Poliomyelitis surveillance in Shandong Province, China, 1990–92

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In Shandong Province, China, programmes were initiated in 1991 for mass immunization against poliomyelitis and for the immediate reporting of acute flaccid paralysis (AFP). The incidence of non-poliomyelitis AFP was found to be 0.46–0.61 cases per 100 000 children per annum. It appeared that illness resembling the Guillain–Barré syndrome was underreported. The incidence of such illness peaked among children aged 2–3 years. Although laboratory investigations have improved, in 1992 they were still inadequate in nearly a third of confirmed poliomyelitis cases. As the prevalence of wild poliovirus declines in China, reliable laboratory support needs to be established and adequately sensitive and specific AFP surveillance be developed if poliomyelitis is to be eradicated.

Introduction

In China, poliomyelitis was well controlled until the mid-1980s by the development of immunization services supported by the Expanded Programme on Immunization (EPI).[a, b] However, in 1988, outbreaks occurred in the provinces on the east coast of the country, and nationwide outbreaks followed in 1989 and 1990. Shandong Province reported 200–500 cases annually over the period 1988–90, and approximately 5000 cases were reported nationally in each of 1989 and 1990. The epidemiological characteristics of the outbreaks in Shandong Province have been described previously (*1*).

Through supplementary immunization activities and nationwide efforts, the numbers of poliomyelitis cases have been steadily reduced in many provinces. In Shandong Province, mass campaigns were launched in January 1991 to immunize as many under-4-year-olds as possible with oral poliovirus vaccine (OPV). As a prerequisite for evaluating the interruption of wild poliovirus transmission the quality of poliomyelitis surveillance itself had to be thoroughly reviewed.

The poliomyelitis surveillance programme in Shandong Province included the immediate reporting of cases of acute flaccid paralysis (AFP), case studies involving laboratory investigation, and the monitoring of surveillance indicators (*1*). We describe here the recent status of poliomyelitis eradication in the province, with particular reference to AFP surveillance and laboratory investigations.

Methods

Until 1990, confirmation of poliomyelitis cases in China was based on a case definition prepared by the Ministry of Public Health in accordance with the original WHO definition.[c] Most cases lacked laboratory confirmation because stool specimens were unavailable; poliomyelitis was considered to be confirmed if any residual neurological sequelae were present 60 or more days after their onset. From 1991 onwards, a specific diagnosis was given in cases of non-poliomyelitis AFP after examination by a neurologist.

Before early 1991, when the system for the immediate reporting of AFP was introduced, no independent channel for the notification of poliomyelitis existed in Shandong Province: poliomyelitis

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[a] *EPI overview: China.* Manila, WHO Regional Office for the Western Pacific, unpublished document EPI/POLIO, 1989.

[b] *EPI Global Advisory Group meeting: regional overview of poliomyelitis eradication in the Western Pacific Region.* Manila, WHO Regional Office for the Western Pacific, unpublished document, 1989.

[c] *Manual for immunization programme managers on activities related to polio eradication.* Unpublished WHO document 1989.

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reporting was undertaken as part of the general surveillance activities for communicable diseases. AFP reporting aimed to detect all cases of sudden-onset flaccid paralysis except those caused by injury or other immediately identifiable factors. Local epidemic prevention stations were requested to initiate case investigations within 24 hours of notification. If flaccid paralysis occurred, the stations immediately reported the cases to the central level and began to collect specimens for laboratory investigations. Some essential components of this action have been monitored using previously described indicators (*1*).

Statistics for the estimation of the baseline levels of AFP incidence in children were not available in Shandong prior to 1991. In 1992, in order to obtain information on the types and incidence of AFP, a retrospective study was carried out in four general hospitals, a children's hospital, and an infectious diseases hospital in Jinan City, the provincial capital. The staff of the provincial epidemic prevention station reviewed patients' records for 1991 in paediatric departments and other units concerned with childhood infectious diseases or neurology. Since there were few records for some of the AFP cases, because they had only attended outpatient clinics, we attempted to support documented diagnoses either by comparison with records in the provincial epidemic prevention station or by follow-up through the station networks.

In China, only children aged ≤12 years attend paediatric clinics. A survey covering older children would have required much extra work and would probably have yielded very little additional information. Investigations were therefore confined to children aged ≤12 years. The data were analysed using information obtained from the 1990 census.

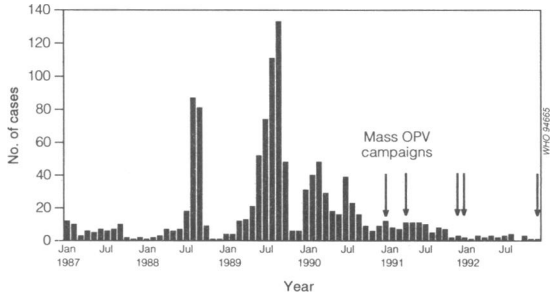
Laboratory investigations were carried out in accordance with the WHO-recommended standard procedures for virus isolation and identification. Polymerase chain reaction/restriction fragment length polymorphism assays were used for intratypic differentiation (*2*). When vaccine poliovirus was cultured, the etiological role of the isolates in paralytic illness was determined after careful evaluation of the OPV immunization history of the patients.

Results

Diagnosis and classification of acute flaccid paralysis

The number of cases of poliomyelitis declined steadily following the introduction of provincial mass immunization campaigns with OPV (Fig. 1). In 1991, 95 cases of poliomyelitis were confirmed among 231 reported cases of AFP; laboratory confirmation was secured in eight cases, whereas 82 cases were confirmed only by residual paralysis; three cases were lost to follow-up and two patients died. In 1992, 130 cases of AFP were reported and poliomyelitis was confirmed in 25 of them; laboratory confirmation was obtained in 11 cases and one patient died.

Fig. 1. **Monthly distribution of poliomyelitis cases, Shandong Province, China, 1987–92.**

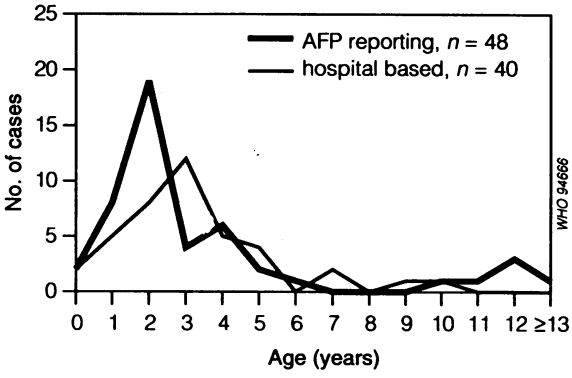


The cases of non-poliomyelitis AFP involved a number of disorders, although 30–40% of subjects presented no neurological abnormality at the follow-up examination (Table 1). Among these disorders, illnesses resembling the Guillain–Barré (GB) syndrome and transverse myelitis emerged as the most frequent causes of paralysis. The incidence of GB-like illness peaked in children aged 2 years (Fig. 2).

Table 1: **Clinical diagnosis of acute flaccid paralysis, Shandong Province, China, 1991–92**

	No. of cases in:	
Clinical diagnosis	1991	1992
Poliomyelitis	95	25
Non-poliomyelitis acute flaccid paralysis		
Illness resembling Guillain–Barré syndrome	23	25
Transverse myelitis	10	29
Encephalitis	2	4
Todd paralysis	1	0
Spinal tuberculosis	1	0
Trauma	1	1
Hemiplegia	1	1
Injection injury	0	3
Brachial plexus paralysis	0	1
Spina bifida	0	1
Myositis	3	3
Muscle disease	1	0
Arthritis	2	0
No residual signs	91	37
Total	231	130

Fig. 2. **Age distribution of cases with Guillain–Barré-like syndrome found in the acute flaccid paralysis (AFP) immediate reporting system and in the hospital-based survey.**



The overall incidences of non-poliomyelitis AFP were 0.61 and 0.46 per 100 000 children aged <15 years in 1991 and 1992, respectively, which is lower than the expected incidence (1 case per 100 000).

Incidence of acute flaccid paralysis

The hospital survey uncovered 80 AFP cases for 1991, of which 63 were non-poliomyelitis AFP. The diagnosis and incidence of the non-poliomyelitis AFP cases are shown in Table 2, broken down by location: the diseases included GB-like illnesses (40 cases, 63%), transverse myelitis (seven cases) and other types of paralysis (16 cases). Most cases of GB-like illness involved children aged 2–4 years, as was observed with the AFP immediate reporting system (Fig. 2). The highest overall incidence was in Jinan (2.1 cases per 100 000 children). The next highest (0.8 cases per 100 000) occurred in the prefectures of Liaocheng and Dezhou, which are contiguous with Jinan. The lower incidences recorded elsewhere possibly arose because a smaller proportion of cases from the more distant prefectures sought treatment in the capital city, artificially depressing the observed rate of AFP.

We found that 35 of the 40 cases of GB-like illness (87%) had been left unreported. All 17 poliomyelitis cases had been registered with the provincial epidemic prevention station. Altogether, 32 of the 80 AFP cases discovered had been reported to the provincial station.

Laboratory investigations

The proportion of AFP cases for which specimens were obtained and the timing of their collection are basic indicators for the evaluation of the laboratory investigations. In 1990, before the initiation of AFP surveillance, specimens were taken in only 12% of cases (35 of 284 poliomyelitis cases); in 1991 and 1992, the proportions increased to 59% (136 of 231 AFP cases) and 74% (96 of 130 AFP cases), respectively. The timing of specimen collection remained unsatisfactory in 1992, since 57% of all specimens were collected more than 2 weeks after the onset of illness.

Table 2: **Distribution of cases of non-poliomyelitis acute flaccid paralysis in 1991 found in the hospital-based survey, Shandong Province, China**

Prefecture or city	Population ≤12 years of age	Disease			
		GB[a]	Transverse myelitis	Other	Total
Jinan	874 107	11 (1.26)[b]	3 (0.34)	5 (0.57)	19 (2.17)
Liaocheng	1 267 441	6 (0.47)	1 (0.08)	3 (0.24)	10 (0.79)
Dezhou	1 001 346	4 (0.40)	1 (0.10)	3 (0.30)	8 (0.80)
Taian	1 191 708	4 (0.34)	1 (0.08)	1 (0.08)	6 (0.50)
Binzhou	824 468	2 (0.24)	1 (0.12)	2 (0.24)	5 (0.61)
Heze	1 599 458	2 (0.13)	0	2 (0.13)	4 (0.25)
Zibo	684 798	4 (0.58)	0	0	4 (0.58)
Jining	1 737 725	3 (0.17)	0	0	3 (0.17)
Weifang	1 628 003	3 (0.18)	0	0	3 (0.18)
Zhaozuang	716 924	1 (0.14)	0	0	1 (0.14)
Total cases		40	7	16	63

[a] Illness resembling Guillain–Barré syndrome.
[b] Figures in parentheses are the annual incidence per 100 000 population aged ≤12 years.

The laboratory investigation of cases confirmed during the period 1990–92 was further analysed (Table 3). Before 1990 no specimens were collected in the majority of cases; since 1991 the situation has improved with the introduction of AFP surveillance, although in 1992 no specimens were collected for 16% of cases.

Both wild and vaccine polioviruses were isolated from a number of cases in 1990, but since surveillance was poor it was not possible to determine whether vaccine poliovirus had an etiological role. In 1991 and 1992 all cases of culture-proven poliomyelitis were caused by vaccine poliovirus.

Because unsuccessful virus isolation might have resulted from delayed specimen collection, groups of poliovirus-negative cases were analysed in terms of the interval between the onset of paralysis and specimen collection. In both 1991 and 1992, in about half of the cases, specimens were taken later than 2 weeks after the onset of illness. Including cases without specimens, 65% (62 out of 95 confirmed cases) lacked appropriate laboratory investigation in 1991; in the following year, 36% of cases were not appropriately investigated.

Several types of non-polio enteroviruses were isolated from some confirmed cases at a relatively early stage of the illness. In the majority of cases, however, no etiological role for the isolates could be determined.

Table 3: **Laboratory investigations of confirmed poliomyelitis cases, Shandong Province, China, 1990–92**

Laboratory diagnosis	No. of confirmed cases in:		
	1990	1991	1992
Specimens not available[a]	249 (87.6)[b]	48 (50.5)	4 (16.0)
Wild poliovirus infection[c]	6 (2.1)	0	0
Vaccine poliovirus infection[d]	8 (2.8)	8 (8.4)	10 (40.0)
No poliovirus cultured from specimens taken on the following days after onset:			
30	4 (1.4)	4 (4.2)	3 (12.0)
15–29	8 (2.8)	10 (10.5)	2 (8.0)
≤14	9 (3.1)	20 (21.0)	5 (20.0)
Suspected non-poliomyelitis enterovirus infection[e]	0	5 (5.2)	1 (4.0)
Total	284	95	25

[a] Includes cases dead or lost to follow-up.
[b] Figures in parentheses are percentages.
[c] Type-1 infection in all cases.
[d] In 1990, one type-1, five type-2 and two type-3 viruses were isolated but their etiological roles were less clearly defined. In 1991, five type-2, two type-3, and one mixture of type-2 and type-3 were included. In 1992, five type-2, four type-3 and one mixture of type-2 and type-3 were included.
[e] Viruses were positive in specimens taken within 14 days after the onset of paralysis.

Discussion

Infections with wild poliovirus have not been detected since 1991 in Shandong Province. However, evaluation of the interruption of wild poliovirus transmission needs precise documentation of the quality of AFP surveillance and laboratory investigation.

The incidence of non-poliomyelitis AFP cases determined in the reporting system was 0.46–0.61 per 100 000 children per annum, which was less than the expected level of 1.0 per 100 000 per annum. The hospital-based survey gave a higher incidence. In areas with ready access to hospital care, especially in the provincial capital, the incidence of AFP was higher than in more remote areas, suggesting that large numbers of AFP cases may not have been reported. Improvement of surveillance requires the cooperation of the hospital sectors where most patients initially attend. Active searching in hospitals at different levels and the establishment of close relations between epidemic prevention stations and hospitals are essential in order that suspected poliomyelitis cases be identified and examined at the local surveillance stations.

Until recently, suspected cases of poliomyelitis in Shandong were often confirmed on the basis that neurological sequelae were present, regardless of the types of paralysis; a similar state of affairs may exist in other provinces. In view of the recent advances towards poliomyelitis eradication in China, the improved specificity of clinical diagnosis as an element of surveillance is emerging as a critical issue.

In this regard, the GB-like illness observed during the surveillance may need further consideration. A disorder of this kind, referred to as "Chinese paralytic syndrome", occurs frequently in children and young adults in Hebei Province (*3*), which shares a border with Shandong. This disorder involves acute motor axonal neuropathy, as indicated by electrophysiological examination. Although we did not carry out detailed studies, our cases seemed to have at least the following clinical characteristics: the illness occurred most frequently among 2–3-year-olds, which corresponds closely to the age group for which poliomyelitis is commonest; the prodromal symptoms usually observed in typical cases of GB syndrome were either lacking or unclear, while in some cases ascending paralysis of the limbs started immediately after episodes of diarrhoea and/or fever. Asymmetric paralysis, somewhat similar to that which occurs in poliomyelitis, was observed in only

one case. The greatest problem with GB-like illness is the persistence of the paralysis. Among the cases covered by the AFP reporting system, at least 20–30% of the subjects continued to have paralysis for more than 2–3 months. Chinese paralytic syndrome may thus present a clinical picture that overlaps with that of poliomyelitis. At the moment, however, the real impact of the disorder on the overall specificity of poliomyelitis surveillance is not known. Further characterization of GB-like illness is required to clarify this issue. Such a study may also be important when prioritization for the screening of the increased number of AFP cases, particularly of Chinese paralytic syndrome, is considered (*4, 5*).

Laboratory investigations ultimately determine the specificity of poliomyelitis surveillance and are, therefore, critical in the evaluation of the interruption of wild poliovirus transmission. In this regard the analysis of confirmed cases is of particular importance. More cases were subjected to laboratory investigation in 1992 than in 1991 or previous years. Although wild poliovirus was not detected during 1991 and 1992, caution is required in the interpretation of the results, since for a significant proportion of cases there were no specimens or only those that had not been collected correctly. The low rate of enterovirus isolation may suggest that further improvements are needed in stool collection and transport as well as in laboratory testing.

The type of analysis we have performed seems to be a useful tool for monitoring the progress of laboratory investigation of poliomyelitis cases, allowing an estimate to be made of the degree to which the transmission of wild poliovirus is being interrupted.

The Pan American Health Organization recently proposed a revised case definition on the basis of the progress that has been made in poliomyelitis eradication in the Americas (*6*). Increased emphasis was laid on the results of reliable laboratory investigations aimed at detecting wild poliovirus, and on the importance of such investigations in enhancing the specificity of poliomyelitis surveillance. The disappearance of wild poliovirus from Shandong Province suggests that laboratory confirmation of all poliomyelitis cases in China is now desirable.

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Résumé

Surveillance de la poliomyélite dans la province de Shandong (Chine) en 1990–1992

Pour combattre les flambées de poliomyélite et éradiquer le virus sauvage, la province de Shandong (Chine) a lancé en janvier 1991 deux programmes importants prévoyant des campagnes provinciales de vaccination de masse et la notification immédiate des cas de paralysie flasque aiguë (PFA). Avec la disparition progressive du poliovirus sauvage, la nécessité d'améliorer la sensibilité et la spécificité de la surveillance de la PFA a pris une importance cruciale. Le système de notification a permis de détecter une incidence de PFA non poliomyélitique de 0,46 à 0,61 cas pour 100 000 enfants par an, alors que le taux mesuré lors d'une enquête indépendante menée dans les hôpitaux était de 0,8 à 2,1 pour 100 000. L'incidence plus faible constatée avec le système de notification de la PFA est probablement due à la sous-notification d'une maladie rappelant le syndrome de Guillain–Barré (GB), très fréquente en Chine du Nord. Cette maladie a une incidence maximale chez les enfants âgés de deux à trois ans. Elle s'accompagne souvent de signes neurologiques qui persistent deux à trois mois ou plus après l'installation de la paralysie. On ne sait pas encore jusqu'à quel point cette maladie aura une influence sur la spécificité générale du programme de surveillance de la poliomyélite. Pour ce qui est des examens en laboratoire, la situation s'est améliorée au cours de l'étude, mais près d'un tiers des cas confirmés en 1992 n'ont pas été étudiés de façon adéquate.

La création de services de laboratoire fiables, allant de pair avec le développement d'un système de surveillance de la PFA suffisamment sensible et spécifique, est d'une importance cruciale pour l'éradication de la poliomyélite en Chine.

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