hospital staff to obtain their cooperation and continued involvement in reporting AFP. One staff member should be identified as the contact person who is responsible for weekly reviews and reporting. It must be explained clearly to clinicians that even cases that are not likely to be poliomyelitis need to be reported if they fit the case definition of AFP and that adequate stool specimens must be collected from cases and their contacts.

8.2 Rewards

At the final stages of eradication, one technique that has been used to promote community-based active surveillance is the offering of monetary rewards. Such rewards are given for reporting a case of AFP that is subsequently confirmed as polio. PAHO offers a US$ 100 reward to any person who reports the first confirmed polio case of an outbreak in which poliovirus is isolated, and some countries have increased the reward to US$ 1,000. The enlistment of the private sector to assist in funding and publicizing rewards should be considered. Rewards should be publicized widely among health professionals and within the community.

8.3 Social Communication

Medical community: Educational campaigns for the medical community (particularly pediatricians, neurologists, orthopedists, and rehabilitation specialists) are needed to promote the knowledge that its cooperation and interest are essential to the eradication of polio.

Public: Publicity campaigns for the public, including TV ads, newspaper articles, public service announcements, and the distribution of posters, should be carried out in order to increase the public's awareness of the polio eradication program, the need to vaccinate, and where to report cases of acute flaccid paralysis.

8.4 Laboratory Participation

Every effort should be made to ensure that laboratory, epidemiologic, and operational personnel work closely and effectively together. Routine communications should be established with all local laboratories that may receive specimens from probable polio cases. Laboratory personnel should be instructed to notify the state surveillance coordinator immediately when specimens are labeled "paralysis," "polio," "Guillain-Barré syn-

drome," or "transverse myelitis." The log books of local laboratories should be checked by the surveillance coordinator once each week to ensure that all cases are being promptly reported.

8.5 Evaluation

PAHO relies on several ways of assessing the sensitivity of surveillance. The two most critical are monitoring of the reported rate of AFP and evaluation of weekly negative reporting.

Rates of AFP: Monitoring national rates of AFP is the principal way to evaluate the sensitivity of surveillance systems. A variation in rates between geographic areas may depend on environmental conditions. Nevertheless, based upon a number of previous studies, one would expect at least one case of AFP to be reported for every 100,000 children under the age of 15 years.

Weekly negative reporting: Both the number of units reporting and the timeliness of the reports should be monitored on a weekly basis. As the program progresses and the number of cases decreases, the number of reporting units will need to increase. As a general rule, when no cases of paralytic polio are occurring, there should be at least five reporting sites per 100,000 population <15 years of age, although this number may be as small as one unit in some areas and as high as 15 in others. Negative reports may not reflect accurately the presence or absence of cases of acute flaccid paralysis among the population served by a reporting unit. In order to evaluate the reliability of weekly negative reporting of cases, interviews should be conducted with personnel involved in surveillance of acute flaccid paralysis at the regional level, as well as in selected districts and at individual reporting units within a state or area (see section 8.6, Active Search, below).

Centralization of surveillance: The efficiency of the surveillance system will be increased by ensuring that the entire population is covered, down to the smallest geographic political unit, that is, the district level. Health personnel at all levels should be sufficiently trained to ensure the quality of decentralized surveillance. It must be remembered that decentralization does not imply foregoing central analysis and supervision.

Well-defined procedures: All health professionals who are likely to be in contact with cases should have written materials that describe their responsibilities and duties with regard to reporting communicable diseases, including acute flaccid paralysis. There is substantial turnover among medical staff in ambulatory facilities, and some will have received little or no orientation regarding their reporting responsibilities. All medical records staff and other paramedical hospital personnel who have responsibility for reporting cases of acute flaccid paralysis should receive training, written instructions (including a sample list of possible diagnoses or presenting symptoms), and close ongoing supervision as well as feedback from a medical epidemiologist. Development and utilization of posters and other materials displaying these concepts should be encouraged.

8.6 Active Search

Enhanced surveillance systems should incorporate periodic active searches, particularly in those areas where indicators show poor surveillance or where units have been reporting zero cases (see Appendix M).

In choosing areas to investigate, the following should be given priority:

- areas with a history of a polio case
- "silent areas" (rates of reported AFP <1 per 100,000 population under 15 years of age)
- areas with heavy migration
- risk areas—low coverage, poverty, high population density, periurban
- areas where other field work is taking place.

Community leaders should be contacted and their assistance obtained. Door-to-door searches are especially useful in areas where patients are unlikely to seek or have access to medical care. A protocol for conducting such searches should be clearly outlined and address the following topics:

Case definition—any flaccid paralysis in children <5 years of age, in which there is no evidence of trauma and in which onset of paralysis occurred less than 1 year ago in urban areas or less than 5 years ago in rural areas.

GUIDELINES FOR INVESTIGATION

- *Establish whether the paralysis is flaccid.*
- *Identify the patient's age and date of paralysis onset.*
- *Confirm whether the case is compatible with poliomyelitis.*
- *Include for future review by special committee those cases with recent onset (within 6 months) which still present sequelae.*

Places to investigate—institutions, health services, schools, day-care centers, and rehabilitation centers. The data that should be reviewed include daily consultation records, discharge records, death certificates, etc. Information may be gathered from teachers as well. Any cases fitting the "probable case" definition should be investigated.

Review of hospitals should be especially thorough. Surveillance workers should periodically review hospital discharge data to check whether and how admitted cases are reported. Where possible, high priority should be placed on extending reporting to private physicians and other facilities likely to see cases of acute flaccid paralysis.

In addition to the above sources, information should be gathered through interviews in communities, at market places, house-to-house, during mop-ups, at clubs, etc. Questions should be phrased to include local expressions that may be used to describe a possible case of polio: weakness, limpness, paralysis, etc.

8.7 Environmental Monitoring

While surveillance of wastewater for the presence of wild poliovirus is an accepted strategy, it has inherent difficulties. High ambient temperatures and the high bacterial content of wastewater in tropical areas promote rapid inactivation of the poliovirus. Given that the predicted survival times of polioviruses under such conditions are short (the half-life for infectivity is < 2 days), it is likely that most of the virus detected in wastewater represents what has been excreted from children only a few days before sampling. Therefore, the reliability of environmental monitoring for detecting the existence of wild poliovirus is limited to the brief period during which the virus is still circulating in the community. A good AFP surveillance system, meanwhile, is not as time-sensitive, since it detects the presence of wild poliovirus in the community by identifying cases of paralytic poliomyelitis. This emphasizes again the importance of high-quality AFP surveillance information, not only for the eradication of wild poliovirus transmission but also for the certification of this accomplishment.

9 CASE INVESTIGATION AND OUTBREAK CONTROL

Each reported case of AFP should be investigated within 48 hours of being reported. Outbreak control should begin as soon as one or more cases of AFP fit the definition of a probable case, that is, AFP is present and no nonpolio cause can be identified. The outbreak should be publicized and immunization activities set up immediately, so that transmission can be stopped. Mop-up operations (detailed in Chapter 7, Immunization Activities) should be employed to obtain the most effective results as quickly as possible. At the same time, it is important to intensify surveillance in order to find additional cases.

Health authorities at all levels and in nearby jurisdictions should be informed and become involved in all aspects of outbreak control. If a probable case has traveled or had close contact with individuals from other areas of the country within the 40 days prior to the onset of paralysis, the state surveillance coordinator in those areas should be notified immediately. When appropriate, other countries should be notified. The public should also be informed through the communications media.

9.1 Case Investigation

The home of each probable case should be visited and the case investigation form completed (Appendix N). Also, the line listing of probable (AFP) cases should be maintained (Appendix O). Inquiries should be made to determine whether other AFP cases have appeared in places the case had visited during the month prior to paralysis, such as a preschool center, school, or another town or village. For cases from rural areas, the investigator should inquire about the nearest large urban center or other site, such as marketplace or travel hub, that might be a likely reservoir.

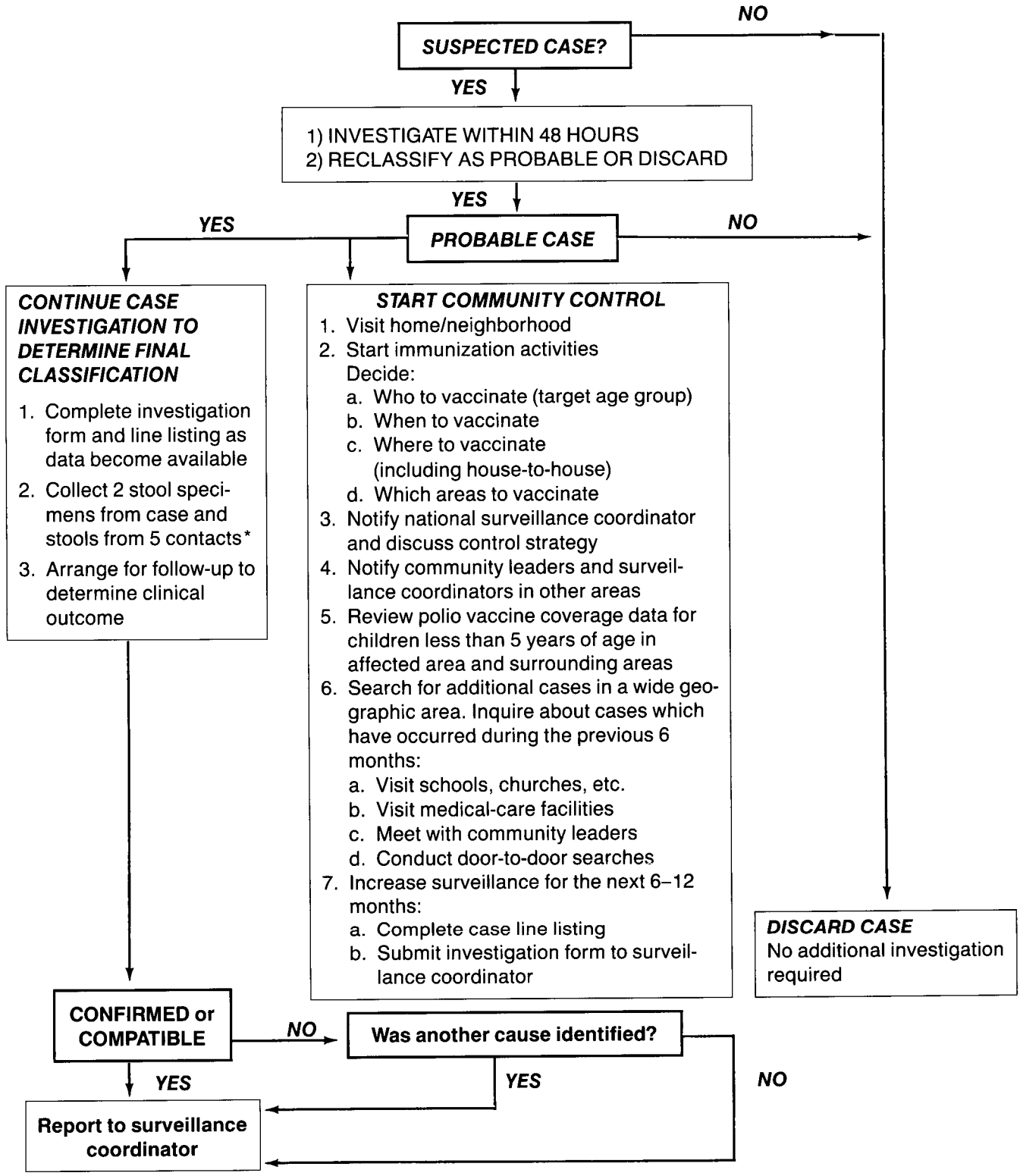
All investigations should be carried out by specially trained epidemiologists from the state or national level. The following sections describe the necessary steps in the investigation of all suspected and probable cases.

Suspected cases: A decision should be made to classify the case as either AFP or "discarded" within 48 hours of notification. The definitions presented in Chapter 4, Case Definitions, should be strictly followed, irrespective of vaccination status.

Probable cases (AFP): After a case is classified as "probable" the following actions should be taken (see Figure 12):

- Collect all available demographic and clinical information on the case (Appendix N).
- Fill out the Probable (AFP) Case Line Listing form (Appendix O).
- Collect two stool samples 24–48 hours apart from the case and a single sample from each of five contacts under 5 years of age who have not received oral polio vaccine within the last 30 days. If the case is seen later than 2 weeks after onset of paralysis and if it is still clinically compatible with polio, then in addition to the two stool samples from the case and the five from contacts, special studies need to be conducted over a wide area. Such studies include community surveys that may collect samples from 50 to 100 contacts and neighbors of the case who are <5 years of age and have not been vaccinated within the last 30 days.
- Establish time and place for continued follow-up, in order to (1) collect additional stools and (2) determine if residual paralysis is present after 60 days.
- Inform surveillance sites and surveillance coordinators in surrounding areas that an AFP case has been identified.
- If the onset of paralysis occurred less than 6 months earlier, initiate community investigation to identify additional cases and institute widespread control measures regardless of coverage levels.
- If the onset of paralysis occurred more than 6 months earlier, start mop-up vaccination activities as soon as the low transmission season begins.

Case-finding during an outbreak: In order to find additional cases, procedures similar to those described in section 8.6, Active Search, should be conducted. In conjunction, community leaders should be contacted and their assistance obtained. Door-to-door searches are an effective way to find the first additional cases, particu-



*If case is seen after more than 2 weeks following onset of paralysis, then collect stool samples from 50–100 contacts and neighbors.

FIGURE 12
Case Investigation Decision Tree

larly in areas where patients are not likely to seek medical care.

Each church, preschool center, school, hospital, clinic, drugstore, and rehabilitation center in the affected area must be identified and listed. A minimum of one visit should be made to each place; depending upon the extent of the outbreak and the personnel available (volunteers can be used), weekly contact is encouraged. During the first visit, health staff should be asked if any case of paralytic disease had been seen or diagnosed within the last 6 months. If such cases occurred, the patient's medical record should be reviewed to determine if there is any possibility that the case was polio; if there is, the patient's home should be visited next.

In larger population centers, contacts may also include selected medical professionals, such as neurologists and pediatricians. Efforts to identify additional cases should extend well beyond the neighborhood/community in which the probable case lives.

9.2 Control Measures

It is important that all stool specimens be collected from cases and contacts prior to the start of special immunization activities; otherwise, vaccine virus may interfere with attempts to isolate the wild virus from these cases and contacts. Trivalent OPV is the vaccine of choice for containment vaccination. For purposes of polio eradication there are virtually no contraindications to OPV. The mop-up approach is the most effective method for outbreak control (see Chapter 7, Immunization Activities).

Target group: In general, children under 5 years of age should receive the highest priority. However, if cases occur in children 5 years of age or older, the older affected age groups should be vaccinated as well. Regardless of documented polio vaccine history, all vaccinees should receive a single dose followed with a second dose 4–6 weeks later.

Concept of high-risk communities: Each paralytic case probably represents 100 to 1,000 infected persons. As a result, the spread of the virus may be wider than the local area where the case resides. It should be emphasized that mass immunization programs with OPV have been shown to interrupt wild poliovirus transmission quickly; thus, immunization activities should cover a wide geographic area, particularly if there is any doubt about the quality of surveillance and/or vaccine coverage data. Adjacent areas may have coverage levels similar to the affected village or city, or there may be frequent or large-scale population movements. If so, vaccination campaigns may need to be conducted in those areas as well. Such immunization activities should be organized promptly and publicized extensively.

9.3 Outbreak Management

When it is decided that outbreak control is necessary, certain information should be gathered and a plan of required actions developed. The following points must be considered in managing an outbreak.

Population data—Obtain most recent population size and distribution.

What's been done—List any actions already taken.

Case review—List prior reports of cases in the area during the last 6 months. Construct an epidemic curve.

Coverage rates—Obtain existing coverage data and also include unofficial estimates.

Spot map—Use pins or a pen to mark the location of case(s) and areas targeted for immunization on a map.

Resources—Determine what resources are available at all levels (transportation, vaccine, cold chain materials, etc.). Field staff to assist in outbreak control should include staff from other programs, district staff, medical and nursing students, interpreters, and drivers. Arrange for transport and for travel advances.

Coordination—Inform appropriate health/community authorities when and where the team will be arriving, and ask that specific health staff/community representatives be present.

Supplies—Organize necessary supplies to take to the outbreak area:

- Adequate vaccine, based on estimated target population.
- Cold chain materials: ice packs, cold boxes, vaccine carriers, vaccine monitors, thermometers. Determine if ice-pack freezing capacity is locally available or needs to be brought in, e.g., a kerosene freezer.
- Adequate supply of forms: line listings, case investigation forms, outbreak control summary, mop-up work tally sheets.

Outbreak Monitoring: Information on cases, immunization activities, and villages visited needs to be

updated continuously and monitored during an outbreak. This information should be kept on a form that can be summarized quickly, such as the Outbreak Control Summary provided in Appendix P. If outbreak containment is successful, no additional cases should be reported 1 month after the second round of immunization. Special reviews and checks should be made at this time, to ensure that no new cases have occurred.

10 INFORMATION SYSTEMS AND ANALYSIS

An important aspect of a successful polio eradication program is a well-developed information system—one which provides program managers and health workers with the necessary information to take appropriate actions. Information from the disease surveillance system is best used to produce regular summary reports. These reports should be distributed to the personnel responsible for acting on the problems that are identified. All surveillance information should be standardized and include the same type of data elements.

10.1 Data Collection

Whether or not the information system is computer-based, it consists of two main elements:

Case tracking and data collection—At the national level and regional sublevels within a country there should be a system that is capable of tracking reported AFP cases until they are either confirmed or discarded. Such a system is based upon a number of important characteristics:

- a uniform case identification number
- a standardized case investigation form
- the collection of basic demographic data on each case
- the collection of basic clinical data on each case
- the recording and monitoring of laboratory specimens from collection to final test results.

Site reporting—At the national level and regional sublevels within a country, there should be a system that is capable of keeping track of reporting units. Such units may be a geographic jurisdiction such as a county, district, or municipality, or a care-providing facility such as a hospital or private clinic. The critical data to monitor for such sites are:

- timeliness of reporting (on-time or late)
- frequency of reporting.

10.2 Computerization

In the Americas a computer-based system known as the Polio Eradication Surveillance System (PESS) has been used to manage the above kind of information for all countries in the Region. The database is menu-driven, which allows users with little computer knowledge to successfully operate the program (see Figure 13). Most importantly, this system has helped to create a standard set of variables that allows comparisons between countries and within countries over time. The standardization of surveillance data is critical.

10.3 Analysis

Data from case investigation forms and line listings need to be analyzed to provide a descriptive picture of the cases and to determine whether standards for case reporting and investigation are being met (see Appendix Q). The following types of information should be analyzed:

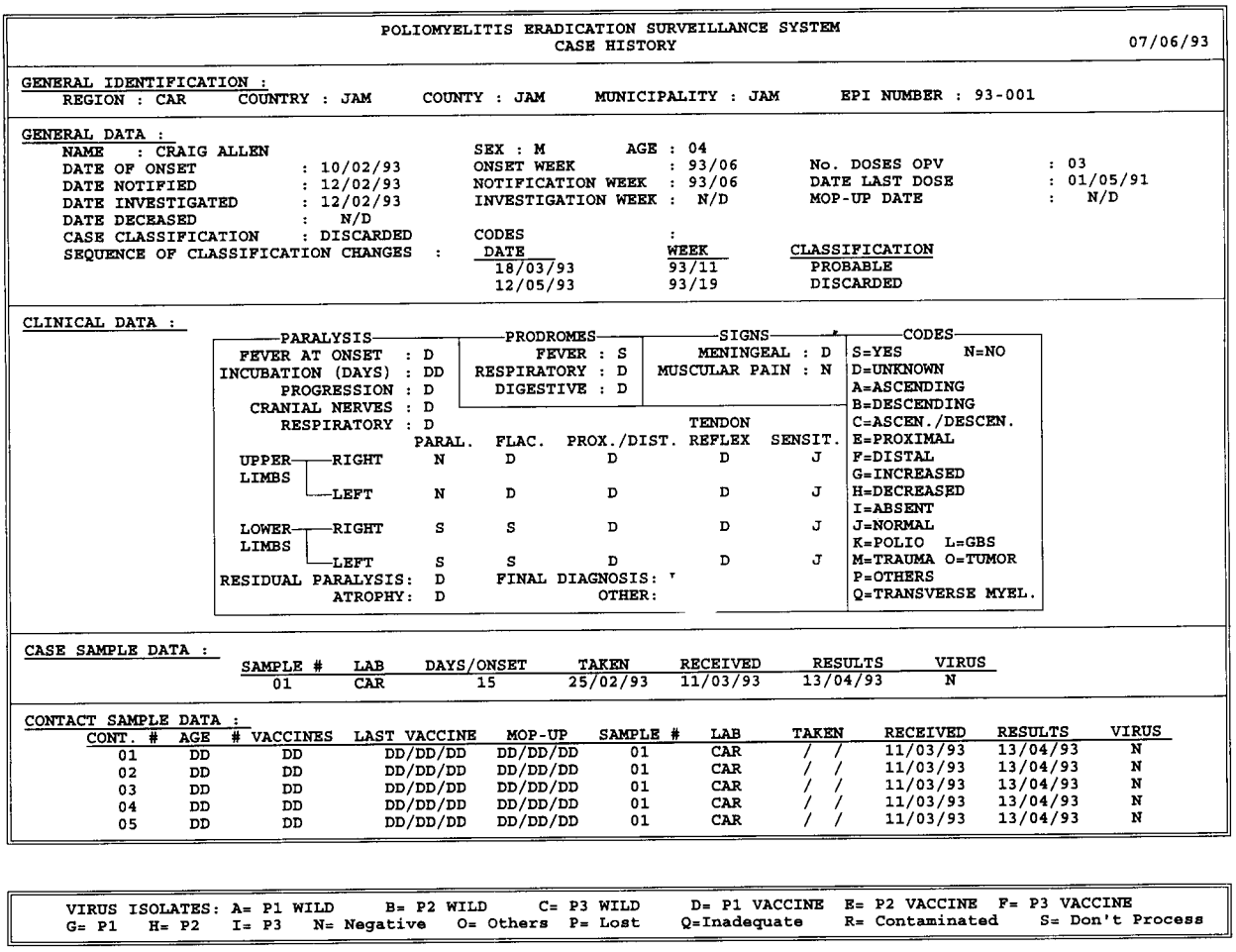
Stool samples—The collection of two stools from the case within 14 days of the onset of paralysis and stools from at least five contacts is critical to the confirmation of polio.

Clinical data—Presence of clinical risk factors for poliomyelitis, such as fever at onset, rapid progression of paralysis, and residual paralysis at 60 days, likewise is critical information.

Age—The age distribution of cases is useful to establish what age groups to target for vaccination. In the Americas the vast majority of cases have been less then 6 years of age.

Geographic location—Cases should be plotted on a map according to their place of residence and the plot compared with coverage data and surveillance reporting sites. These maps can be useful for coordinating activities (such as vaccination points, etc.).

Source of notification—This information will help determine whether improvements in surveillance contacts are needed; for example, if cases are being reported only from rehabilitation centers, then additional clinic and hospital contacts may be required.



POLIOMYELITIS ERADICATION SURVEILLANCE SYSTEM
CASE HISTORY
07/06/93

GENERAL IDENTIFICATION :
REGION : CAR COUNTRY : JAM COUNTY : JAM MUNICIPALITY : JAM EPI NUMBER : 93-001

GENERAL DATA :
NAME : CRAIG ALLEN
SEX : M AGE : 04
DATE OF ONSET : 10/02/93
ONSET WEEK : 93/06
No. DOSES OPV : 03
DATE NOTIFIED : 12/02/93
NOTIFICATION WEEK : 93/06
DATE LAST DOSE : 01/05/91
DATE INVESTIGATED : 12/02/93
INVESTIGATION WEEK : N/D
MOP-UP DATE : N/D
DATE DECEASED : N/D
CASE CLASSIFICATION : DISCARDED
SEQUENCE OF CLASSIFICATION CHANGES :

CODES DATE	WEEK	CLASSIFICATION
18/03/93	93/11	PROBABLE
12/05/93	93/19	DISCARDED

CLINICAL DATA :

PARALYSIS
FEVER AT ONSET : D
INCUBATION (DAYS) : DD
PROGRESSION : D
CRANIAL NERVES : D
RESPIRATORY : D

PRODROMES
FEVER : S
RESPIRATORY : D
DIGESTIVE : D

SIGNS
MENINGEAL : D
MUSCULAR PAIN : N

		PARAL.	FLAC.	PROX./DIST.	TENDON REFLEX	SENSIT.
UPPER LIMBS	RIGHT	N	D	D	D	J
	LEFT	N	D	D	D	J
LOWER LIMBS	RIGHT	S	S	D	D	J
	LEFT	S	S	D	D	J

RESIDUAL PARALYSIS: D
ATROPHY: D
FINAL DIAGNOSIS:
OTHER:

CODES
S=YES N=NO
D=UNKNOWN
A=ASCENDING
B=DESCENDING
C=ASCEN./DESCEN.
E=PROXIMAL
F=DISTAL
G=INCREASED
H=DECREASED
I=ABSENT
J=NORMAL
K=POLIO L=GBS
M=TRAUMA O=TUMOR
P=OTHERS
Q=TRANSVERSE MYEL.

CASE SAMPLE DATA :

SAMPLE #	LAB	DAYS/ONSET	TAKEN	RECEIVED	RESULTS	VIRUS
01	CAR	15	25/02/93	11/03/93	13/04/93	N

CONTACT SAMPLE DATA :

CONT. #	AGE	# VACCINES	LAST VACCINE	MOP-UP	SAMPLE #	LAB	TAKEN	RECEIVED	RESULTS	VIRUS
01	DD	DD	DD/DD/DD	DD/DD/DD	01	CAR	/ /	11/03/93	13/04/93	N
02	DD	DD	DD/DD/DD	DD/DD/DD	01	CAR	/ /	11/03/93	13/04/93	N
03	DD	DD	DD/DD/DD	DD/DD/DD	01	CAR	/ /	11/03/93	13/04/93	N
04	DD	DD	DD/DD/DD	DD/DD/DD	01	CAR	/ /	11/03/93	13/04/93	N
05	DD	DD	DD/DD/DD	DD/DD/DD	01	CAR	/ /	11/03/93	13/04/93	N

VIRUS ISOLATES: A= P1 WILD B= P2 WILD C= P3 WILD D= P1 VACCINE E= P2 VACCINE F= P3 VACCINE
G= P1 H= P2 I= P3 N= Negative O= Others P= Lost Q=Inadequate R= Contaminated S= Don't Process

FIGURE 13
Sample Screen from the Poliomyelitis Eradication Surveillance System

Rate of acute flaccid paralysis—The effectiveness of the surveillance program can be monitored by knowing this rate, which should be at least 1 case in children < 15 years of age per 100,000 such children.

Vaccination history of cases—Accurate information on the vaccination history of persons with poliomyelitis is essential for evaluating vaccine efficacy and possible cold chain problems.

Virus typing—Ultimately, results of genomic sequencing will be useful in determining whether an outbreak was caused by the circulation of indigenous poliovirus or by an importation. The source area from which the importation originated will also need to implement emergency control measures.

10.4 Information Dissemination

At the country level, a newsletter should be distributed to all those involved in surveillance and eradication to provide results on reported and confirmed cases. In addition, the newsletter should indicate the number of units reporting each week (including negative reporting). Information about the current epidemiology of poliomyelitis and other EPI target diseases should also be included. Polio update bulletins should be distributed to all health care workers and other interested health providers on a weekly or monthly basis (see Figure 14).

Acute Flaccid Paralysis Surveillance

Table No. 1
CASES OF ACUTE FLACCID PARALYSIS UNDER INVESTIGATION
BY WEEK OF REPORT

SITE	TOTAL 1992	CUM. 1993	WEEKS 1- 4	5- 8	9-12	13	14	15	16
ARG	56	17	4	5	8	0	NR	NR	NR
BOL	0	10	0	4	5	0	0	1	0
BRA	101	104	35	24	32	6	4	3	0
CAN	NR	NR	NR	NR	NR	NR	NR	NR	NR
CAR	0	4	2	1	0	0	0	0	1
CHI	85	1	1	0	0	0	0	0	0
COL	13	33	12	14	6	1	0	0	0
COR	3	1	1	0	0	0	0	0	0
CUB	0	2	1	1	0	0	0	0	0
DOR	0	3	0	0	3	0	0	0	0
ECU	5	14	4	3	5	0	0	2	0
ELS	9	16	4	7	4	0	0	1	0
GUT	0	11	0	0	3	6	1	1	0
HAI	0	6	2	2	1	1	0	0	0
HON	2	18	9	5	4	0	0	0	0
MEX	22	69	9	18	29	3	6	4	0
NIC	0	5	0	2	2	1	0	0	0
PAN	3	1	0	0	1	0	0	0	0
PAR	1	14	2	1	5	3	0	2	1
PER	0	30	0	8	10	3	2	6	1
U J	6	2	1	1	0	NR	NR	NR	NR
USA	NR	NR	NR	NR	NR	NR	NR	NR	NR
VEN	1	14	0	3	8	0	1	1	1
TOTAL	307	375	87	99	126	24	14	21	4

NR NO REPORT RECEIVED

Table No. 2
CASES OF AFP REPORTED , RATE PER 100,000 < 15 yrs., % INVESTIGATED WITHIN 48 hrs, % WITH 2 ADEQUATE SAMPLES AND % WITH 5 CONTACT SAMPLES TAKEN
AS OF WEEK 16

SITE	TOTAL CASES 1992	TOTAL RATE 1992	CUMULATIVE CASES 1993	RATE 1993*	% INV. < 48hr	% 2 SMPLS+	% 5 CONT.
ARG	106	1.10	17	0.57	76	12	6
BOL	59	1.84	14	1.42	93	86	79
BRA	605	1.14	114	0.70	87	37	46
CAN	NR	-	NR	-	-	-	-
CAR	21	0.86	6	0.80	50	0	33
CHI	100	2.48	1	0.08	0	0	0
COL	211	1.83	43	1.22	88	70	72
COR	10	0.92	1	0.30	100	100	0
CUB	19	0.84	2	0.29	100	50	0
DOR	32	1.18	7	0.84	100	86	100
ECU	82	1.87	20	1.48	100	80	90
ELS	63	2.70	17	2.37	100	94	88
GUT	90	2.15	27	2.10	100	93	78
HAI	7	0.27	7	0.89	14	57	71
HON	39	1.70	18	2.55	100	89	100
MEX	495	1.50	131	1.29	75	55	62
NIC	16	0.90	7	1.28	71	57	57
PAN	12	1.42	1	0.38	100	0	0
PAR	26	1.51	17	3.20	100	94	94
PER	92	1.05	43	1.60	93	98	88
URU	9	1.10	2	0.79	0	0	0
USA	NR	-	NR	-	-	-	-
VEN	95	1.26	29	1.25	93	83	90
TOTAL♦	2189	1.35	524	1.05	85	63	66

* Adjusted + Taken within 14 days of onset of paralysis
♦ Excluding Canada and USA

Table No. 3
CONFIRMED CASES OF POLIOMYELITIS
BY WEEK OF ONSET

AS OF WEEK 16

SITE	TOTAL 1992	CUMULATIVE 1992	CUMULATIVE 1993
ARG	0	0	0
BOL	0	0	0
BRA	0	0	0
CAN	0	0	0
CAR	0	0	0
CHI	0	0	0
COL	0	0	0
COR	0	0	0
CUB	0	0	0
DOR	0	0	0
ECU	0	0	0
ELS	0	0	0
GUT	0	0	0
HAI	0	0	0
HON	0	0	0
MEX	0	0	0
NIC	0	0	0
PAN	0	0	0
PAR	0	0	0
PER	0	0	0
URU	0	0	0
USA	0	0	0
VEN	0	0	0
TOTAL	0	0	0

CAR Includes reports from all CAREC member countries

Table No. 4
POLIO COMPATIBLE CASES
BY WEEK OF ONSET

AS OF WEEK 16

SITE	TOTAL 1992	CUMULATIVE 1992	CUMULATIVE 1993
ARG	2	0	0
BOL	0	0	0
BRA	8	2	0
CAN	0	0	0
CAR	1	1	2
CHI	1	1	0
COL	6	0	0
COR	0	0	0
CUB	0	0	0
DOR	0	0	0
ECU	2	2	0
ELS	2	2	0
GUT	3	1	0
HAI	0	0	0
HON	0	0	0
MEX	4	2	2
NIC	0	0	0
PAN	0	0	0
PAR	0	0	0
PER	2	1	0
URU	0	0	0
USA	0	0	0
VEN	2	0	0
TOTAL	33	12	4

FIGURE 14
Sample of the Weekly Bulletin for Acute Flaccid Paralysis Surveillance

11 PROGRAM INDICATORS

The following indicators should be evaluated and reported on a routine basis (Appendix R).

11.1 Surveillance

(1) Proportion of reporting sites reporting each week—at least 80% of sites should report each week, even in the absence of cases.
(2) Sensitivity of surveillance—a minimum of 1 case of acute flaccid paralysis per 100,000 children <15 years of age detected per year (see Figure 15).
(3) Interval between case onset and notification—at least 80% of all cases should come to the attention of health/medical workers within 14 days of the onset of paralysis.

11.2 Investigation

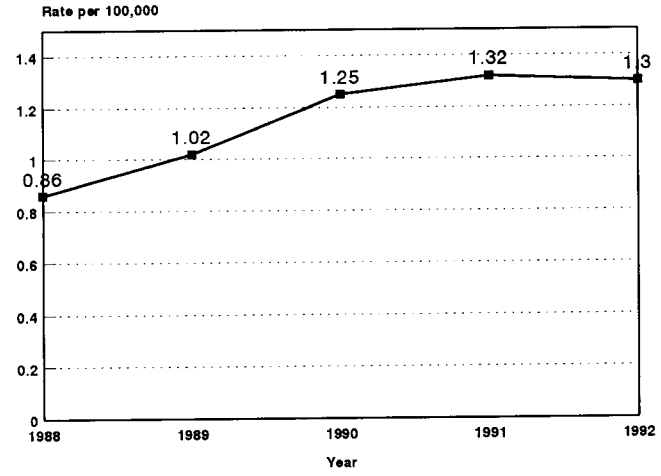
(1) Interval between notification of a suspected case and investigation—100% of cases should have been investigated within 48 hours of notification.
(2) Case specimens—the proportion of AFP cases with two stool specimens collected within 14 days of the onset of paralysis and 24–48 hours apart should be at least 80%.
(3) Contact specimens—for 80% of probable cases, one stool should be collected from a minimum of five contacts who are under 5 years old and who have not been vaccinated with OPV within the last 30 days.
(4) Interval between specimen collection and receipt by laboratory—100% of specimens should be received by the laboratory within 3 days.
(5) Follow-up of case—at least 80% of all probable cases should be followed up within 70 days of paralysis onset to establish whether residual paralysis is present.
(6) Case investigation form—100% of cases should have a completed investigation form with demographic, clinical, and laboratory information.
(7) Critical clinical variables—the records on 100% of cases should include the following variables: date of paralysis onset, time or period of progression (installation) of paralysis, presence of fever at onset of paralysis, residual paralysis at 60 days after onset, atrophy at 60 days, location of paralysis (proximal or distal, symmetrical or asymmetrical), and final diagnosis.

11.3 Laboratory

(1) Condition of specimens—100% of specimens received should have proper epidemiologic data, be packaged with proper materials, and be surrounded with ice.
(2) Interval between specimen receipt and results—100% of results should be returned to the submitter within 10 weeks.
(3) Recovery of virus—enterovirus should be recovered in $\geq 15\%$ of the stools processed.

11.4 Control

(1) For 90% of all cases identified as probable or confirmed, control measures should begin within 72 hours of notification.



Source: Ministry of Health

RATE OF REPORTED ACUTE FLACCID PARALYSIS
PER 100,000 POPULATION < 15 YEARS OF AGE
BY DEPARTMENT—FICTICIA, 1989–1992

	YEAR			
DEPARTMENT	1989	1990	1991	1992
AKRON	4.10	7.50	2.00	0.70
ALLENTOWN	0.30	1.50	1.00	1.50
BERKELEY	0.60	0.00	0.00	0.00
BRIDGEPORT	5.70	0.90	1.80	0.90
CHATTANOOGA	0.40	0.40	0.40	0.00
EVANSVILLE	1.90	1.90	0.70	0.60
HARTFORD	2.30	0.00	1.10	1.10
JACKSONVILLE	3.20	1.70	0.70	0.70
KNOXVILLE	0.00	0.60	1.21	0.60
LOWELL	0.40	0.80	0.40	0.00
OGDEN	4.10	2.10	2.10	1.00
PROVIDENCE	0.20	1.60	3.30	1.40
ROCKFORD	1.10	1.10	0.40	1.50
SAVANNAH	0.30	0.30	0.60	0.00
SCHENECTADY	2.40	1.50	1.50	1.00
SCRANTON	4.70	2.20	2.20	0.70
SHREVEPORT	10.90	0.00	0.00	0.00
SOMERVILLE	10.90	0.00	4.40	0.00
SPOKANE	1.60	1.60	0.00	0.00
TAMPA	1.80	0.40	1.10	0.40
TOLEDO	0.70	0.50	0.70	0.50
WATERBURY	1.10	0.00	1.60	0.00
YONKERS	1.80	1.80	0.00	0.00
YOUNGSTOWN	0.00	0.00	2.00	2.00
TOTAL	1.77	1.15	1.11	1.06

Source: PESS

FIGURE 15
Rate of Reported Acute Flaccid Paralysis, Ficticia

12 CERTIFICATION OF POLIO ERADICATION

On 6 July 1990, delegates to the first meeting of the International Certification Commission on Polio Eradication (ICCPE) put forth preliminary criteria for certifying countries in the Americas as free of poliomyelitis. The Commission recognized the extraordinary difficulties involved in demonstrating with certainty that no wild polioviruses were in circulation in a given country, let alone in the Region as a whole. The problem is similar to that which was experienced in certifying that smallpox had been eradicated, and it is made more difficult because of the much larger proportion of asymptomatic poliovirus infections compared to the number of clinical cases. However, the basic principles essential to certifying smallpox eradication are equally applicable to polio eradication: failure to detect wild poliovirus over an extended period of time in the context of a surveillance system that is adequate to detect both cases and the virus if present; and a thorough country-by-country documentation by an independent international commission that sufficient evidence is available to support the belief that poliovirus circulation has ceased. For smallpox, it was stipulated that at least 2 years should have elapsed since the last confirmed infection; for poliomyelitis, the Commission decided provisionally that the period should not be less than 3 years.

The certification process serves to verify the absence of transmission of indigenous wild poliovirus. At the same time, it serves to demonstrate that if polio caused by wild virus were to occur, the case would be identified, reported, and investigated in a timely manner to ensure that wild poliovirus transmission could be halted.

The measures to be taken are set forth below:

(1) Verification of the absence of virologically confirmed indigenous poliomyelitis cases in the Americas for a period of at least 3 years under circumstances of *adequate* surveillance;
(2) Verification of the absence of detectable wild polioviruses from communities as determined by testing of stools from normal children and, where appropriate, testing of wastewater from high-risk populations;
(3) On-site evaluation by national certification commissions appointed jointly by PAHO and respective member countries, composed of knowledgeable local persons and outside experts. After the national commission considers that the criteria have been met, the information will be submitted to the ICCPE for final certification;
(4) Establishment of appropriate measures to deal with importations.

As discussed by Fenner et al.,[1] the first smallpox certification commission to be established was for South America. It suffered from defects in both composition and performance. The certification process left much to be desired; fortunately, subsequent history demonstrated that smallpox had indeed been eradicated from South America. More rigorous measures will be needed for polio certification. It will be important for countries to appoint persons to their polio certification commissions who do not have ties to the national polio programs (thereby maintaining the objectivity of the evaluation) and who have been properly briefed on specific plans of action for and status of the areas they are reviewing.

The ICCPE is composed of members who are both critical in their assessments and whose judgments are respected nationally and internationally. Some of those selected are experts in communicable disease control, others in virology or health management. Some have also had the benefit of serving previously as members of various international smallpox certification commissions.

The mode of operation of the ICCPE has been established as follows:

(1) For each area of the Americas, one or two ICCPE commissioners will have responsibility for overseeing certification procedures. The seven areas are: the Southern Cone, Brazil, the Andean countries, Central America, the Caribbean, Mexico, and Canada and the United States.
(2) Areas will be considered for certification only if all their constituent countries have been free of po-

[1] Fenner F, Henderson DA, Arita L, et al. *Smallpox and its eradication*. 1st ed. Geneva: World Health Organization, 1988.

liomyelitis for a period of at least 3 years. All countries should now be engaged in the precertification process of collecting and evaluating data from surveillance of AFP and wild poliovirus, as discussed in previous sections.

(3) National commissions will be organized in each country to review and oversee the precertification activities of intensified AFP surveillance, active case searches in areas where surveillance is poor, surveillance of wild poliovirus, and immunization campaigns in risk areas, e.g., areas where confirmed and compatible cases have occurred in the past. Criteria for membership on the national commissions are the same as those established for membership on the ICCPE.

(4) Each country will prepare a country report to be reviewed by the responsible ICCPE commissioner, which will serve to document the interruption of transmission of wild poliovirus within each area.

Once preliminary approval of country reports has been achieved, the ICCPE will meet and review country presentations for a final decision on each area's status. Ultimately, it will be the responsibility of the ICCPE to reach one of two conclusions: either that it is satisfied that transmission has been interrupted, or that it would be satisfied if certain specific additional measures were undertaken.

Four strategies will be essential for generating country reports that would justify certification by the ICCPE: (1) surveillance of AFP; (2) surveillance of wild poliovirus; (3) active AFP case searches in areas of poor surveillance, such as those areas where confirmed or compatible cases occurred in the past or from which reports were not received; and (4) documentation of mass immunization campaigns in areas of risk, such as those areas where confirmed or compatible polio cases have occurred.

The ICCPE has indicated that every country's surveillance of AFP and wild poliovirus should meet five key surveillance indicators: (1) at least 80% of all the health units included in the reporting network should be reporting regularly each week; (2) the rate of AFP cases should be approximately 1 case reported per 100,000 population < 15 years of age; (3) at least 80% of all AFP cases reported should be investigated within 48 hours of reporting; (4) at least 80% of all AFP cases reported should have two stool specimens taken for virus culture within 2 weeks of paralysis onset; and (5) at least 80% of all AFP cases reported should have stool investigations of at least five contacts.

As a rule, the effectiveness of the reporting system for AFP and wild poliovirus will determine how prepared a country is to deal with importations of wild poliovirus. Countries will need to document what additional tactics have been implemented to prevent spread if importations were to occur. Surveillance of wild poliovirus will also include limited sampling and testing of sewage in areas at risk for wild poliovirus transmission.

Additionally, the certification report of each country should provide an account of active case searches, using standardized methodologies; in particular, the identification of risk areas, the questionnaire employed, and the analysis of the data collected should be included.

Finally, the ICCPE recognizes two important concerns regarding certification of countries. Some countries may have national averages that already meet all five of the AFP surveillance indicators described above; however, when the information is stratified geographically, some states, provinces, or districts within countries may be clearly at risk. Also, the occurrence of high-risk polio-compatible cases within the last 4 years raises concerns about possible continued transmission of wild poliovirus. A PAHO investigation revealed that the specificity of confirmation of AFP cases as polio could be increased remarkably by using the following screening criteria: age < 6 years, and the presence of fever at paralysis onset. Accordingly, spot maps of these high-risk compatible cases in children under 6 years of age who had fever at paralysis onset will be useful. These situations call for special mop-up immunization campaigns, the results of which will need to be reported by the countries. These reports (to be incorporated in the certification document) should describe the number of children < 5 years of age targeted for immunization, number or percentage immunized with OPV, and the number of households visited.

Other certification strategies that would be important to include in a country's final report are establishment of a rumor register, conduct of publicity campaigns, and creation of a system for rewards. The reward system established by PAHO in 1988 has not been readily accepted in all countries, because some national health authorities fear that it would set a precedent with regard to the reporting of other diseases, although in fact no evidence has been found to substantiate those concerns. Indeed, the smallpox experience demonstrated that rewards were an important aid to surveillance. The smallpox rewards were initially small but were gradually increased to a high of US$ 1,000 offered by WHO in 1978. At present the polio reward is US$ 100. Serious consideration should be given to increasing this reward,

particularly in view of the over 2 years that have passed since the last culture-confirmed polio case in the Americas was reported in Junín, Peru, on 23 August 1991. Ecuador has already raised the reward to US$ 1,000.

As with the eradication of smallpox, epidemiologic surveillance (of AFP and wild poliovirus in the case of polio) will be the key component of the certification process. Most importantly, it must be demonstrated that when cases of AFP occur, they will be identified, reported, and investigated in a timely manner to ensure that if any wild poliovirus is present, it will be identified.

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Slides, folders, posters, and other materials are available from PAHO offices upon request.

APPENDICES

APPENDIX A

DISTRIBUTION OF DIAGNOSES FOR DISCARDED CASES OF ACUTE FLACCID PARALYSIS

JURISDICTION _____

YEAR						
DIAGNOSIS	#	%	#	%	#	%
GUILLAIN-BARRÉ SYNDROME						
TRAUMATIC NEURITIS						
TRANSVERSE MYELITIS						
TUMOR						
WITHOUT DIAGNOSIS						
TOTALS						

APPENDIX B

FURTHER DISCUSSION OF THE DIFFERENTIAL DIAGNOSIS OF POLIOMYELITIS

Guillain-Barré Syndrome (GBS)

GBS is the most common cause of AFP in childhood. Important differences exist between GBS and polio. Generally, poliomyelitis occurs earlier in life than GBS. In one study polio cases ranged from 9 months to 5 years of age, while GBS cases ranged from 4 to 18 years (with exceptions in both cases). Approximately 50% of cases of AFP are discarded as GBS.

1. **Prodromes and Fever:** Prodromes are present in both polio and GBS; they consist of an upper respiratory tract infection and gastrointestinal infection. However, in polio these conditions occur nearer to the onset of AFP (within 4 to 10 days), whereas in GBS they present 7–15 days prior to the onset of AFP.

   A hallmark of paralytic polio is the presence of fever at onset of paralysis. The fever disappears the day after onset with remarkable uniformity. In GBS, fever may appear several days after onset and is often secondary to bacterial pneumonia, the most common complication in GBS patients.

2. **Progression of Paralysis:** Since AFP is synonymous with lower motor neuron syndrome, muscle strength, tone, and deep tendon reflexes (DTR) have to be considered together. Onset of paralysis or lack of muscle strength is acute in polio and GBS; however, in polio it usually progresses to completion in 24 to 48 hours, while in GBS it may take up to 2 weeks to gradually progress to its maximum. The distribution of flaccid paralysis in polio is asymmetric and irregular, affecting each limb to different degrees, predominantly in the proximal muscle groups. In GBS, demyelination of peripheral nerves is symmetrical and a universal finding. In general, it occurs in an ascending fashion, affecting lower limbs first, then trunk, and then upper limbs; it may even reach the cranial nerves (Miller-Fisher syndrome).

3. **Muscular Pain:** Children with polio suffer severe myalgia 1 or 2 days prior to the onset of AFP and up to 1 or 2 weeks afterward. Myalgias are also more severe in the most extensively affected limbs. They can be spontaneous or initiated upon touch. Older children complain of back pain. The child with polio usually refuses to be seated, touched, or handled.

4. **Sensation:** Children with GBS often complain of hypoethesia or anesthesia in a glove-boot distribution. Tingling and burning sensations in soles and palms are also frequent, as well as cramps in peroneal muscles; however, the child with GBS is *not* disturbed by handling or changes in position.

5. **Cranial Nerve Involvement:** Cranial nerve involvement is rare in polio. It is only present in the bulbar form accompanied by severe respiratory insufficiency, often leading to death. Children with GBS present lower cranial nerve involvement much more often than previously thought, possibly in up to 70% to 80% of cases.

6. **Respiratory Insufficiency:** In polio, respiratory insufficiency may present in the bulbar form or when thoracic involvement of the spinal cord is severe. In children with GBS, respiratory insufficiency occurs secondary to demyelination of the intercostal nerves.

7. **Neurophysiologic Studies:** (a) Nerve conduction velocity (motor and sensory) study is preferably performed 3 weeks after onset of flaccid paralysis. For both GBS and polio the test should be abnormal at this time. (b) Electromyography is recommended at 3 weeks and is highly abnormal in polio, with signs of severe denervation and giant action potentials. In GBS it remains normal or minimally abnormal in severe cases. *However, a normal exam does not rule out polio.*

8. **Cerebrospinal Fluid (CSF):** In polio, the spinal fluid is inflammatory and it may or may not be under pressure. It may be transparent or slightly turbid. Protein is increased moderately to 40–65 mg. From 10 to 200 cells per mm^3 are present with a mononuclear predominance. The CSF pressure in GBS is usually not elevated and the fluid is transparent. The most important feature is an increase in protein up to 200 mg, with a cell count of usually 10 or fewer monocytes per mm^3 of CSF. A white cell count of 50 is strong evidence against the diagnosis of GBS. If GBS is suspected and the CSF did not show an albuminocytologic dissociation in the first lumbar puncture, it should be repeated 1 week later.

9. **Sequelae:** Sequelae can be severe and permanent in children with polio. Because anterior horn cells are destroyed, the motor units supplied by these nerves in the muscle are also destroyed. This is manifested in the patient as mild to severe atrophy of muscle groups with an asymmetrical, haphazard distribution. Weakness of some muscle groups allows functional predominance of others, thus causing skeletal deformities requiring orthoses and orthopedic surgery. Severely affected limbs remain flaccid, hypotonic, and areflectic.

   Sequelae in children with GBS may be present at 3 months after flaccid paralysis onset and consist of symmetrical atrophy of peroneal and anterior tibial muscles in legs and atrophy of thenar and hypothenar eminence in palms. The children drop their feet when seated and when walking, and for this reason walk like a stork in a "steppage" fashion. When asked to extend their arms, hands also hang in a drop fashion. As the child recovers strength and muscle tone, DTRs return to normal. Skeletal deformities do not generally occur, so orthoses and orthopedic surgery are not needed.

Traumatic Neuritis (TN) Secondary to Intramuscular Injections

The onset of AFP in the affected lower limb occurs from 1 hour to 5 days after injection. The onset of fever may occur before, during, or after onset of paralysis if the injection was given for a pre-existing illness or causes an abscess. The sequence is difficult to establish when several injections are applied in both gluteus muscles. In the great majority of children the substance injected is penicillin. Injections may have been applied by the mother, a drug store clerk, or a private physician. AFP is usually accompanied by pain in the gluteal region or along the affected leg. Atrophy may appear 40 to 60 days later, accompanied by hyporeflexia. However, atrophy never reaches the degree seen in polio. Differences in leg circumference usually do not exceed 0.5 to 1.5 cm. Upper limbs and cranial nerves are not affected. Rarely, children are affected in both lower limbs because injections were given in both sides. Sequelae are rarely severe and children gradually recover with physiotherapy within 3 to 9 months.

Transverse Myelitis (TM)

In general, patients with TM range from 4 to 18 years of age. Fever may be present before the onset of AFP, but rarely during onset. Paralysis is usually symmetrical in the lower limbs and is accompanied by profound anesthesia to all forms of sensation. The level of sensory deficit may vary and can be lumbar, thoracic, or cervical. Arms may also be partially paralyzed, but this occurrence is not frequent. Muscle strength, tone, and DTRs are usually absent in TM.

Autonomic and bladder dysfunction occur frequently with this disease. Recovery is related to onset: When onset is fulminant or rapid (within hours), recovery usually begins several weeks to months later, and neurologic deficits remain. In contrast, children whose paralysis took several days to develop to completion usually begin to recover 1 to 5 days after symptoms peak and may recover completely.

Other Differential Diagnoses

1. **Peripheral Neuropathy:** The major peripheral neuropathy that is relevant to the differential diagnosis of polio in the Americas occurs secondary to ingestion of the poisonous berries of *Karwinskia humboldtiana* or *K. calderoni*, a shrub of the buckthorn family found in areas of Mexico and Central America. Paralysis usually lasts 3 to 4 days; recovery is spontaneous and does not leave sequelae. Mortality can reach 20% of the cases if proper respiratory support is not given. Other peripheral neuropathies are caused by metabolic defects (diabetic), toxins (including lipid solvents and fish toxins), organophosphate pesticides, raw metals (lead), several pharmacological products, hereditary disease (Charcot-Marie-Tooth), diphtheria toxin, and tick bite.

2. **Enteroviruses:** A number of other enteroviruses are known to cause AFP. Many of the Coxsackie A viruses, most of the Coxsackie B and ECHO viruses, and enterovirus types 70 and 71, as well as the mumps virus, have been temporally associated with both mild and severe neurolytic disease. Reports on sequelae are not clear, although most cases show a course of improvement. However, because normal children excrete other nonpolio enteroviruses, the isolation of such viruses from patients with AFP may not be causally related.

3. **China Syndrome:** It is not certain whether the China syndrome is a form of GBS or some other neurologic condition. It appears to attack the motor neurons of the spinal cord, while GBS generally attacks the myelin sheath that surrounds peripheral nerve fibers, blocking nerve impulses that have already fired. Patients do not exhibit high fevers early in the course of the illness, as is common in polio. The paralysis is often less extensive than in polio. Despite frequently requiring respiratory support, children appear to have a better prognosis for eventually recovering most or all of their motor function. Unlike polio, paralysis in China syndrome is symmetrical. In addition, seasonal cases are generally sporadic and almost exclusively from rural areas.

Postpolio Syndrome

Postpolio syndrome, also called postpolio sequelae and postpolio muscular atrophy, refers to a group of disorders experienced by many poliomyelitis survivors, typically starting 25–35 years after initial onset. Symptoms include renewed, usually gradual progression of muscle weakness, increased fatigability, joint pain, muscle cramps, intolerance to cold, and sometimes increased difficulty in breathing (when respiratory muscles are involved). Postpolio syndrome appears to be more frequent and severe in persons who had a more severe initial poliomyelitis illness. No single examination procedure or laboratory test can definitely diagnose this condition. There is no evidence to suggest that these patients are reinfected or have chronic infection; rather, they may be experiencing the consequences of long-term overuse to compensate for the original destruction of nerve cells.

APPENDIX C

SPECIMEN TRACKING FORM

PATIENT'S NAME:
CASE ___ OR CONTACT ___
CASE No.: _____
COUNTY/STATE/COUNTRY:
DATE ONSET OF PARALYSIS (CASE): ___/___/___
DATE SPECIMENS TAKEN: 1ST ___/___/___ 2ND ___/___/___
NUMBER OF OPV DOSES (PATIENT): ____
DATE OF LAST DOSE (PATIENT): ___/___/___
DATE CONTAINMENT STARTED: ___/___/___
DATE SPECIMENS SENT TO LAB: ___/___/___
COMMENTS: _____
_____

TO BE FILLED OUT AT LABORATORY

DATE SPECIMENS RECEIVED: ___/___/__
CONDITION OF SPECIMENS: GOOD___ FAIR___ POOR___
RESULTS OF VIRUS ISOLATION: 1ST _____ 2ND _____
DATE REPORTED: ___/___/___
SPECIMENS SENT TO REFERENCE LAB: ISOLATES FROM 1ST ___ 2ND ___
DATE REFERRED TO REFERENCE LABORATORY: ___/___/___
COMMENTS: _____
_____

TO BE FILLED OUT BY REFERENCE LABORATORY

DATE SPECIMENS RECEIVED: ___/___/___
CONDITION OF SPECIMENS: GOOD___ FAIR___ POOR___
RESULTS OF VIRUS IDENTIFICATION: 1ST _____ 2ND _____
DATE REPORTED: ___/___/___
COMMENTS: _____

APPENDIX D

GUIDELINES FOR LABORATORIES WITHIN A NETWORK

1. Laboratories should be supplied with the reagents and materials needed to carry out polio diagnosis. They should also have the human resources necessary to carry out this task.

2. The laboratory should be aware of clinical and epidemiologic criteria that will aid in establishing priorities for processing the samples received by the regional laboratories.

3. Serologic diagnosis of poliomyelitis should be eliminated since it is not possible to determine whether antibody is due to the vaccine or wild virus.

4. The laboratory should report results of stool sample analyses within 4 weeks for negative cultures and 6 weeks for positive cultures.

5. All polio strains isolated from probable cases or their contacts should be immediately characterized by DNA probes.

6. Reisolation should be attempted with all wild strains isolated from confirmed cases.

7. Virus isolation by means of concentration techniques (that is, ultracentrifuge at 150,000 G for 2 hours) should be attempted for all negative samples of clinically confirmed cases. Epidemiologists should be requested to collect a sufficient amount of sample so that the laboratory can perform re-isolation if necessary.

8. Quality control measures for poliovirus isolation and identification (that is, coded samples) should be carried out in order to maintain a quality level of over 90% correct results.

9. Laboratories should implement adequate measures to prevent intra-laboratory viral contamination.

10. All laboratory workers must be completely immunized against polio and hepatitis B.

APPENDIX E

LABORATORY LINE LISTING

LABORATORY _____

COUNTRY NAME	CASE ID	LAB ID NUMBER	DATE OF PARALYSIS ONSET	DATE STOOL TAKEN	DATE RECEIVED	CONDITION OF SPECIMEN*	SPECIMEN QUANTITY SUFFICIENT?**	DATE OF RESULTS	RESULTS	OBSERVATIONS

*Adequate or inadequate
**Yes or no

APPENDIX F

REFRIGERATOR RECORD FORM

MONTH		DAY	1						7						14						21						28		31
ALL TYPES	Temperature (°C)	morning																											
		afternoon																											
	Is the ice solid?	Yes___ No___																											
	Refrigeration	No. of hours																											
	Breakdown	Temp. when found																											
		Mark days not in use																											
KEROSENE		Clean & fill tank																											
		Gallons fuel used per week																											
		Trim wick																											
	Parts replacement	Wick																											
		Glass																											
		Burner																											
GAS	New gas bottle																												
	New hose																												
	Clean jet																												

Source: WHO/EPI Training Course for Mid-Level Managers.
"Manage the Cold Chain System," p. 48, WHO—Geneva, 1985

REFRIGERATOR TEMPERATURE CHART					
DATE	TEMPERATURE		DATE	TEMPERATURE	
				AM	PM

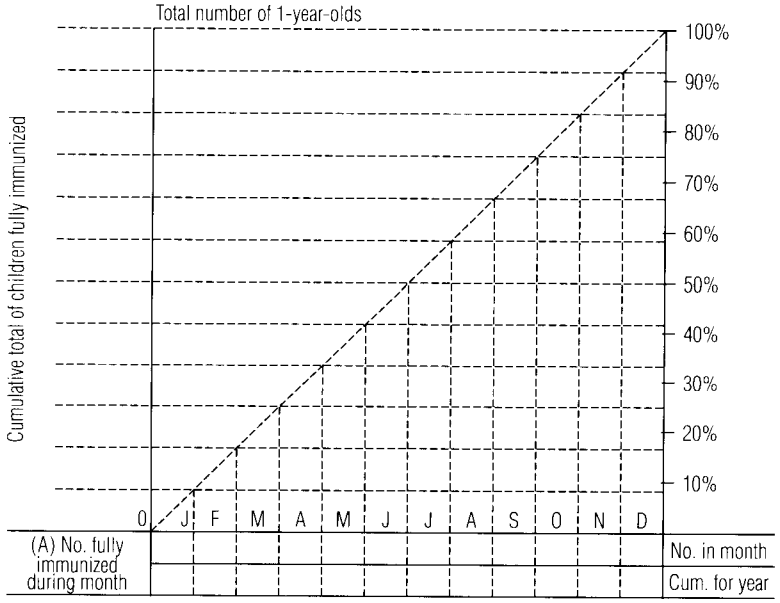
APPENDIX G

GRAPH TO MONITOR IMMUNIZATION COVERAGE OF TOTAL NUMBER OF 1-YEAR-OLDS

Area (district or municipality) _____ Year _____

VACCINE _____ (FULL IMMUNIZATION = _____ DOSES)

Total number of 1-year-olds _____



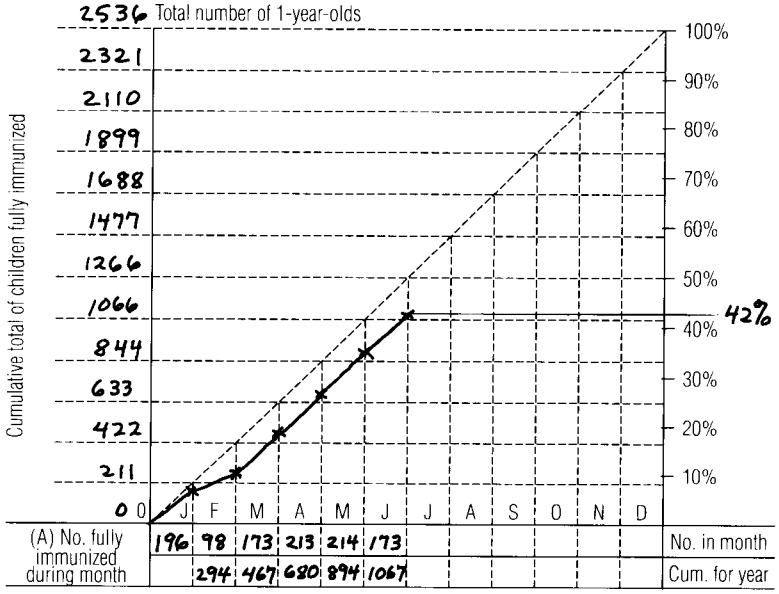
1. Enter in box "A" the number of children fully immunized during that month and the cumulative total for the month.
2. Plot monthly progress on the graph by marking "x" for the cumulative total at the end of each month and join with a solid line.

SAMPLE:

Area (district or municipality) EPILAND Year 1986

VACCINE POLIO (FULL IMMUNIZATION = 3 DOSES)

Total number of 1-year-olds 2536



1. Enter in box "A" the number of children fully immunized during that month and the cumulative total for the month.
2. Plot monthly progress on the graph by marking "x" for the cumulative total at the end of each month and join with a solid line.

APPENDIX H: LEVELS OF COVERAGE FORM

NUMBER AND PERCENT OF COUNTIES/MUNICIPALITIES WITH CERTAIN LEVELS OF COVERAGE WITH 3 OR MORE DOSES OF OPV IN CHILDREN AT 1 YEAR OF AGE

COUNTRY _____ *YEAR* _____

PROVINCE/STATE	TOTAL NUMBER OF COUNTIES/MUNICIPALITIES (A)	NUMBER* WITH <50% (B)	% (B/A)	NUMBER* WITH 50%–79% (C)	% (C/A)	NUMBER* WITH 80%–89% (D)	% (D/A)	NUMBER* WITH 90%+ (E)	% (E/A)
TOTALS									

*Enter the number of counties/municipalities with coverage at this level in this column

APPENDIX I

MOP-UP WORK SHEET

VILLAGE/CITY _____ MUNICIPALITY/COUNTY _____

STATE/PROVINCE _____ COUNTRY _____

DATES OF MOP-UP ___/___/___ TO ___/___/___

PERSON RESPONSIBLE FOR SUPERVISION _____

PERSON RESPONSIBLE FOR VACCINE SUPPLY _____

PERSON RESPONSIBLE FOR EQUIPMENT _____

Keep a tally of persons vaccinated during mop-up.
Vaccine should be given to all children under 5 years of age, whether or not they have a history of vaccination.

AGE	TALLY OF CHILDREN VACCINATED	TOTALS
<1 YR		
1–4		
≥5		

Keep a tally of all houses visited in the area, whether or not children live in the house or were vaccinated there. "Open" means someone was at home. "Closed" means that people live in the house but were not at home at the time of the visit.

VISITED	TALLY OF HOUSEHOLDS VISITED	TOTALS
OPEN		
CLOSED		

During the visits to households for vaccination, an active search should be conducted. Enter the name of any person who has or had acute flaccid paralysis.

NAME OF CASE	ADDRESS AND DIRECTIONS

APPENDIX J

MOP-UP VACCINATION FORM

COUNTRY _____ *YEAR* _____ *ROUND* _____

STATE/ PROVINCE	COUNTY/ MUNICIPALITY	DATE OF ROUND	TOTAL POPULATION <5 YRS (A)	NUMBER VACCINATED <5 YRS (B)	% (B/A)	NUMBER HOUSEHOLDS (C)	NUMBER HOUSEHOLDS VISITED (D)	% (D/C)
TOTALS								

APPENDIX K

WEEKLY REPORTING MONITOR FORM

INSTRUCTIONS *1) Mark with a check each week a report is received on time; mark with a X when a report is received late.*
2) Calculate percentage of sites reporting on time by dividing the number reporting on time by the total number of sites.

REPORTING UNITS	WEEK # 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
TOTAL # REPORTING																										
% REPORTING ON TIME																										

APPENDIX K (cont'd.)

WEEKLY REPORTING MONITOR FORM

INSTRUCTIONS *1) Mark with a check each week a report is received on time; mark with a X when a report is received late.*
2) Calculate percentage of sites reporting on time by dividing the number reporting on time by the total number of sites.

REPORTING UNITS	WEEK # 27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
TOTAL # REPORTING																											
% REPORTING ON TIME																											

APPENDIX L

WEEKLY REPORTS SUMMARY

COUNTRY _____ *YEAR* _____

WK #	# SITES IN SYSTEM	# SITES NOTIFYING	% REPORTING	WK #	# SITES IN SYSTEM	# SITES NOTIFYING	% REPORTING
1				27			
2				28			
3				29			
4				30			
5				31			
6				32			
7				33			
8				34			
9				35			
10				36			
11				37			
12				38			
13				39			
14				40			
15				41			
16				42			
17				43			
18				44			
19				45			
20				46			
21				47			
22				48			
23				49			
24				50			
25				51			
26				52			
				53			

APPENDIX M: ACTIVE SEARCH FOR CASES OF PARALYSIS

A) HEALTH INSTITUTION CASE INVESTIGATION FORM

Health Center:
County:
Health District:

Date:
Investigator:

DIRECTOR OF CENTER SIGNATURE SEAL

PROCEDURE

(check the box that applies)

☐ Review of _____ (#) diagnoses on daily outpatient records.
☐ Review of _____ (#) compatible diagnoses on discharge records, out of _____ (#) discharges over that period of time.

The diagnoses were made of:

☐ children under 15 years of age.
☐ all age groups.

The review period covered _____ (#) year(s), from __/__/__ to __/__/__

FINDINGS

The following cases of flaccid paralysis were found in children under the age of 15 years:

No clinical history	Case name	Paralysis onset		Address	Urban? Rural?	Parent(s) name(s)	Visit Yes/No	Final diagnosis	Discharged/ Deceased
		Age	Date						

APPENDIX M: ACTIVE SEARCH FOR CASES OF PARALYSIS (cont'd.)

B) CASE INVESTIGATION FORM FOR SCHOOLS, NURSERIES, AND OTHER INSTITUTIONS

Institution:
County:
Health District:

Date:
Investigator:

DIRECTOR OF CENTER SIGNATURE SEAL

1. POPULATION STUDIED

Ages	No. of children	Cases with paralysis	Cases examined
0 to 4 years			
5 to 14 years			
TOTAL			

2. CASES FOUND

No. of cases	Age (years)	Date of onset	Address	Diagnosis

Teachers or other responsible adults interviewed:

APPENDIX M: ACTIVE SEARCH FOR CASES OF PARALYSIS (cont'd.)

C) CASE INVESTIGATION FORM FOR THE COMMUNITY

Health Center:	Date:
County:	Investigator:
Health District:	

1. PERSONS INTERVIEWED

No.	Name	Address	Does he/she know a case of paralysis?	
			Yes	No
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

No.	Name	Address	Does he/she know a case of paralysis?	
			Yes	No
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				

2. CASES ENCOUNTERED

*	Complete first and last names	Address	Mother/Father	Diagnosis	Visit (Y/N)	Date

*Please enter in this column the ID number (from above) of the person interviewed.

APPENDIX M: ACTIVE SEARCH FOR CASES OF PARALYSIS (cont'd.)

D) INFORMATION SHEET

Country:	Date:
Health District:	Investigator:

Active search carried out from ___/___/___ to ___/___/___

1. HEALTH CENTERS

No. of hospitals visited _____
No. of other establishments _____
Total diagnoses reviewed _____
Total number of cases of paralysis found _____
Number of cases already known to the surveillance system _____
Total number of cases visited _____
Total cases of poliomyelitis found _____
Date of onset of the most recent case of polio ___/___/___

2. SCHOOLS, NURSERIES, AND OTHER ESTABLISHMENTS

No. of establishments visited: Schools _____
Nurseries _____
Other _____
Total _____
Total number of children included in the investigation _____
Number of cases of paralysis detected _____
Cases already known to the surveillance system _____
Cases visited _____
Cases of poliomyelitis found _____
Date of onset of the most recent case of polio ___/___/___

3. COMMUNITY

Number of communities visited _____
Number of houses visited _____
Number of people interviewed _____
Cases detected _____
Cases already known to the surveillance system _____

Cases visited _____
Cases of polio _____
Date of last polio case: ___/___/___

APPENDIX N

ACUTE FLACCID PARALYSIS CASE INVESTIGATION FORM

(This form should be completed for all persons in which acute flaccid paralysis is found and no specific cause can be immediately identified.)

IDENTIFICATION CASE ID_____

YR_____ COUNTRY _____ PROV./STATE_____ MUNICIP. _____ LOCALE _____

Name_____ Mother's name _____

Address _____ Urban____ Rural____

Sex M____F____ Date of birth:__/__/__ Age: yrs. _____ mos. _____ No. OPV doses____ Date last dose__/__/__

Date investigated:__/__/__ Date reported: Local__/__/__ National__/__/__ First reported by: _____

OBSERVATIONS:

CLINICAL DATA

PRODROME	Yes	No	Unk
Fever	___	___	___
Respiratory	___	___	___
Diarrhea	___	___	___
SIGNS			
Muscle Pains	___	___	___
Stiff Neck	___	___	___

AT ONSET OF PARALYSIS

Date of onset__/__/__

	Yes	No	Unk
Fever at onset	___	___	___

PROGRESSION

Days for paralysis to fully develop: ____days

Ascending ____

Descending ____

SITE OF FLACCID PARALYSIS

	Yes	No	Unk		REFLEXES I/D/A/N/U*	SENSATION I/D/A/N/U*
RIGHT ARM	___	___	___	PROXIMAL	_____	_____
				DISTAL	_____	_____
LEFT ARM	___	___	___	PROXIMAL	_____	_____
				DISTAL	_____	_____
RIGHT LEG	___	___	___	PROXIMAL	_____	_____
				DISTAL	_____	_____
LEFT LEG	___	___	___	PROXIMAL	_____	_____
				DISTAL	_____	_____

*I = Increased, D = Decreased, A = Absent

N = Normal, U = Unknown

If hospitalized: Hospital name_____ Date__/__/__ Med. Rec. #_____

Death: Yes___ No___ Unk___ If yes: Date__/__/__ Cause_____

OBSERVATIONS:

LABORATORY

CASE	How stool obtained	Submitting laboratory	Date stool taken	Date received central lab	Date received regional lab	Date results received	Results
FECES 1	_____	_____	__/__/__	__/__/__	__/__/__	__/__/__	_____
FECES 2	_____	_____	__/__/__	__/__/__	__/__/__	__/__/__	_____

CONTACTS*	Initials	Age	No. OPV doses	Date of last dose	Date stool taken	Date received central lab	Date received regional lab	Date results received	Results
CONTACT 1	_____	____	_____	__/__/__	__/__/__	__/__/__	__/__/__	__/__/__	_____
CONTACT 2	_____	____	_____	__/__/__	__/__/__	__/__/__	__/__/__	__/__/__	_____
CONTACT 3	_____	____	_____	__/__/__	__/__/__	__/__/__	__/__/__	__/__/__	_____
CONTACT 4	_____	____	_____	__/__/__	__/__/__	__/__/__	__/__/__	__/__/__	_____
CONTACT 5	_____	____	_____	__/__/__	__/__/__	__/__/__	__/__/__	__/__/__	_____

*Contacts should be <5 yrs of age and not vaccinated within 30 days. List add'l contacts on separate page.

SPINAL TAP Yes___ No___ Date__/__/__ Cells_____ Protein_____

OBSERVATIONS:

CONTROL

Date special control vaccination begun __/__/__ Population <5 years_____ No. <5 years vaccinated_____

Estimated number of households in target area_____ Number of households visited_____

FOLLOW-UP

Date follow-up __/__/__ Residual paralysis at 60 days: Yes___ No___ Unk___ Atrophy: Yes___ No___ Unk

FINAL DX: POLIO___ POLIO COMPATIBLE___ POLIO VACCINE ASSOC___ DISCARDED___ DATE CLASSIFIED __/__/__

IF DISCARDED: GUILLAIN-BARRÉ___ TRAUMATIC NEURITIS___ TRANSVERSE MYELITIS___ TUMOR___ OTHER_____

INVESTIGATOR

Name of Investigator _____ Signature _____

Title Office Date __/__/__

OBSERVATIONS:

APPENDIX O

LINE LISTING OF PROBABLE CASES

CASE ID	NAME OF CASE	SEX	AGE	ADDRESS	DATE RE-PORTED	DATE INVEST-IGATED	VACCINE STATUS (NO. OF DOSES)	DATE ONSET PARAL-YSIS	FEVER AT ONSET?	PROGRESSION IN DAYS/ ASCENDING OR DESCENDING	SITE OF PARALYSIS/ PROXIMAL OR DISTAL	DESCRIBE PARALYSIS

APPENDIX O (cont'd.)

LINE LISTING OF PROBABLE CASES

CASE ID	STOOL SAMPLES: DATE TAKEN	STOOL SAMPLES: DATE REC'D BY LAB	STOOL SAMPLES: DATE RESULT	STOOL SAMPLES: LAB RESULTS P1,P2,P3, OTHER	CONTACTS: NUMBER CONTACT STOOLS COLLECTED	CONTACTS: LAB RESULTS	FOLLOW-UP: DATE	FOLLOW-UP: RESIDUAL PARALYSIS AT 60 DAYS	FINAL DX: POLIO POLIO-COMPATIBLE POLIO VACCINE-ASSOC. DISCARD (SPECIFY)	FINAL DX: DATE CLAS-SIFIED	CONTROL: DATE CONTROL STARTED/ NUMBER <5 YRS VACCINATED	COMMENTS

APPENDIX P

POLIO OUTBREAK CONTROL SUMMARY FORM

NAME OF INDEX CASE _____ CASE ID _____

PROVINCE/STATE _____ COUNTRY _____

MUNICIPALITY/COUNTY _____ VILLAGE/CITY _____

List neighboring areas which also have polio outbreaks _____

Date of onset of paralysis of earliest case: __/__/__ Date of onset of paralysis of last case: __/__/__

NUMBER OF CASES BY AGE IN YEARS

	<1	1	2	3	4	5–9	10–14	>15	TOTALS
PROBABLE									
CONFIRMED									

IMMUNIZATION STATUS OF CASES

AGE (YEARS)	CONFIRMED POLIO CASES					
	Not immunized	Documented OPV history*			Unknown if immunized	Total No.
		1 Dose	2 Doses	3+ Doses		
<1						
1–2						
3–4						
5–9						
10–14						
15+						
TOTALS						

COMMUNITY COVERAGE

AGE (YEARS)	3+ DOSES %
<1	
1–2	
3–4	
5–9	
10–14	
15+	
TOTALS	

*Do not count OPV Zero (given at birth)

IMMUNIZATIONS FOR OUTBREAK CONTROL

Date first round __/__/__ Number vaccinations given:

Date second round __/__/__ Number vaccinations given:

	<1 yrs	1–4 yrs	>5 yrs	TOTAL
TOTALS				

LIST VILLAGES/CITIES WHICH WERE VISITED IN THE COURSE OF THE INVESTIGATION

NAME	DATE	# IMMUNIZED	COMMENTS (Cases found?)
_____	__/__/__	_____	_____
_____	__/__/__	_____	_____
_____	__/__/__	_____	_____
_____	__/__/__	_____	_____
_____	__/__/__	_____	_____
_____	__/__/__	_____	_____
_____	__/__/__	_____	_____
_____	__/__/__	_____	_____

Describe control activities: _____

_____

_____

Describe follow-up activities: _____

_____

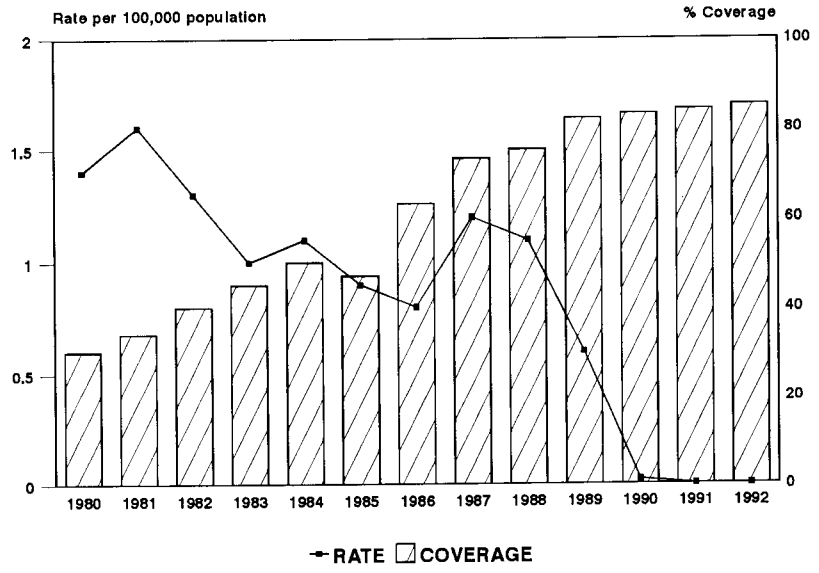
_____

Name of investigator _____ Place _____ Date __/__/__

APPENDIX Q

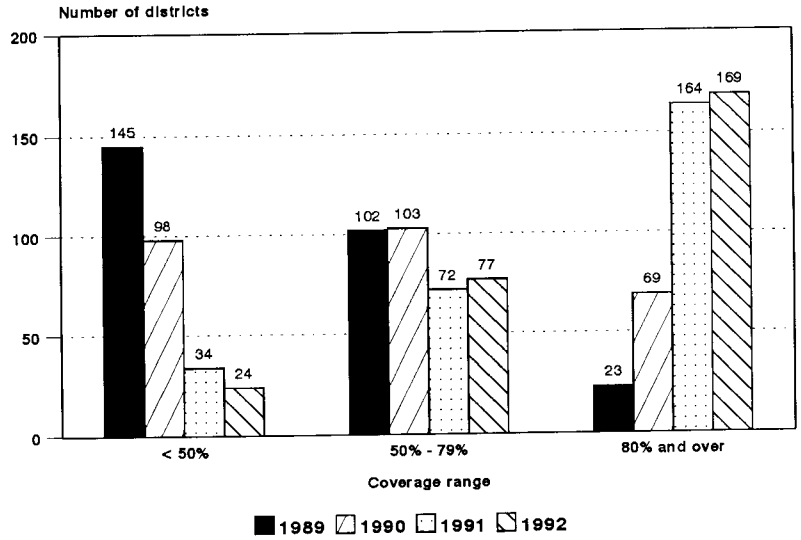
EXAMPLE OF A COUNTRY ANALYSIS

INCIDENCE OF REPORTED PARALYTIC POLIO AND OPV COVERAGE IN CHILDREN <1 YEAR OF AGE, FICTICIA, 1980 - 1992



Source: Ministry of Health

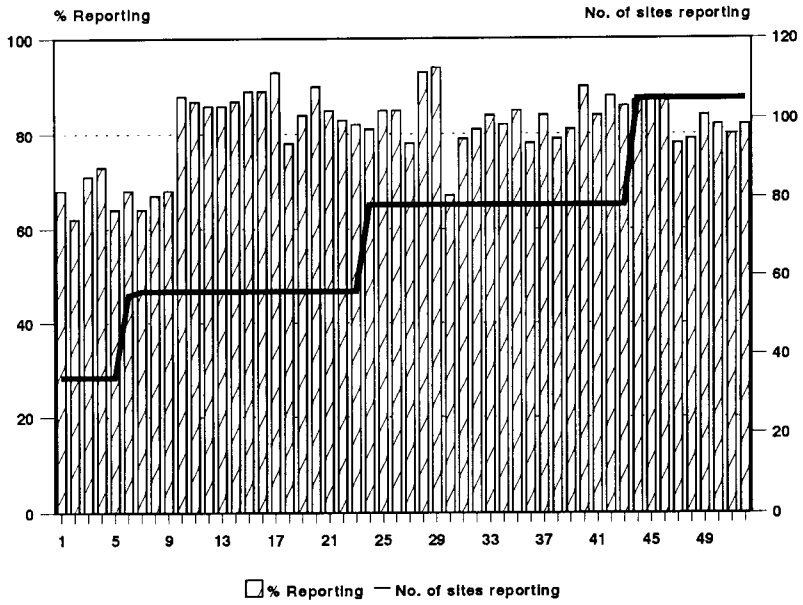
DISTRIBUTION OF DISTRICTS ACCORDING TO OPV3 COVERAGE RANGE IN CHILDREN <1 YEAR, FICTICIA, 1988 - 1992



Source: Ministry of Health data
Total number of districts: 270

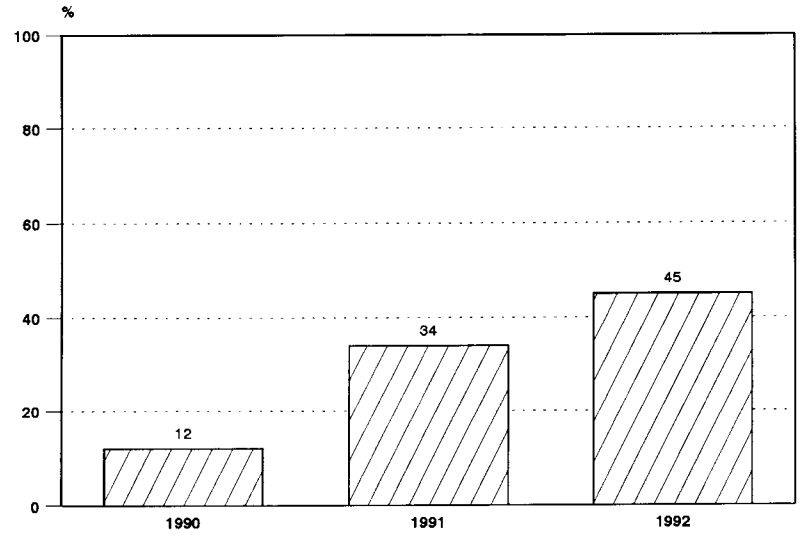
APPENDIX Q (cont'd)

WEEKLY NEGATIVE NOTIFICATION, FICTICIA, 1992



Source: Ministry of Health

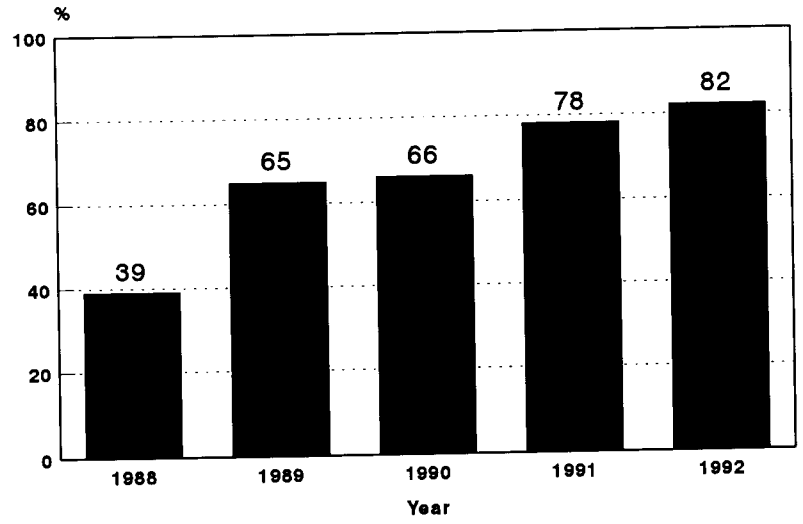
PERCENTAGE OF AFP CASES WITH STOOL SAMPLES TAKEN FROM 5 OR MORE CONTACTS, FICTICIA, 1988 - 1992



Source: Ministry of Health

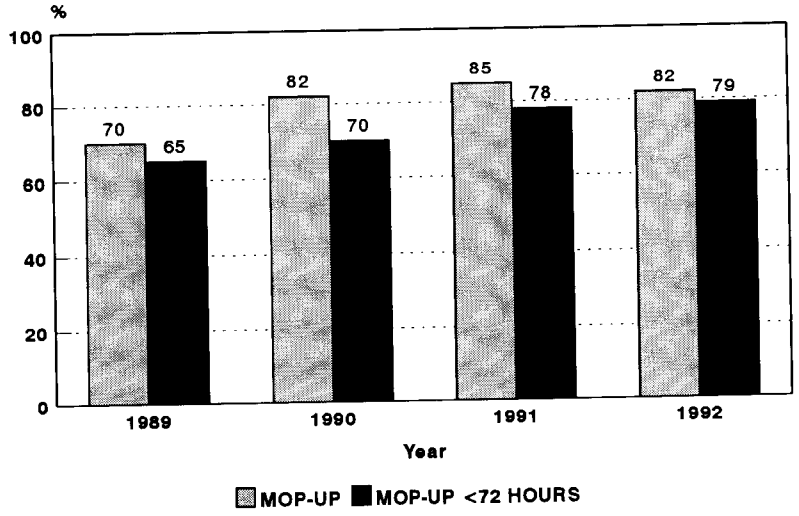
APPENDIX Q (cont'd)

PERCENTAGE OF AFP CASES INVESTIGATED WITHIN 48 HOURS OF REPORT, FICTICIA, 1988 - 1992



Source: Ministry of Health

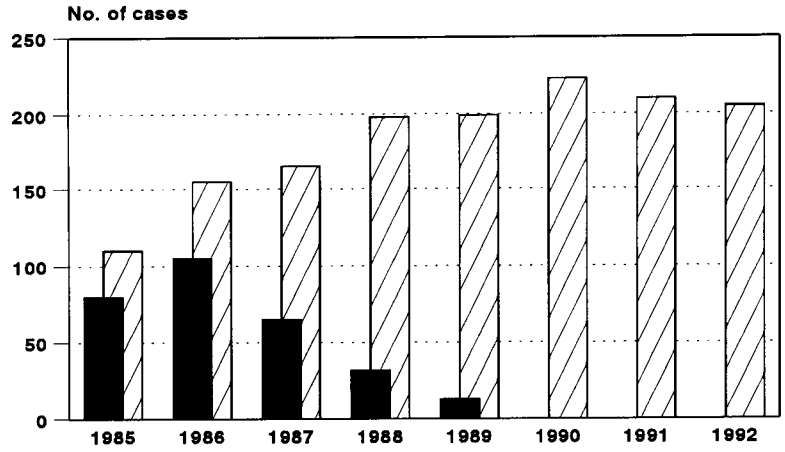
% AFP WITH MOP-UP (CONTROL MEASURES) AND WITH MOP-UP WITHIN 72 HOURS OF REPORT, FICTICIA, 1988 - 1992



Source: Ministry of Health

APPENDIX Q (cont'd)

POLIO -- REPORTED AND CONFIRMED CASES, FICTICIA, 1985 - 1992

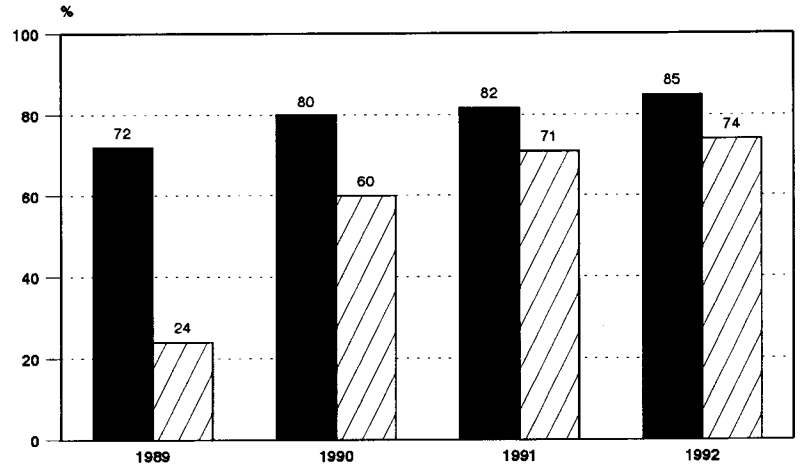


	1985	1986	1987	1988	1989	1990	1991	1992
CONFIRMED	80	105	65	32	13	0	0	0
REPORTED	110	155	165	198	199	223	210	205

■CONFIRMED ▨REPORTED

No. of compatible cases: 1990, 5; 1991, 3; 1992, 1
Source: Ministry of Health

PERCENTAGE OF AFP CASES WITH STOOL SAMPLES COLLECTED, BY NUMBER OF SAMPLES, FICTICIA, 1988 - 1992

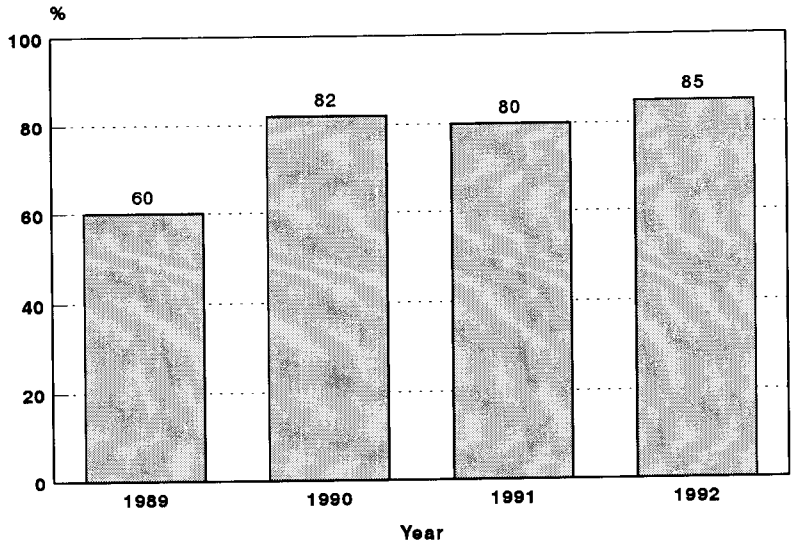


■2 or more samples ▨2 adequate samples

Adequate samples are samples taken within 14 days of onset of paralysis and transported with adequate refrigeration.
Source: Ministry of Health

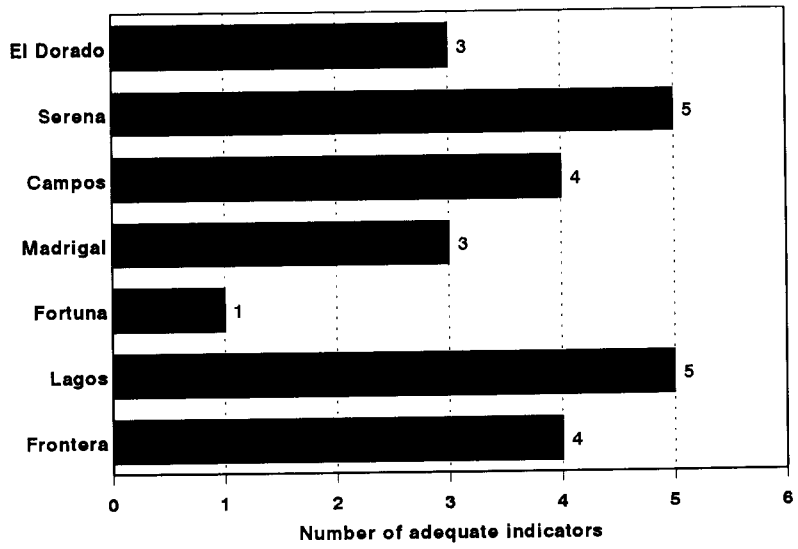
APPENDIX Q (cont'd)

PERCENTAGE OF AFP WITH FOLLOW-UP WITHIN 70 DAYS OF ONSET OF PARALYSIS, FICTITIA, 1989 - 1992



Source: Ministry of Health

NUMBER OF SURVEILLANCE INDICATORS FOR AFP MEETING CERTIFICATION CRITERIA, BY STATE, FICTICIA, 1992



Source: Ministry of Health

APPENDIX R

SELECTED KEY SURVEILLANCE INDICATORS

COUNTRY _____

CRITERIA	YEAR		
	1991	1992	1993
% OF SURVEILLANCE UNITS WHICH NOTIFY WEEKLY			
RATE OF REPORTED ACUTE FLACCID PARALYSIS (AFP) PER 100,000 POPULATION <15 YEARS OF AGE			
% OF AFP CASES WITH INTERVAL BETWEEN ONSET OF PARALYSIS AND NOTIFICATION <15 DAYS			
% OF AFP CASES WITH CONTROL ACTIVITIES CARRIED OUT			
% OF AFP CASES WITH TIME BETWEEN NOTIFICATION AND START OF MOP-UP <72 HOURS			
% OF AFP CASES WITH 2 STOOL SAMPLES COLLECTED WITHIN 15 DAYS OF ONSET OF PARALYSIS			
% OF AFP CASES WITH 5 CONTACT STOOLS COLLECTED			
% OF LABORATORY RESULTS RECEIVED <43 DAYS			
% OF AFP CASES WITH ENTEROVIRUSES ISOLATED			
% OF AFP CASES WITH A FOLLOW-UP VISIT AT 70 DAYS AFTER DATE OF ONSET			
% OF AFP CASES WITH KEY CLINICAL DATA RECORDED (Date Onset of Paralysis; Days Paralysis Developed; Fever at Onset of Paralysis; Residual at 60 Days; Location of Paralysis, Proximal or Distal; and Final DX)			