

# Poliomyelitis in Oman: acute flaccid paralysis surveillance leading to early detection and rapid response to a type 3 outbreak

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*Countries are increasingly requesting guidance on carrying out acute flaccid paralysis (AFP) surveillance, aimed at detecting and confirming all cases of acute paralytic poliomyelitis. The experience of Oman provides many lessons in this respect. AFP surveillance in Oman was established systematically. First, an epidemiologist was assigned to coordinate surveillance, and a laboratory for performing poliovirus isolation was identified. Next, operational guidelines for AFP surveillance were developed and widely promoted among health staff. The quality of the system has been monitored for more than 3 years with selected performance indicators.*

*From January 1990 to April 1993, 49 AFP cases were reported, corresponding to an average annual rate of 2.1 AFP cases per 100 000 children aged less than 15 years. A total of 98% of the AFP cases were investigated within 48 hours of being reported; two stool samples were obtained from 94% of the cases. Following complete investigation, nearly a third of the reported AFP cases were classified as being clinically compatible with Guillain-Barré syndrome. Four AFP cases, all reported in 1991, were confirmed to be due to wild type 3 poliovirus. Because AFP surveillance detected these cases rapidly, Oman was able to carry out outbreak control measures promptly and more than 350 000 extra doses of oral poliovirus vaccine were delivered to children under 6 years of age.*

## Introduction

The Expanded Programme on Immunization (EPI) in Oman was started in 1981. A primary series of three doses of trivalent oral poliovirus vaccine (OPV) was recommended at 3, 5, and 7 months of age, with a booster at 19 months. Coverage of children by their first birthday with three doses of OPV (OPV3) reached 67% in 1985 and 83% by the end of 1987. Based on routine reporting through a passive surveillance system, the incidence of poliomyelitis and the other EPI target diseases declined considerably during this period (Fig. 1).

From January 1988 to March 1989, a widespread outbreak of paralytic poliomyelitis due to wild type 1 poliovirus occurred in Oman. Based on an active search, 118 cases were identified (1). Following confirmation that the outbreak was due to wild poliovirus, mass immunization campaigns were conducted from October to December 1988 to provide an extra dose of OPV to all children in the country aged less than 18 years. After the 1988–89 outbreak, the immunization schedule in Oman was modified to include five primary doses of OPV—at birth, 40 days, and 3, 5, and 7 months of age; and three booster doses—at 19 months, on entering primary school (6 years), and on leaving secondary school (17 years). Since mid-1990, coverage with five doses of OPV has been 95% or higher among children by their first birthday (Fig. 1).

Another change following the 1988–89 outbreak was the development of a more intensive system of surveillance for acute flaccid paralysis (AFP), with immediate case reporting and rapid investigation to rule out or confirm the diagnosis of acute poliomyelitis. This article reports on the establishment of the enhanced surveillance system and data collected using it from January 1990 to April 1993. Discussed is how linking surveillance to action led to early response to a type 3 poliomyelitis outbreak in 1991.

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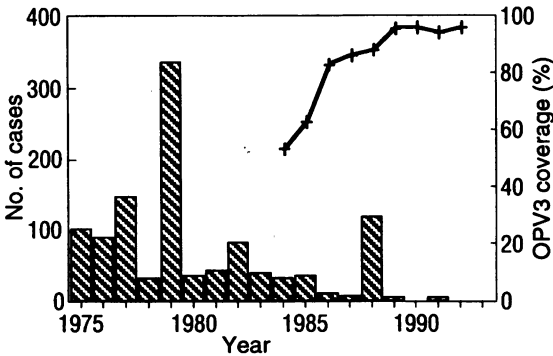
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Fig. 1. Annual reported number of cases of poliomyelitis and coverage with three doses of oral poliovirus vaccine (OPV3), Oman, 1975–92 (from 1990, coverage is for 5 doses of OPV).



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## Materials and methods

### Case definitions

Improvements in the surveillance system in Oman are based on recommendations made by EPI.<sup>a</sup> In 1990, the Ministry of Health adopted the following standard definitions.

- Suspected poliomyelitis—any case of AFP, including Guillain-Barré syndrome, in a person under 15 years of age.
- Probable poliomyelitis—any suspected case for which an alternative diagnosis is not found following clinical and epidemiological investigation.
- Confirmed poliomyelitis—any probable case from which poliovirus is isolated. The final determination of status “confirmed” is the responsibility of an expert committee composed of paediatricians, a paediatric neurologist, an epidemiologist, and a virologist.

### Operational guidelines

Operational guidelines were specified for the enhanced surveillance system. Telephone or facsimile reporting is required within 24 hours for any case of AFP in a person younger than 15 years of age seen at a health facility. Each AFP patient is reported simultaneously to the national, regional, and district levels. A clinical and epidemiological investigation of the AFP patient must be completed by a consult-

ant paediatrician and an epidemiologist within 48 hours of the report. If the AFP patient is determined to have probable poliomyelitis during the initial investigation, control measures are instituted within 72 hours. These measures include delivery of an extra dose of OPV to all children aged less than 6 years in the immediate neighbourhood or village of the AFP patient, with delivery of a second dose of OPV one month later. If virus isolation studies indicate that one or more stools of the AFP patient contain poliovirus, control measures are extended to all children under 6 years of age in the region.

Negative reporting is required monthly, e.g., each hospital and health facility must report the presence or absence of AFP cases to the regional and national levels. In March 1993, negative reporting became a weekly requirement for 20 sentinel sites at regional and referral hospitals.

A communicable disease epidemiologist at the national level is responsible for coordinating AFP surveillance activities with regional public health staff, reporting physicians, and the national poliomyelitis laboratory. The epidemiologist maintains the national listing of AFP patients, which is updated daily with details on case investigations, laboratory findings, and control measures.

### Laboratory aspects

The operational guidelines call for the collection of at least two stool specimens from each AFP patient. Since December 1991, stool specimens have been collected also from at least five contacts of each AFP patient, preferably children aged less than 6 years. Special specimen carriers, which maintain a temperature of 0–8 °C for up to 72 hours when filled with ice-packs, are used to transport specimens to the laboratory.

A national laboratory for poliovirus isolation was established at Sultan Qaboos University Hospital. The laboratory isolates virus on Vero and HEp-2 cell lines using standard methods.<sup>b</sup> Typing of polioviruses is performed using type-specific antisera obtained from Istituto Immunologico, Italy. Temperature-sensitivity criteria are used to classify poliovirus isolates as wild or vaccine related (2). Poliovirus isolates are sent to the Centers for Disease Control and Prevention (CDC), Atlanta, GA, USA, for confirmation and characterization by genomic sequencing studies and DNA-probe hybridization (3).

<sup>a</sup> Expanded Programme in Immunization. *Manual for immunization programme managers on activities related to polio eradication*. Unpublished document, WHO/EPI/POLIO/89.1, 1989.

<sup>b</sup> Expanded Programme on Immunization/Division of Communicable Diseases. *Manual for the virological investigation of poliomyelitis*. Unpublished document, WHO/EPI/CDS/POLIO/90.1, 1990.

**Training staff**

The Ministry of Health implemented AFP surveillance at all levels of the national health care system. The case definitions for poliomyelitis were widely disseminated. Guidelines for AFP surveillance were included in the national EPI manual.<sup>c</sup> A flow chart on AFP reporting and case investigation was prepared as a wall-poster in Arabic and English (Fig. 2). Copies of the EPI manual and the AFP poster were delivered to all government hospitals, health facilities, and private clinics. Training on AFP surveillance was provided to health care staff through the

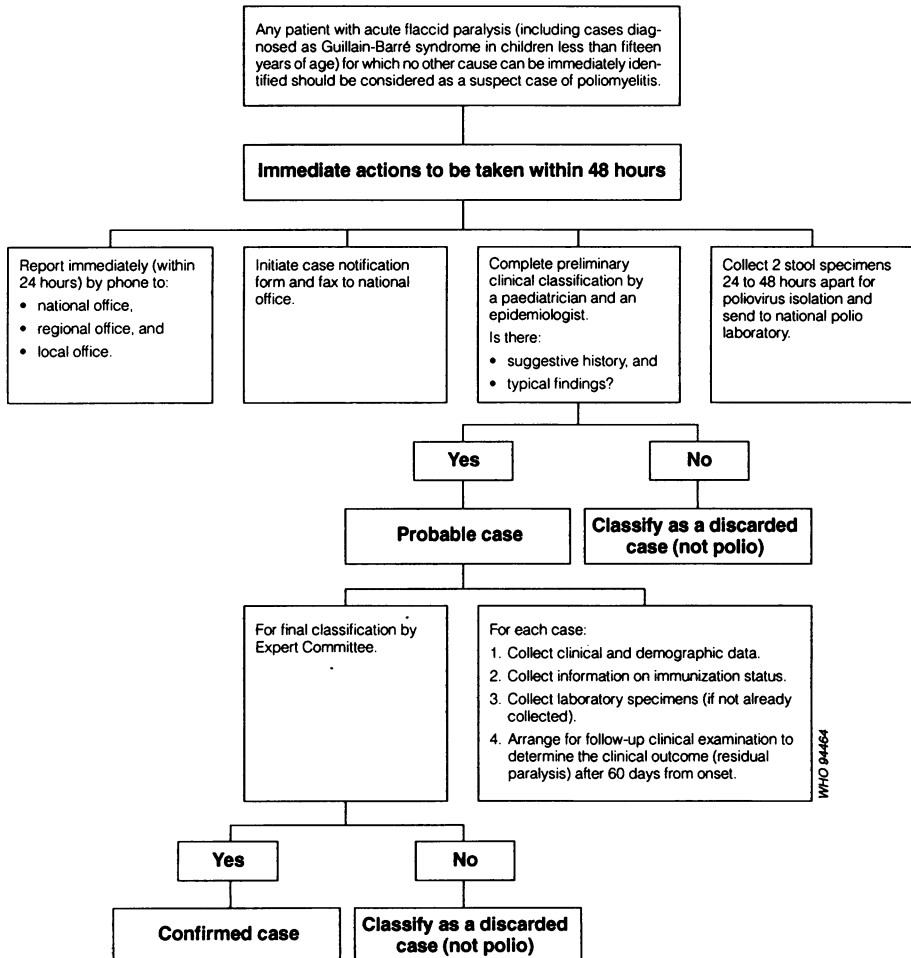
country, including physicians, nurses, and paramedical workers.

**Providing feedback**

The introduction of AFP surveillance occurred at a time when the Ministry of Health was improving surveillance for all communicable diseases. The chief of paediatrics at the national level targeted AFP surveillance as a priority for paediatricians. The national epidemiologist worked to establish personal lines of communication with hospital-based physicians, who were considered the most likely to report AFP cases. To provide feedback, updates on the AFP surveillance system were presented at the annual continuing medical education seminar for maternal and child health staff and at the annual meeting of

<sup>c</sup> Ministry of Health, Oman. EPI manual. Unpublished document, 1991.

Fig. 2. Poster on acute flaccid paralysis used in Oman (simplified version).



private sector physicians. Since 1992, further feedback has been provided by a quarterly communicable disease surveillance newsletter, which is distributed to all public and private health facilities.

### Monitoring performance

The quality of the surveillance system was monitored using poliomyelitis surveillance indicators adapted from the Region of the Americas (4). The key indicator is achievement of a detection rate of at least one AFP case per 100 000 children aged less than 15 years. The following surveillance indicators were also used in Oman: percentage of AFP cases seen within 7 days after onset of paralysis; percentage of AFP cases investigated within 48 hours of report; and percentage of AFP cases from whom two stool samples were obtained.

## Results

### Surveillance reports

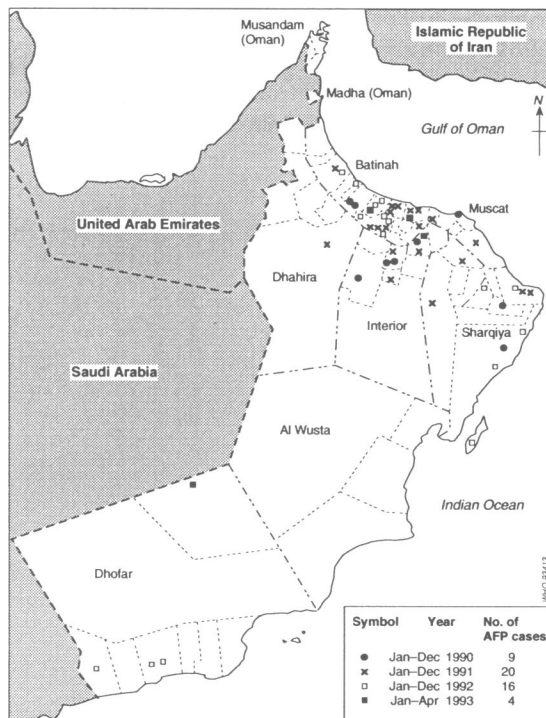
From January 1990 to April 1993, a total of 49 AFP cases were reported in Oman, as follows: 9, 20 and 16 cases for 1990, 1991, and 1992, respectively. From January to April 1993, four AFP cases were reported. For 1990, 1991, 1992, and 1993, respectively, the annual rate was 1.3, 2.8, 1.6, and 1.8 AFP cases per 100 000 children aged less than 15 years. Over the period January 1990 to April 1993, the average annual rate was 2.1 per 100 000 children aged less than 15 years.

Of these 49 AFP cases, 43 (88%) were 0–4 years of age and six (12%) were 5–14 years of age. For children under 5 years of age, four were aged <1 year; 17 were aged 1 year; 13 were aged 2 years; seven were aged 3 years, and two were aged 4 years.

The geographical distribution of AFP cases is shown in Fig. 3. A total of 37% of the patients came from villages with populations less than 1000, 43% were from villages of 1000–9999 persons, and the remaining 20% came from urban areas with populations of  $\geq 10\,000$ . This parallels the general population distribution in Oman. AFP cases were reported from six of the eight regions in the country. The two regions that did not report cases are exceptional: Al Wusta Region is a sparsely populated arid zone with only 5000 children under 15 years of age; and Musandum Region is physically separated from the rest of the country by the United Arab Emirates. For the six regions that did report AFP cases, the average annual incidence ranged from 0.5 to 3.3 per 100 000 (Table 1).

A total of 82% of AFP patients were reported within 7 days of onset of paralysis, 14% by 8–14

Fig. 3. Geographical distribution of reported cases of acute flaccid paralysis among under-15-year-olds, Oman, January 1990 to April 1993.



days of onset, and 4% by 15–21 days of onset. The proportion of the AFP cases that had been investigated within 48 hours of being reported was 98%. Two stool samples were taken from 46 (94%) of the AFP patients; three patients for whom stool specimens were not obtained had clear alternative diagnoses for their flaccid paralysis (trauma).

Table 1: Notification of acute flaccid paralysis (AFP) cases by region, Oman, January 1990 to April 1993

Region	No. of AFP cases	Population aged <15 years	Average annual rate <sup>a</sup>
Batinah	22	200 700	3.3
Sharqiya	11	100 470	3.3
Interior	8	91 350	2.6
Dhofar	4	79 960	1.5
Muscat	3	163 000	0.6
Dhahira	1	63 000	0.5
Al Wusta	0	5 000	0.0
Musandum	0	10 800	0.0
Total	49	714 280	2.1

<sup>a</sup> No. of AFP cases per 100 000 children aged under 15 years.

The differential diagnosis of the 49 AFP cases reported from January 1990 to April 1993 is shown in Table 2. Guillain-Barré syndrome was the commonest diagnosis (15 cases, 31%) followed by poliomyelitis-like illness with no poliovirus isolated from stools (7 cases, 14%); for six of the latter patients, all symptoms had resolved by 60 days after onset. Four cases (8%) were confirmed as being due to wild type 3 poliovirus.

### Laboratory findings

From January 1990 to April 1993, the designated laboratory examined a total of 118 stools from 46 AFP patients (average, 2.6 stool specimens per patient); and from December 1991 to April 1993, a total of 176 stools from contacts of AFP patients (average, 8 contact stool specimens per patient) were examined. The results of virus isolation studies were provided by Sultan Qaboos University Hospital within 3 weeks. For AFP cases, poliovirus was isolated in the stools of five patients, non-polio enterovirus in one patient, and adenovirus in one patient (Table 3). For the contacts of AFP cases, no polioviruses were isolated from stool specimens, non-polio enterovirus was isolated from one specimen, and adenovirus from two specimens.

The five poliovirus isolates were determined to be type 3 and classified by Sultan Qaboos University

Table 2: Differential diagnosis of children under 15 years of age reported to have acute flaccid paralysis, Oman, January 1990 to April 1993

Final diagnosis	n
Guillain-Barré syndrome	15 (31) <sup>a</sup>
Poliomyelitis-like illness, no poliovirus isolated	7 (14)
Post-traumatic paresis	5 (10)
Poliomyelitis	4 (8)
Hypokalaemia secondary to acute gastroenteritis	4 (8)
Myositis	3 (6)
Transient synovitis of hip	3 (6)
No paralysis	3 (6)
Acute infantile hemiplegia	1 (2)
Cerebral malaria	1 (2)
Encephalitis	1 (2)
Post-infection cerebellar syndrome	1 (2)
Transient weakness of upper limb	1 (2)
Total	49

<sup>a</sup> Figures in parentheses are percentages.

Table 3: Virus isolations at Sultan Qaboos University Hospital: stools from acute flaccid paralysis (AFP) patients (January 1990 to April 1993) and stools from contacts of AFP cases (December 1991 to April 1993)

Isolation results	AFP cases	Contacts
Poliovirus	5 <sup>a</sup>	0
Non-polio enterovirus	1	1
Adenovirus	1	2
No virus	39	173
Total	46	176

<sup>a</sup> One isolate initially identified as a poliovirus was subsequently determined to be a non-polio enterovirus.

Hospital laboratory as wild strains, based on temperature marker studies. Subsequent testing at CDC, Atlanta, GA, determined that four of the isolates were wild type 3 poliovirus, while the fifth isolate was a non-polio enterovirus (3).

### Type 3 polio outbreak, 1991

For the four AFP cases confirmed as being due to wild poliovirus type 3, additional information is available. The first two cases (aged 3 years and 4 years) had onset of paralysis on 28 March and 2 April 1991 and lived in nearby villages in Batinah Region. The patient with onset in March had an IgA immunodeficiency. The third and fourth cases involved 2-year-olds: in August 1991 one case occurred in Interior Region; and in October 1991 one case occurred in Sharqiya Region.

Of the four patients with confirmed poliomyelitis, two had received four doses of OPV, one had received five doses, and one had received six doses. At 60 days following onset, the four-dose and five-dose patients still had neurological deficits, but paralysis had resolved in the six-dose patient.

### Outbreak control

Seventeen (35%) of the 49 AFP cases were classified as probable poliomyelitis. Within 72 hours after classification as a probable case, mass immunization with an extra dose of OPV was initiated, with a target of covering all children under 6 years of age in the patient's village or neighbourhood. A second round of OPV immunization was conducted one month later in the same area.

When poliovirus was isolated from the stools of a probable poliomyelitis case, mass campaigns were initiated regionwide to deliver two extra doses of OPV one month apart to children under 6 years of age. From April to December 1991 mass campaigns were carried out in five of the eight regions of the country; altogether, 366 000 supplemental OPV

doses were given. Other outbreak control measures included a moratorium for 60 days on all elective surgical procedures, unnecessary injections, and vaccinations.

## Discussion

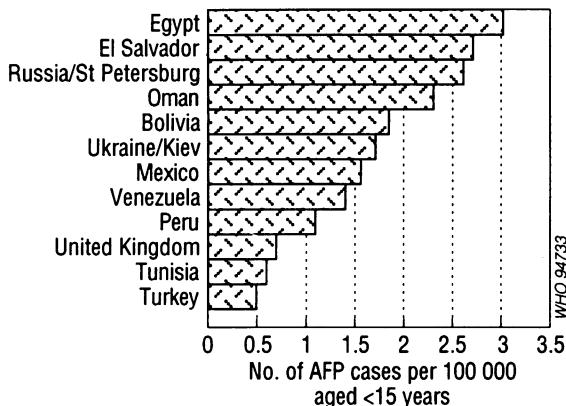
In most countries, communicable disease surveillance is based on routine reports. As immunization programmes have matured worldwide, routine reporting of vaccine-preventable diseases has been extended to cover all geographical areas of countries and all population groups. However, routine reporting has generally remained a passive activity with high levels of underreporting. In 1988 WHO Member States voted to establish the target of global eradication of poliomyelitis by the year 2000 (5). To eradicate the disease, all cases must be detected and investigated. Therefore, the global poliomyelitis eradication initiative has placed emphasis on methods for developing high quality, highly sensitive surveillance.

The present article describes one country's experience in developing surveillance aimed at detecting and investigating every AFP case involving an under-15-year-old, with the ultimate goal of detecting every case of acute paralytic poliomyelitis. The training and infrastructure developed for AFP surveillance can be expanded to other diseases that require highly sensitive surveillance, case investigation, or rapid institution of control measures.

Other countries are now requesting guidance on the details of carrying out AFP surveillance. The efforts of Oman to establish AFP surveillance were systematic. First, a communicable disease epidemiologist was assigned to coordinate the system, operational guidelines were developed, and a laboratory for performing poliovirus isolation was identified. Then, the system was presented to staff at all levels of the health delivery system and their cooperation solicited. Reinforcement of the operational guidelines was provided by the EPI manual, an AFP surveillance poster, telephone feedback to reporting physicians, and feedback to health care staff in a quarterly communicable disease surveillance newsletter. Finally, the quality of the system was monitored using performance indicators.

The annual AFP rates in Oman are comparable to those in both developing and developed countries in different regions of the world (Fig. 4). Experience from the Region of the Americas suggests that a detection rate of one AFP case per 100 000 children aged <15 years is indicative of good surveillance (4, 6). Countries initiating AFP surveillance have usually taken several years to achieve such a rate or high-

Fig. 4. Incidence of acute flaccid paralysis (AFP) among under-15-year-olds, 1992 (based on data reported to WHO by November 1993). Data for the United Kingdom are from a special study.



er. In contrast, from the first year, Oman has consistently achieved an annual detection rate of more than one AFP case per 100 000 children aged <15 years, with reporting and investigation almost always completed within the specified times. This probably is a consequence of the nationwide poliomyelitis outbreak in 1988–89, which increased awareness among health staff about the need for improved disease surveillance. Nevertheless, the rate of AFP in Oman varies by geographical region, and these differences have been used to identify regions with low rates and target efforts to improve reporting. The highest average annual rates in Oman occurred in the regions that reported the greatest number of cases in the 1988–89 epidemic.

To eradicate wild poliovirus, a highly sensitive screening mechanism is critical, e.g., screening for AFP should detect as close to 100% of confirmed poliomyelitis cases as possible. Analysis of data from the Region of the Americas indicates that surveillance for AFP among under-15-year-olds was 100% sensitive, whereas restricting the surveillance age group to under-6-year-olds was 75% sensitive in detecting confirmed poliomyelitis (6). For some countries, restricting AFP surveillance to under-6-year-olds provides a practical way of rationing limited resources.

The etiologies of AFP vary from country to country, in part depending on the prevalence of different infectious diseases. In most countries where poliomyelitis is highly endemic, acute poliomyelitis will probably constitute the majority of AFP cases, as has been reported in Egypt (7) and India.<sup>d</sup> Once poliomyelitis is controlled, Guillain-Barré syndrome is likely to account for the greatest proportion of

AFP cases (4, 8–10).<sup>d</sup> In Oman, Guillain-Barré syndrome accounted for nearly one-third of all AFP cases. From January 1990 to April 1993, the annual rate of the syndrome in Oman was 0.63 per 100 000 children under 15 years of age.

In Oman, non-polio enteroviruses were isolated from the stools of two patients with poliomyelitis-like symptoms; however, these viruses were not further characterized. Previous studies have shown that infection with certain non-polio enteroviruses (coxsackieviruses, echoviruses, and enteroviruses 70 and 71) can cause paralytic disease clinically indistinguishable from that caused by poliovirus (2).

A recent meeting sponsored by WHO and the Association Internationale pour la Recherche et l'Enseignement en Neurosciences (AIREN) reviewed the various disorders that produce AFP. The range of causes seen in Oman is typical. Other causes of AFP include the following: toxic neuritis from organophosphate pesticides, heavy metals, and several pharmacological products; Chinese paralytic syndrome; and neuropathies in the course of infectious diseases such as diphtheria, Lyme borreliosis, and rabies.<sup>d</sup> Much work remains to be done in delineating the causes of AFP and in developing surveillance systems that will provide a clearer picture of their epidemiology.

According to performance indicators, Oman has established an AFP surveillance system that is highly sensitive for detecting confirmed poliomyelitis. In recognition of this achievement, two workshops on AFP surveillance have been conducted in Oman for national immunization programme managers from other countries. Performance indicators for disease surveillance are being promoted globally and regionally to monitor the completeness, timeliness, and accuracy of disease reporting, and the quality of laboratory support services. In the WHO Eastern Mediterranean Region, AFP surveillance indicators are now being used routinely in Bahrain, Egypt, Islamic Republic of Iran, Oman, Pakistan, and Tunisia (7).

For Oman, the development of AFP surveillance was timely. When wild poliovirus led to paralytic cases in 1991, it was detected promptly, with laboratory analysis available within 3 weeks of onset of disease in the first patient. Moreover, AFP surveillance was linked to immediate action, according to a written plan, i.e., control measures were initiated in the village or neighbourhood within 72 hours of

detection (or onset) of an AFP case. Following rapid laboratory confirmation, regional mass immunization was underway in less than a month. This compares with the 1988–89 poliomyelitis outbreak, where control activities were not implemented until 10 months after the first cases. In all, the 1991 outbreak persisted for 7 months with only four cases of poliomyelitis, compared with the 1988–89 outbreak which persisted for 15 months with 118 cases. Several changes in Oman may have contributed to this marked difference, including an increase in the number of OPV doses routinely delivered to infants, implementation of active surveillance for acute flaccid paralysis, and development of the capacity to initiate outbreak control measures with great speed.

### Acknowledgements

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### Résumé

#### **Poliomyélite en Oman: détection précoce et réponse rapide lors d'une épidémie de poliomyélite de type 3 grâce à la surveillance de la paralysie flasque aiguë**

De plus en plus, les pays demandent des conseils sur les modalités d'une surveillance de la paralysie flasque aiguë (PFA), un système de surveillance renforcée destiné à détecter et confirmer tous les cas de poliomyélite paralytique aiguë. L'expérience de l'Oman, qui a mis en place un tel système sur une période de trois ans, est riche d'enseignements. En premier lieu, un épidémiologiste en maladies transmissibles a été désigné pour coordonner le système de surveillance renforcée, et un laboratoire chargé de l'isolement des poliovirus au niveau national a été établi. Ensuite, des directives pratiques pour la surveillance de la paralysie flasque aiguë, comportant des définitions de cas, ont été préparées et présentées aux personnels de tous les niveaux du système de santé. Ces directives ont été renforcées par la diffusion large du manuel national du PEV, d'affiches sur la surveillance de la PFA et d'un bulletin trimestriel sur la surveillance des maladies transmissibles. La qualité du système a été surveillée au moyen d'indicateurs.

<sup>d</sup> Division of Mental Health, Expanded Programme on Immunization, AIREN. *Acute onset flaccid paralysis*. Unpublished document, WHO/MNH/EPI/93.3, 1993.

De janvier 1990 à avril 1993, 49 cas de PFA ont été notifiés en Oman. L'incidence moyenne annuelle était de 2,1 cas pour 100 000 enfants de moins de 15 ans. Sur les 49 cas notifiés, 43 (88%) concernaient des enfants de 0 à 4 ans et 6 (12%) des enfants de 5 à 14 ans; 98% de ces cas ont été vus par un pédiatre et un épidémiologiste dans les 48 heures suivant la notification. Deux échantillons de selles ont été recueillis chez 46 (94%) des cas de PFA; les trois sujets restants avaient un diagnostic manifestement non poliomyélique. Après investigation complète, 15 cas de PFA (31%) ont été classés comme cliniquement compatibles avec un syndrome de Guillain-Barré. Le deuxième diagnostic par ordre de fréquence, posé chez 7 sujets (14%) était une affection de type poliomyélique, mais sans isolement de poliovirus; chez 6 de ces sujets, les symptômes ont disparu spontanément dans les 60 jours suivant le début de la maladie. Quatre cas de PFA, tous notifiés en 1991, ont été confirmés comme cas de poliomyélite due au virus sauvage de type 3. Grâce à la détection rapide de ces cas par le système de surveillance de la PFA, l'Oman a pu mettre en œuvre rapidement des mesures de lutte contre l'épidémie et délivrer plus de 350 000 doses supplémentaires de vaccin antipoliomyélique oral aux enfants de moins de 6 ans.

La plupart des pays qui ont mis en place un système de surveillance de la PFA ont mis plusieurs années avant de détecter des incidences égales ou supérieures à 1 cas pour 100 000. L'Oman a dès la première année régulièrement obtenu un taux annuel de détection de plus de 1 cas de PFA pour 100 000 enfants de moins de 15 ans. Ce résultat vient probablement de ce que le personnel de santé était déjà sensibilisé à la nécessité d'améliorer la surveillance, après l'épidémie de poliomyélite de type 1 qui a frappé l'ensemble du pays en 1988-1989. Néanmoins, les taux régionaux de notification de la PFA sont variables; cette variabilité est utilisée pour améliorer le processus de notification, comme cela a été fait dans la Région des Amériques. La liaison entre la détection des cas et le contrôle des épi-

démies est l'un des éléments-clés du système de surveillance de la PFA. En Oman, la détection et l'endiguement rapides d'une flambée de poliomyélite de type 3 en 1991 montre l'excellence de la liaison entre la surveillance et la lutte contre la maladie, cette dernière activité relevant de plus en plus des programmes nationaux de vaccination.

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