CHAPTER 25

CERTIFICATION BY INTERNATIONAL COMMISSIONS: 1973–1977

Contents

INTRODUCTION

In the previous chapter we examined in broad terms the process by which the certification of smallpox eradication was undertaken, culminating in the adoption by the World Health Assembly on 8 May 1980 of a resolution declaring that smallpox had been eradicated throughout the world. In the present chapter and the two which follow, this process is examined in more detail. It is evident that the problems that occurred paralleled those encountered during the elimination of smallpox from different countries. In this chapter an account is given of the activities of 9 international commissions which operated before the Consultation on the Worldwide Certification of Smallpox Eradication took place at WHO Headquarters in Geneva in October 1977. These include the 3 commissions which laid the foundation for all the others (see Chapter 24)—namely, those for South America, the first exploratory effort; Indonesia, a much more sophisticated procedure, but still in process of development; and western and central Africa, which set the pattern for the certification of many other countries in Africa and Asia from which smallpox had been eliminated several years earlier. The chapter closes with a brief de-

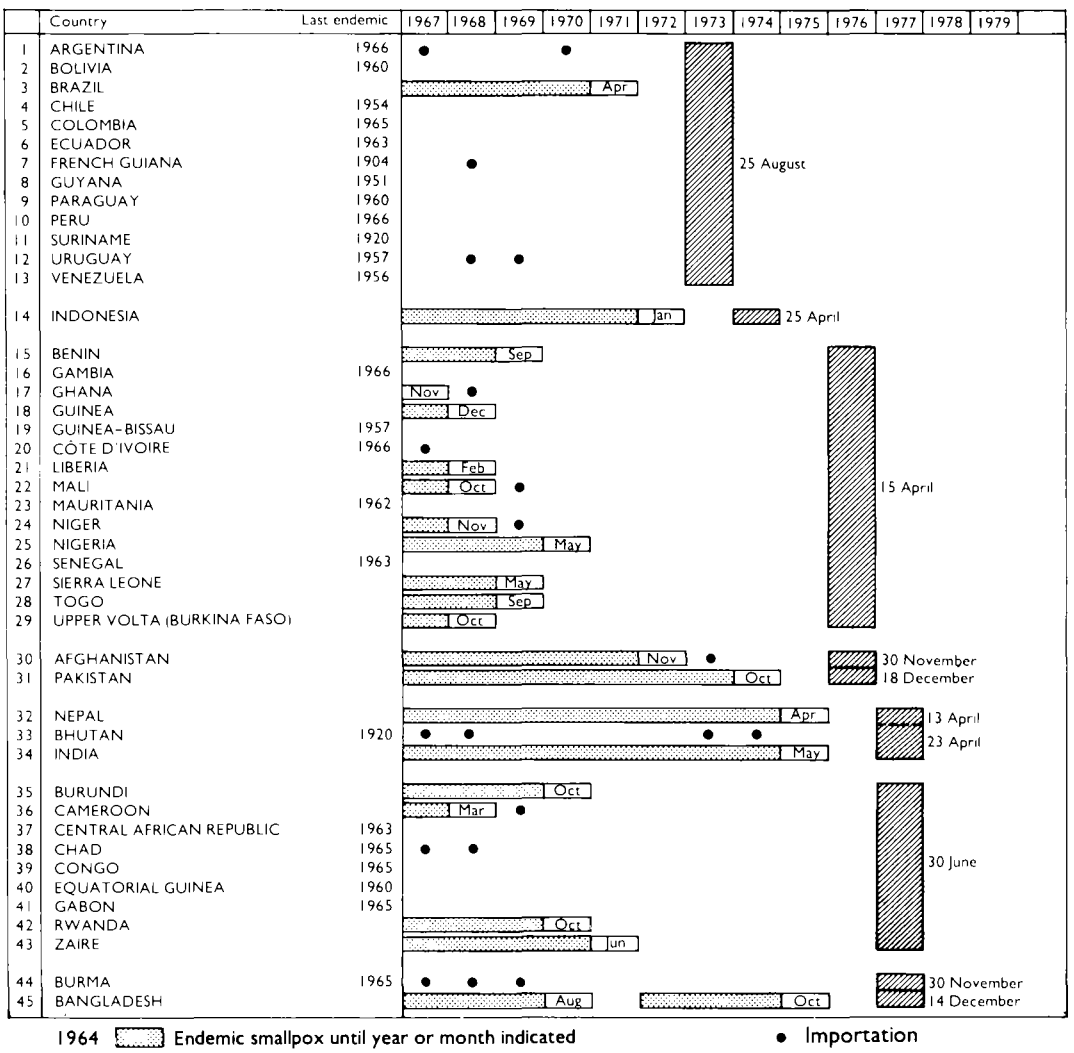


Fig. 25.1. Countries certified to be smallpox-free by international commissions operating between 1973 and 1977. The vertical boxes indicate the year in which the country was visited by an international commission; the dates on the right of these are those of the certification of the country or group of countries.

scription of the certification of the eradication of variola major from the world. This was carried out by the large international commissions which dealt first with Afghanistan and Pakistan in the west, and then with the principal and ancient home of variola major—India, Bangladesh and some of their small neighbours.

Fig. 25.1 shows the countries covered by these 9 international commissions, the month and year of the last cases in each country, and the dates of certification.

The special procedures adopted, the studies carried out and the factors which affected the decision by each of the international commissions to certify that eradication had been achieved are described in the sections which follow. Common to all countries, and of long standing, was the routine notification of a number of infectious diseases by hospitals and health centres, special attention being given to smallpox and the other diseases subject to the International Health Regulations (cholera, plague and yellow fever); all cases of these diseases had to be notified to WHO. Although the reporting of smallpox had been very incomplete when the Intensified Smallpox Eradication Programme began, the system then in place had served to detect and report cases in the endemic countries. During the course of the Intensified Programme, routine notification systems improved in all countries and, although they were not sufficiently sensitive to detect all the cases of smallpox that might have occurred, it was unlikely that any of them would fail to detect at least some of the numerous cases which would have had to occur if transmission was sustained over many years. The continuing absence of reports of cases of smallpox, often for a period of some years during which other diseases were being reported to WHO, increased confidence in the certification process, especially in countries in which certification was undertaken several years after the occurrence of the last known case of endemic smallpox.

CERTIFICATION IN SOUTH AMERICA

The last case of smallpox in South America was reported from Brazil in April 1971; South America was certified free of smallpox in August 1973.

Recent History of Smallpox

The history of smallpox in South America since the late 1950s has been described in Chapter 12. The essential features are summarized below as a background to the precertification activities and the recommendations of the Commission for the Assessment of the Smallpox Eradication Program in the Americas, which met in 1973.

After 1967, when the Intensified Smallpox Eradication Programme was initiated, only 3 countries in South America and the French Overseas Department of French Guiana reported cases of smallpox. The disease remained endemic in Brazil, which had long been reporting several thousand cases of variola minor annually, while Argentina, French Guiana, and Uruguay reported a few cases between 1967 and 1970, following importations from Brazil (Table 25.1). All the other South American countries had reported their last cases before 1967 (see Chapter 8, Fig. 8.6) and the last importation into the subcontinent from outside South America was believed to have occurred as long ago as 1920. Certification activities were therefore concentrated on Brazil and on adjacent countries in which importations from Brazil might have led to the establishment of new endemic foci.

Precertification Activities

In April 1971, the month in which the last outbreak of smallpox occurred in Brazil, it was decided that surveillance should continue

Table 25.1. South America: number of reported cases of smallpox, 1966–1972

Country	1966	1967	1968	1969	1970	1971	1972
Argentina	21	30[a]	0	0	24[a]	0	0
Brazil	3 623	4 514	4 372	7 407	1 771	19	0
French Guiana	0	0	1[a]	0	0	0	0
Peru	13	0	0	0	0	0	0
Uruguay	0	0	2[a]	3[a]	0	0	0

[a]Considered to be due to importation from Brazil.

in Brazil for 2 years after the occurrence of the last known case and that an assessment of the smallpox situation should then be made throughout South America (see Chapter 24). Over the next 2 years, country reports were prepared for submission to an independent assessment group by 11 countries (Argentina, Bolivia, Brazil, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela) and French Guiana; all of these except Brazil had been free of known endemic smallpox for at least 5 years. Chile was excluded because it had no common border with Brazil and, having a reasonably sophisticated health service infrastructure, had found no endemic smallpox to report since the early 1950s.

Brazil

The vaccination campaign carried out between 1967 and 1971 had covered over 80% of the Brazilian population of 97 million. As has already been mentioned, the last case of smallpox occurred in April 1971, in Guanabara State, but the campaign was continued until the International Commission's visit in 1973. By 1971, epidemiological surveillance units had been established in 2904 of the 3951 *municípios* (73%), and formed an important reporting network for suspected cases, the proportion of *municípios* with such units rising to 89% in 1972 and 90% by June 1973 (Table 25.2).

In 1972, health personnel conducted special inquiries aimed at collecting rumours of smallpox cases throughout the country. They interviewed personnel working in government agencies, such as political and health officials, schoolteachers and pupils, and workers in factories and businesses. More than 300 000 persons were interviewed in areas in which the risk of unreported cases of smallpox was believed to be the greatest (Table 25.3). This survey found 96 suspected cases, but none of them proved to be smallpox.

During the course of the organized surveillance programme between January 1971 and June 1973, 1293 suspected cases of smallpox were investigated (Table 25.4). Specimens

Table 25.2. Brazil: location and number of surveillance units in 1973

States and territories	Number of *municípios*	Number of surveillance units	Coverage (%)
North:			
Rondônia	2	2	100
Acre	7	7	100
Amazonas	44	30	68
Roraima	2	2	100
Pará	83	65	79
Amapá	5	5	100
North-east:			
Maranhão	129	129	100
Piauí	114	93	82
Ceará	142	130	92
Rio Grande do Norte	150	150	100
Paraíba	171	153	90
Pernambuco	164	164	100
Alagoas	94	94	100
Fernando de Noronha	1	1	100
Sergipe	74	74	100
Bahia	336	249	74
South-east:			
Minas Gerais	722	506	70
Espírito Santo	53	53	100
Rio de Janeiro	63	63	100
Guanabara	1	1	100
São Paulo	571	571	100
South:			
Paraná	288	281	98
Santa Catarina	197	197	100
Rio Grande do Sul	232	230	97
Central-west:			
Mato Grosso	84	82	98
Goiás	221	221	100
Distrito Federal	1	1	100
Brazil, total	3 951	3 554	90

Table 25.3. Brazil: results of survey conducted in high-risk areas in 1972

Personnel category or establishment	Number of persons interviewed	Number of suspected cases[a]
Political officials	1 309	1
Health officials	2 535	3
Health services	15 579	2
Private medical services	5 378	1
Public records offices	561	6
Factories or business enterprises	45 605	1
Schools (teachers and pupils)	125 920	19
Other	120 405	63
Total	317 292	96

[a] None found to be smallpox.

Table 25.4. Brazil: investigations of suspected cases of smallpox, 1971–1973

States and territories	1971			1972			1973		
	Number of suspected cases	Number investigated	Number of laboratory tests	Number of suspected cases	Number investigated	Number of laboratory tests	Number of suspected cases	Number investigated	Number of laboratory tests
North:									
Rondônia	0	0	0	0	0	0	0	0	0
Acre	0	0	0	0	0	0	0	0	0
Amazonas	0	0	0	4	4	4	0	0	0
Roraima	0	0	0	0	0	0	0	0	1
Pará	0	0	0	5	5	5	0	0	0
North-east:									
Maranhão	10	10	4	8	8	5	0	0	0
Piauí	2	2	2	30	30	7	5	5	0
Ceará	20	20	15	5	5	4	7	7	6
Rio Grande do Norte	0	0	0	0	0	1	3	3	0
Paraíba	1	1	0	5	5	3	0	0	0
Pernambuco	18	18	9	76	76	34	16	16	12
Alagoas	0	0	0	3	3	4	2	2	1
Fernando de Noronha	0	0	0	0	0	0	0	0	0
Sergipe	5	5	5	11	11	2	6	6	2
Bahia	22	16	18	59	59	26	11	11	8
South-east:									
Minas Gerais	32	32	24	39	39	50	14	14	10
Espírito Santo	31	31	27	19	19	33	4	4	4
Rio de Janeiro	26	26	18	48	48	26	9	9	4
Guanabara	35	35	25[a]	181	181	29	9	9	0
São Paulo	118	118	80	124	124	64	16	16	18
South:									
Paraná	42	42	35	37	37	38	1	1	2
Santa Caterina	9	9	6	13	13	7	11	11	8
Rio Grande do Sul	63	63	40	40	40	24	15	15	18
Central-west:									
Mato Grosso	0	0	0	7	7	3	2	2	3
Goiás	11	11	10	4	4	6	0	0	0
Distrito Federal	5	5	2	0	0	0	0	0	0
Brazil, total	450	444	320	718	718	375	131	131	97

[a] Including 19 confirmed cases from the last outbreak of smallpox in Brazil.

were collected for laboratory diagnosis from 792 of them; all gave negative results except the 19 specimens collected in Guanabara State during the last outbreak, which were positive. No evidence of smallpox transmission was found after April 1971.

Argentina

The last case in Argentina occurred in April 1970, in an outbreak of 24 cases in Misiones Province, which borders on Brazil. This began with an importation from Brazil

and was contained by mass vaccination as soon as it was discovered. By the end of 1971 the vaccination campaign in the province had reached 84% of the population of 443 020 persons. During the summer of 1971 Dr Claudio Marcos da Silveira, a WHO consultant, visited Argentina to assess the smallpox situation. With Dr Juan José Hiriart, chief of the national smallpox eradication programme, he contacted schoolteachers, health officers and community leaders in areas in which cases of smallpox had been reported between 1965 and 1970, paying special attention to the community of Colonia Alicia, in which the 1970 outbreak had occurred. A survey in these areas showed that 88% of the 2819 schoolchildren examined had vaccination scars. Investigation of 26 cases of fever with rash led to the diagnosis of chickenpox in all of them. No cases of smallpox were found.

Colombia

The last cases of smallpox had occurred in Colombia in 1965. Between 1967 and 1972 more than 13 million of the 22 million people in the country were vaccinated, and a survey in 1970 found that 70% of the age group 0–4 years, 85% of the age-group 5–14 years and 77% of those aged 15 years and over had vaccination scars. Vaccination coverage was satisfactory except in 6 sparsely settled departments in the Amazon region. No evidence of recent smallpox was found during the vaccination scar survey.

In November 1971 a special survey was conducted in the Amazon basin in the Commissary of Vaupés (90 000 square kilometres), one of the more isolated areas, adjacent to the Brazilian Amazon basin. It was found that in the previous year, 8 cases of fever with rash had occurred in the San Jorge District on the bank of the Vaupés river opposite the town of Mitú. These had been diagnosed as smallpox in the hospital at Mitú, but the investigation revealed that 4 of them were in persons who had been previously vaccinated and that all were cases of chickenpox. A further search for cases of fever with rash found no evidence of smallpox in this area.

French Guiana

No cases of smallpox had been recorded in the files of the public health authorities of French Guiana since 1904. One case imported from Brazil into Cayenne had occurred in 1968 but it did not appear in the official records although it had been reported to WHO. Dr Marcos da Silveira visited the territory as a WHO consultant in 1971 and concluded that continued smallpox transmission was most unlikely for two reasons. First, the population was small (44 000), the reporting system was reasonably good and, although there was a risk of importation through persons entering illegally from Brazil, the areas adjacent to Brazil were so thinly populated that it was unlikely that an endemic focus could be established. Secondly, the vaccination programme was continuing and the records showed that in 1970 nearly half the children under 1 year of age had been vaccinated; this suggested that the coverage of the older age groups should have been reasonably good.

Paraguay

The last outbreak of 32 cases in Paraguay followed an importation from Brazil in 1965. In 1971 an investigation was conducted by a team of WHO operations officers and national personnel in the areas at highest risk, all of which bordered on Brazil. The survey team travelled 5000 kilometres, visited 88 localities, interviewed 125 health personnel and 451 teachers and educational personnel, and discovered 15 cases of exanthematous diseases, all of which had occurred during the previous 12 months. These cases and an additional 50 persons with a history of attacks of fever with rash were investigated, but no cases of smallpox were found.

Nor was evidence of smallpox found in a national survey of schoolchildren, conducted in 336 schools throughout the country in 1971. During the course of routine spraying operations in May of that year, the malaria control service personnel also conducted a search for smallpox cases among a population which comprised 4% of the national total, but found none. To determine the vaccination coverage, a special scar survey was conducted in May–June 1971 among 19 470 persons in the south of Paraguay. It was found that 78% had vaccination scars; the proportion was 43% in the age group 0–4 years and more than 82% in those aged over 4 years.

Peru

The 13 cases which occurred in Peru in 1966 were the last in a large outbreak of

variola minor that began in 1963, following an importation from Brazil. A vaccination campaign carried out between 1968 and 1970 resulted in a good coverage of the population, as was shown by a vaccination scar survey of 30 000 persons that was conducted in 1970. It was found that 82% of the age group 0–4 years, 92% of the age group 5–14 years and 91% of adults bore scars. The vaccination teams found no evidence of smallpox during the campaign.

Uruguay

The last importation of smallpox into Uruguay was recorded in 1969, before which there had been importations annually between 1960 and 1965 and again in 1968. Each case had been carefully investigated in order to determine the source of infection and each outbreak had been traced to a person exposed in Brazil. The prompt reporting and careful epidemiological investigations gave grounds for confidence that the health authorities would have detected and reported other cases had they occurred. In 1971 a small vaccination scar survey was conducted; of the 1029 persons examined, 98% had been vaccinated.

Other countries

Bolivia, Chile, Ecuador, Guyana, Suriname and Venezuela had also conducted good vaccination programmes (see Chapter 12), and the most recent cases in each country were associated with importations. Bolivia reported its last case in 1964, Chile in 1963, Ecuador in 1963, Guyana in 1951, Suriname in 1920, and Venezuela in 1962; indigenous transmission had been interrupted in most of these countries several years earlier (see Chapter 8, Fig. 8.6).

In 1971 special vaccination and search programmes were carried out in the Amazon basin areas of Bolivia, Ecuador and Venezuela, in parallel with those conducted in Brazil and Colombia. No cases of suspected smallpox were found.

Visit of the International Commission

The Commission for the Assessment of the Smallpox Eradication Program in the Americas, as it was called, first met in Rio de Janeiro on 15 August 1973, and discussed the reports that had been prepared by each of the 11 countries and by French Guiana. The Commission was charged, as were all those that followed it, with the responsibility of reaching one of two possible conclusions: that it was satisfied that smallpox eradication had been achieved, or that it would be satisfied that smallpox eradication had been achieved if a specifically described set of activities were conducted and no further cases discovered.

The Commission split up into teams which visited several areas of epidemiological importance in Brazil. They participated in the epidemiological investigation of suspected cases of smallpox and observed the operation of the existing epidemiological surveillance system. The Commission held its final meeting in Brasilia on 25 August. As has been pointed out in Chapter 24, the constitution of this first international commission was not ideal, nor did it carry out its work with the same thoroughness as later international commissions.

The Commission reviewed the situation in the various countries. Its conclusions may be summarized as follows:

(1) Although the vaccination campaigns conducted in the 1960s throughout South America were in general satisfactory, protection was generally insufficient in children under 5 years of age and in areas to which access was difficult. The Brazilian campaign was regarded as notable for having reached high levels of vaccination coverage throughout the country and in all age groups.

(2) There was a need to improve the reporting system in certain areas. However, the Commission was impressed with the excellent epidemiological surveillance throughout Brazil, where there was a widespread network of reporting posts covering 90% of the *municípios* of the country.

(3) While the larger South American countries and Uruguay maintained services for the laboratory diagnosis of smallpox and, following the last reported case in April 1971, laboratory confirmation of the diagnosis of every suspected case was important, the quality of the laboratory work was not as satisfactory as might have been hoped. The Commission drew attention to certain deficiencies in the collection, packaging and shipment of specimens, which sometimes made laboratory diagnosis difficult. It also observed that there was no interchange of information between laboratories, even within the same country. Although the WHO

collaborating centre in Atlanta, USA, had agreed to test specimens, few specimens were submitted between 1967 and 1977 and most of them were from Brazil (Table 25.5).

(4) Although vaccine production in various countries in South America was sufficient to cover local needs, some countries continued to produce liquid vaccine intended for use wholly or in part in their respective jurisdictions. Even when it was freeze-dried, the quality was often not satisfactory; this applied, in particular, to the heat stability of egg vaccine produced in Brazil (see Chapter 12). Few laboratories regularly sent vaccine specimens for quality control to the WHO Reference Centre for Smallpox Vaccine for the Region of the Americas in Toronto, Canada.

Despite the deficiencies mentioned above, the Commission concluded that smallpox transmission had been interrupted in the region, but took a cautious approach to post-eradication policy, recommending that:

(1) Countries should continue to give due attention to reporting systems and to their improvement, particularly in areas in which reporting was weak, so that consistent information was immediately available on every suspected case.

(2) A sufficient number of adequately trained epidemiologists should be made available for epidemiological surveillance services, so that each case of suspected smallpox might be thoroughly investigated by a competent epidemiologist and specimens, taken under satisfactory conditions, sent to a laboratory.

(3) Smallpox having been eliminated from the Region of the Americas, and the laboratory investigation of every suspected case being of fundamental importance to epidemiological surveillance, the Pan American Health Organization should stimulate the establishment of a system designed to ensure the technical proficiency of the laboratories performing smallpox diagnostic procedures.

(4) In order to ensure that the vaccines produced in the region were of high quality, samples of 3 consecutive lots of vaccine should be sent every 4 months to the reference laboratory for quality control tests.

In essence, the Commission recommended that vaccination and surveillance activities should be continued in much the same way as before eradication. Since it was agreed that there was little likelihood of importing smallpox from another continent, this recommendation reflects a certain lack of confidence in the decision that smallpox transmission had been interrupted. Such caution is understandable; this was the first time that smallpox eradication had been certified, and the disease had been endemic in South America for more than 400 years.

CERTIFICATION IN INDONESIA

Although Indonesia was geographically close to the endemic countries of south-eastern Asia, no importation of smallpox had been recorded from them since 1949. It was therefore considered reasonable to undertake the certification of the eradication of smallpox in Indonesia in 1974, 2 years after the last known case.

Recent History of Smallpox

Smallpox was reintroduced into Indonesia in 1947, but it remained confined to the larger islands of the western part of the archipelago

Table 25.5. Numbers of specimens from suspected cases of smallpox received by the WHO collaborating centre, Atlanta, USA, from countries in South America, 1967–1977[a]

Year	Bolivia	Brazil	Colombia	Guyana	Uruguay	Venezuela
1967–1968	2	154	7	5	1	0
1969	1	0	0	5	0	0
1970	0	14	0	1	0	0
1971	4	0	0	0	0	4
1972	0	0	0	0	0	1
1973	0	0	0	0	0	0
1974	0	0	0	0	0	0
1975	0	0	0	0	0	1
1976	0	0	0	0	0	0
1977	0	0	0	0	0	1
Total	7	168	7	11	1	7

[a] All negative for variola virus.

(see Chapter 13, Fig. 13.3). The numbers of cases in these islands between 1967 and 1973 are shown in Table 25.6. The last case of smallpox in the country occurred in January 1972, in a village some 30 kilometres from Jakarta, West Java.

Precertification Activities

Smallpox surveillance continued until April 1974, when the International Commission visited Indonesia. In collaboration with national staff, WHO smallpox eradication programme staff—namely, Dr Giuseppe Cuboni (May 1971–October 1974) and Mr William Emmet (August 1970–July 1974)—continued to help with precertification surveillance.

In August 1973, Dr Paul Wehrle, a WHO consultant, visited Indonesia to review the progress of certification activities and to advise on other steps to be taken in order to demonstrate convincingly that eradication had been achieved. He visited 26 provinces in North Sumatra, South Sulawesi, West Java and West Kalimantan to assess surveillance activities, using as indices the regularity with which the weekly smallpox reports were submitted, the number of notifications and the number of laboratory samples collected and tested. He reported that he was personally convinced that smallpox transmission had been interrupted in Indonesia but recommended various measures to improve surveillance.

Neither the activities of the national eradication programme nor those of the International Commission subsequently covered all the thousands of small islands in the archipelago. After 1949, no smallpox cases had been reported from any of the islands east of Sulawesi and Nusa Tenggara, although authorities on these islands routinely reported cases of other diseases. If smallpox had occurred there, rumours would have come to the notice of the health service. Experience in many islands in the South Pacific had shown that smallpox transmission could not be maintained on isolated oceanic islands because the populations were too small to provide a continuous supply of susceptible persons. The small islands of the Indonesian archipelago had apparently been free from smallpox for several decades, and the chance of continuing endemicity there was considered to be nil.

Special searches

Between March and December 1972 visits to the villages in which cases of smallpox had occurred during the period 1970–1972 were carried out by surveillance teams, consisting of national, provincial and regency smallpox eradication programme staff, in 11 provinces of Java, Sulawesi and Sumatra (Fig. 25.2). The main purpose of these visits was to ensure that the recent smallpox outbreaks had been thoroughly contained. In addition, rumours about suspected cases in localities or areas in frequent contact with those affected were investigated. Other localities that were searched were those that did not report regularly, those that were seldom visited by health personnel, and those in which frequent staff changes suggested some weakness in the local health services.

During these special searches, 1352 villages were visited and the civil authorities, religious leaders and the security forces questioned, and inquiries were made at health centres and schools. Of 650 reports of cases of suspected smallpox discovered, 629 proved to be cases of chickenpox; none was smallpox. Approximately 180 laboratory specimens were collected and tested by Indonesian laboratories, all with negative results. The

Table 25.6. Indonesia: number of reported cases of smallpox in various islands, 1967–1973

Island	1967	1968	1969	1970	1971	1972	1973
Bali	43	0	0	0	0	0	0
Java	10 067	15 654	14 069	4 648	195	34	0
Kalimantan	537	81	41	0	0	0	0
Sulawesi	670	101	833	1 721	1 451	0	0
Sumatra	962	1 514	3 029	3 712	454	0	0
West Nusa Tenggara	1 199	0	0	0	0	0	0
Others	0	0	0	0	0	0	0
Total	13 478	17 350	17 972	10 081	2 100	34	0

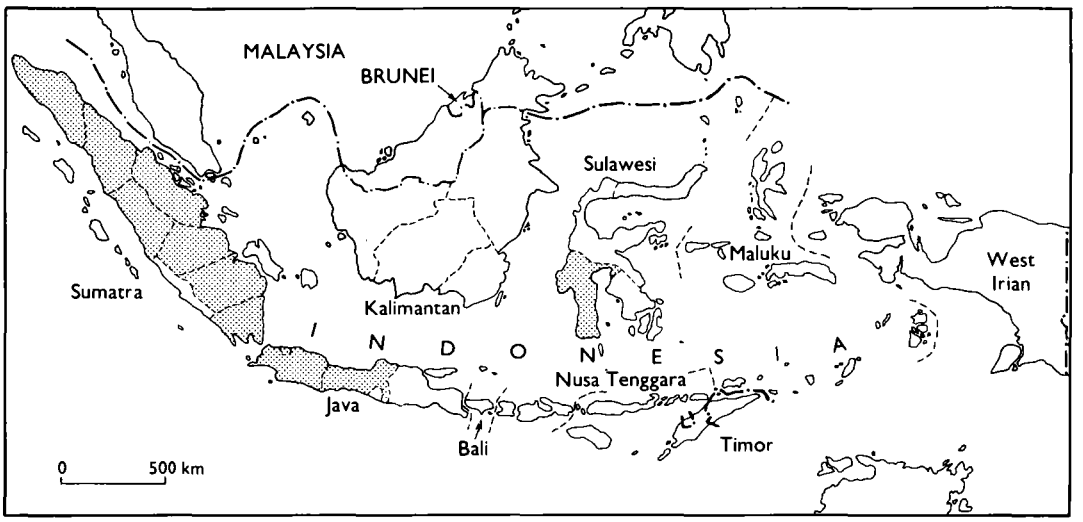


Fig. 25.2. Provinces of Indonesia in which cases of smallpox were reported between 1970 and 1972. Special searches were conducted in all these provinces (shaded).

special searches failed to elicit any evidence of the occurrence of smallpox after January 1972.

Reward for smallpox detection

In May 1972, immediately after the last known case has been detected, the Indonesian government offered a reward of 5000 rupiahs (US$12) to any person reporting a case of smallpox which was confirmed by laboratory tests. A similar amount was to be given to the first health worker who investigated and confirmed the case. The reward was given wide publicity by health workers when talking to the public during field visits (see Chapter 10, Plate 10.8C) in the hope of urging people to reveal rather than hide any new case.

Routine reporting of suspected cases

The existing system for the routine weekly reporting of suspected smallpox cases was strengthened. In 1972, roughly 20% of the expected number of weekly reports were submitted, whereas in 1974 the level had risen to 50% at both the regency and provincial levels. Between 1972 and 1974, 6186 cases of suspected smallpox were reported and 8505 cases investigated (Table 25.7), the latter number including additional suspected cases discovered during the investigations of the original cases. As usual, the disease most frequently mistaken for smallpox was chickenpox, which accounted for about 70% of the total suspected cases seen, other skin diseases (scabies, measles, impetigo and dermatitis) accounting for the remainder.

Laboratory diagnosis

After what was thought to be the last case of smallpox in Indonesia had been reported in 1972, the laboratory investigation of suspected smallpox became of vital importance. The number of specimens collected in various

Table 25.7. Indonesia: routine reporting of cases of suspected smallpox, May 1972–February 1974

Year	Number of suspected cases					Source of reports (%)			
	Reported	Total investigated	Chicken-pox	Smallpox	Others	Health personnel	Civil authorities	Members of the public	Unspecified
1972	2 298	3 223	2 236	0	987	38	27	25	10
1973	3 067	4 175	2 781	0	1 394	38	31	18	13
1974	821	1 107	613	0	494	44	26	21	9
Total	6 186	8 505	5 630	0	2 875	–	–	–	–

geographical areas was considered to be an index of the sensitivity of the surveillance system. Laboratory tests (gel precipitation and virus isolation) were carried out locally at the Biofarma Virological Laboratory in Bandung or the Central Public Health Laboratory in Jakarta, but specimens considered to be of special importance were also investigated by the WHO collaborating centres. In spite of the time required for shipment and communications—from the field to Jakarta, then to Geneva, then to a collaborating centre in the USA or USSR, and back by the same route—the results of tests carried out at the collaborating centres were available to the field staff within 5 weeks of the specimen being collected in 1972 and within 4 weeks in 1973 and 1974.

In addition to collecting laboratory specimens from all suspected smallpox cases, from September 1972 onwards health personnel were instructed to collect specimens from clinically unequivocal chickenpox in persons over 14 years of age who had no evident vaccination scar and from persons who had become ill in an outbreak of chickenpox in which a death had occurred. This type of surveillance was introduced after the last smallpox outbreak, in which cases had been reported to resemble chickenpox.

Between 1971 and 1973, altogether 1758 specimens were tested (Table 25.8), none being found positive for smallpox after 1972. Since chickenpox virus did not grow on the chorioallantoic membrane, hundreds of specimens from chickenpox viruses might be examined with consistently negative results. To encourage the laboratory workers and to test the laboratories' ability to grow poxviruses on the chorioallantoic membrane, samples were occasionally submitted from vaccinial lesions, from which vaccinia virus could be grown; this explains the positive results for vaccinia virus in 1972 and 1973 shown in Table 25.8.

Table 25.8. Indonesia: laboratory diagnosis of suspected cases of smallpox, 1971–1973[a]

Year	Number of specimens	Number positive for:	
		variola virus	vaccinia virus
1971	150	15	0
1972	1 009	12	1[b]
1973	599	0	6[b]
Total	1 758	27	7

[a] Biofarma, Bandung, tested 1479 specimens, the Central Public Health Laboratory, Jakarta, 247 specimens and WHO collaborating centres 32 specimens.

[b] From samples from vaccinial lesions, submitted as a means of checking the ability of the laboratory to grow poxviruses on the chorioallantoic membrane.

Local declaration of smallpox-free status

The national programme director decided that the local authorities should be responsible for confirming that smallpox was no longer prevalent in the areas under their jurisdiction. A total of 12 provinces in Java, Sulawesi and Sumatra had been defined as areas of concern, since cases of smallpox had been reported from them after 1970. In these provinces, both the civil authorities and the health service representatives of every village or area were requested to sign a document declaring that that locality was free of smallpox. Before this document was signed, every village chief and his local medical staff were given 2 weeks in which to check the area carefully and report any suspected case to the nearest health centre. However, the signing of the statement did not remove the duty to report any suspected case. On the contrary, all those involved were informed about the dangers of importation and the need for vigilance. This process was started in April 1973 and concluded in April 1974, involving 12 of the 26 provinces, as already mentioned, 158 of the 288 regencies and municipalities, 1771 of the 3203 subdistricts and about 25 000 of the 46 396 villages (*desas*) in Java, Sulawesi and Sumatra—a formidable task that required considerable organizational effort and logistic support.

These precertification efforts drew attention to smallpox and increased awareness of the reward offered both to health workers and to the general public for the notification of a case that could be confirmed.

Special survey in Kalimantan and Sulawesi

The health services in Kalimantan and Sulawesi were less well developed than those in Java and Sumatra; both islands had recently experienced smallpox and both were difficult places in which to work. In February and March 1974 special searches for smallpox, involving pockmark and vaccination scar surveys in the age group 0–14 years, were therefore carried out in these islands. South Sulawesi, in which the last endemic cases had

been reported, was not visited, since an intensive eradication programme had been conducted there, followed by intensive surveillance. Primary schools and health centres were visited in the towns and large villages of 7 provinces of Kalimantan and Sulawesi, and inquiries made about smallpox rumours. It was considered that the epidemiological situation in these towns and villages, which were located in coastal areas and on rivers and served as communication centres for remote areas, would reflect that in the inland part of the islands which, because of limitations of time, funds and manpower, could not be searched.

A total of 27 538 children aged 0–14 years were examined in 22 selected localities. No facial pockmarks were found in the age group 0–4 years, while there were 27 pockmarked children in the age group 5–14 years, none of whom had had smallpox during the previous 2 years. This strengthened confidence that both Kalimantan and the selected provinces of Sulawesi had been free of smallpox since 1970. Vaccination scars were found in 26% of children in the age group 0–1 year, 58% in the age group 1–4 years, and 83% in the age group 5–14 years. These levels of vaccination coverage were not satisfactory but, in view of the low population density in these islands and their isolation from the main endemic areas of Java, it was thought likely that smallpox transmission there had been interrupted in 1969.

Visit of the International Commission

On 15 April 1974, 26 months after the last case of smallpox had been reported from Indonesia, the International Commission for the Certification of Smallpox Eradication (Plate 25.1) met in Indonesia. Dr Wehrle, who was well informed about the activities that had been undertaken in Indonesia and was thus in a position to guide the deliberations of the Commission, acted as chairman. After some discussion among the other members of the Commission, Dr Julie Sulianti Saroso, Director-General for the Control and Pre-

WHO

Plate 25.1. Participants in the meeting of the International Commission for the Certification of Smallpox Eradication in Indonesia, 25 April 1975. *Left to right, front row:* **J.J. Dizon (Philippines), J. Sulianti Saroso (Indonesia), P.F. Wehrle (USA)**, A. Karyadi (Indonesia); *middle row:* B. Cantayuda (Indonesia), **I. Tagaya (Japan), N.McK. Bennett (Australia), J.S. Gill (Malaysia), S. Kumarapathy (Singapore)**; *back row:* N. Kumara Rai (Indonesia), G.G.O. Cuboni (WHO), I.F. Setiady (Indonesia), D.A. Henderson (WHO), J. Keja (WHO). The names of the Commission members are in bold type.

vention of Communicable Diseases in the Indonesian Ministry of Health, was included as a member. This arrangement might be thought to have reduced the objectivity of the Commission's assessment but, on the other hand, her presence provided additional assurance that no areas of the country would be barred to members of the Commission (see Chapter 24). After the first meeting in Jakarta, the members of the Commission, accompanied by programme staff, left for the areas judged most likely to harbour smallpox cases—namely, Jakarta, North Sumatra, South Sulawesi and West Java, which were visited during a period of 2 weeks (Fig. 25.3). In their field work, the members concentrated on assessing the extent and sensitivity of the surveillance activities and reporting system, as well as on examining health records and interrogating health service staff and the public. They visited as many localities as possible, searching for patients suffering from fever with rash, whom they examined to ensure that they did not have smallpox. The Commission then held its final meeting in Jakarta on 24 and 25 April 1974. Having concluded that there was no evidence that smallpox had occurred in Indonesia since January 1972 and that surveillance activities appeared to have been adequate to identify cases had they occurred, it approved the certification of the eradication of smallpox in Indonesia as a whole.

Because of the continuing high incidence of smallpox in the Indian subcontinent and the consequent risk of importations, the Commission strongly emphasized that "continuing vigilant surveillance and evaluation are necessary for all persons with illnesses suspected as smallpox", and recommended that "primary vaccination of infants and children against smallpox should be continued until global eradication of smallpox has been achieved".

CERTIFICATION IN AFRICA SOUTH OF THE SAHARA

The organization of certification in Africa south of the Sahara constituted a special challenge for a number of reasons. The region contained 42 countries which had previously been endemic, or whose neighbours had previously been endemic, and had become smallpox-free between 1967 and 1977 (Fig. 25.4). Communication within and between many of these countries was difficult, and the health service infrastructure in most of them was at a rudimentary stage of development. The certification programme was implemented by grouping countries together geographically and on the basis of similar histories of the elimination of smallpox. One such grouping, western Africa, comprising 15 countries, was the first in which the feasibility of certification of a regional group was tested (see Chapter 24); this was followed by the certification of 9 countries in central Africa.

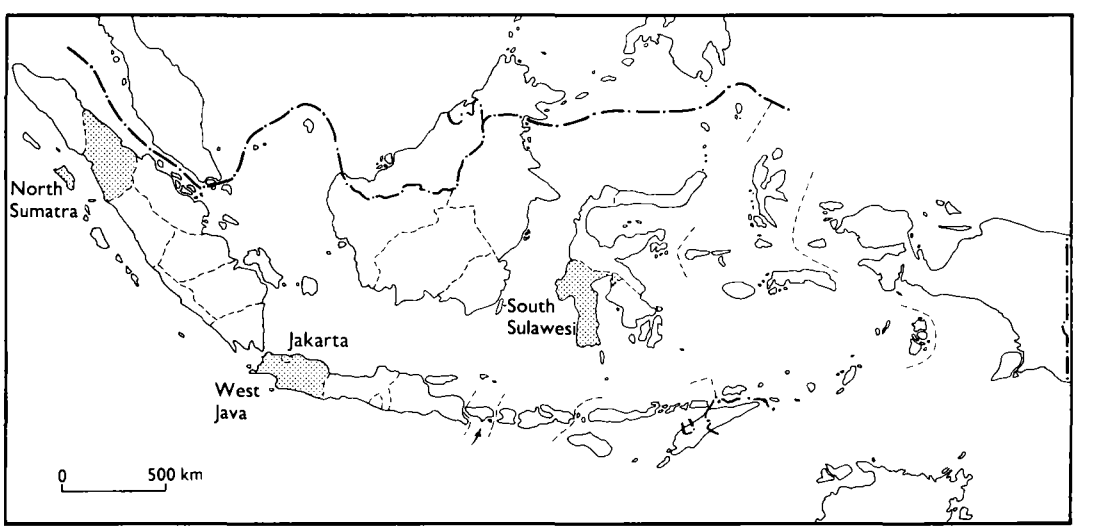


Fig. 25.3. Provinces of Indonesia (shaded) visited by members of the International Commission, 15–25 April 1974.

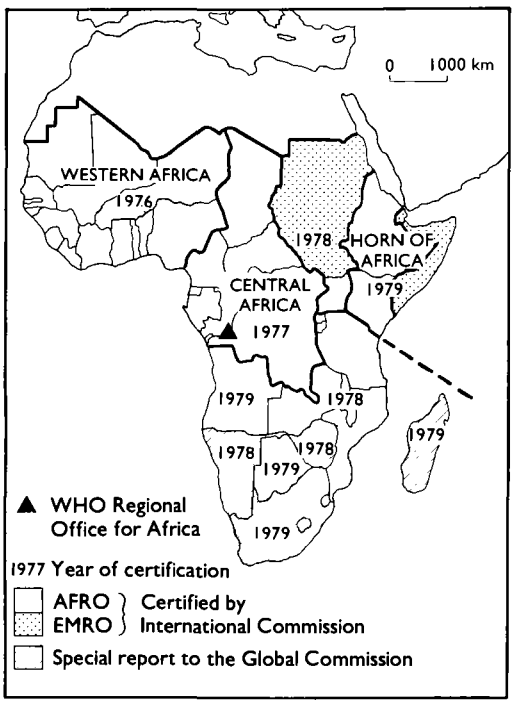


Fig. 25.4. Organization of certification in Africa south of the Sahara. A total of 42 countries were the subject of special certification procedures, 39 of them being in the WHO African Region and 3 (Djibouti, Somalia and Sudan) in the WHO Eastern Mediterranean Region. During 1976–1979 the certification programme was implemented by grouping countries together on the basis of geographical and epidemiological criteria.

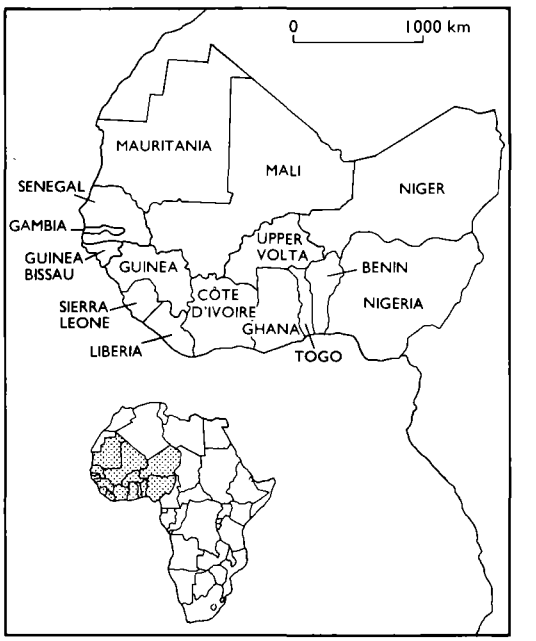


Fig. 25.5. The 15 countries of western Africa which were certified free of endemic smallpox by the International Commission in April 1976. Upper Volta is now Burkina Faso.

Arrangements based on the epidemiological and political situation in another 14 countries in eastern and southern Africa led to their certification in 1978 and 1979, by a variety of methods (see Chapter 26). The 4 remaining countries in the Horn of Africa, as the last group, were eventually certified by international commissions in October 1979 (see Chapter 27).

WESTERN AFRICA

In western Africa, 15 countries—Benin, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta (now Burkina Faso) (Fig. 25.5)—shared many features which made it logical to group them for the certification of smallpox eradication.

As has been described in Chapter 17, smallpox eradication and measles control programmes had been carried out in the region with United States support, and the last known outbreak of endemic smallpox had occurred in April 1970. Intensive surveillance had continued, with bilateral assistance, for more than 2 years thereafter, but both surveillance and the extent of vaccination had declined sharply after the assistance ceased. By 1976, when the International Commission for the Certification of Smallpox Eradication was scheduled to visit the region, the staff who had worked in the campaign had become involved in other activities or gone elsewhere, records were scattered or lost and smallpox surveillance activities had diminished. Because smallpox had been absent from these countries for more than 5 years, and because health services in western Africa were much less well developed than those in South America and Indonesia, it was decided that the surveys and documentation required before the Commission's visit could be—and, indeed, would have to be—simpler and adapted to the local situation.

Recent History of Smallpox

The eradication campaign in these countries has been described in Chapter 17. Data on the numbers of cases reported between 1966 and 1971 are shown in Table 25.9. Unlike certain other regions of Africa, western Africa had experienced only variola major, usually associated with a somewhat lower case-fatality rate than in the Indian subcontinent. Hence facial pockmark surveys provided a valuable means of assessing the past prevalence of the disease.

Variolation had formerly been widely practised in many countries in the region (Herbert, 1975), but in the 1960s it was observed only in a few localized areas, the last being in Dahomey (Benin) in 1969.

Preparations for Certification

Planning meeting, 3–6 February 1975

In order to plan a strategy for the certification of smallpox eradication in Africa, a meeting was held at the WHO Regional Office for Africa in Brazzaville, Congo, from 3 to 6 February 1975. It was attended by Dr Celal Algan, Regional Adviser on Communicable Diseases, Arita from the Smallpox Eradication unit at WHO Headquarters, and Dr Wehrle, the WHO consultant mentioned earlier in this chapter who had assisted with the planning of certification activities in Indonesia, together with other WHO staff.

The meeting agreed with the proposal that certification should start with the 15 countries of western Africa, since importations were very unlikely from Ethiopia, the only African country in which smallpox was then still endemic, as it was 1500 kilometres away and there was little communication between the two areas.

Decisions were reached on 3 matters: local funding, coordination of precertification activities and the preparation of country reports. For most countries, WHO agreed to provide funds to cover the local travelling expenses (living allowances, petrol and oil) of mobile teams carrying out pockmark surveys. The other matters required continuing attention, as described below.

Coordination of precertification activities

During 1975–1976 the WHO Regional Office for Africa had medical epidemiologists stationed in Brazzaville (Dr Ziaul Islam), Côte d'Ivoire (Dr Alexander Dobrescu, Dr André Delas), and Nigeria (Dr Leva A. Arevshatian) to assist in epidemiological surveillance in western Africa. To coordinate the activities, Arita travelled throughout the area twice in 1975. During these trips a detailed manual describing how to carry out a pockmark survey was prepared and various technical and administrative problems were solved in discussions with the WHO epidemiologists and national health staff. At the request of WHO, Dr Joel G. Breman, at that time an epidemiologist from the United States Center for Disease Control working for the Organisation de Coordination et de Coopération pour la Lutte contre les Grandes Endémies en Afrique de l'Ouest (OCCGE), also assisted in promoting prep-

Table 25.9. Western Africa: number of reported cases of smallpox, 1966–1971

Country	1966	1967	1968	1969	1970	1971
Benin[a]	490	815	367	58	0	0
Côte d'Ivoire	10	2	0	0	0	0
Gambia	3	0	0	0	0	0
Ghana	13	114	24	0	0	0
Guinea	56	1 530	330	16	0	0
Guinea-Bissau[b]	0	0	0	0	0	0
Liberia	32	6	5	0	0	0
Mali	281	293	134	1	0	0
Mauritania	76	0	0	0	0	0
Niger	1 023	1 187	678	28	0	0
Nigeria	4 953	4 753	1 832	203	66	0
Senegal	0	0	0	0	0	0
Sierra Leone	293	1 697	1 143	80	0	0
Togo	201	332	784	83	0	0
Upper Volta[c]	69	195	100	0	0	0

[a] Formerly Dahomey.
[b] Portuguese Guinea until 1974.
[c] Now Burkina Faso.

arations in the OCCGE countries (Benin, Côte d'Ivoire, Mauritania, Niger, Senegal, Togo, and Upper Volta).

Preparation of country reports

In preparation for certification, each country was requested to provide, by the end of 1975, a formal country report documenting its smallpox eradication activities. Simple forms indicating the essential information required in the country report were distributed to all countries in the region in order to ensure uniformity in the documentation.

Pockmark surveys. Each of the countries was asked to organize pockmark surveys, carried out by special mobile teams operating for a period of 3–6 months. In order to simplify the operation, towns or villages with more than about 1000 inhabitants were to be selected, based on the demographic data for the country concerned, so that their combined population should be not less than 20% of the total population. In these localities, schools, maternal and child health clinics, hospitals and markets were to be visited to search for facial pockmarks in infants and children up to 15 years of age. Special instructions and forms describing how to select localities, how to conduct pockmark surveys and how to record the results were distributed to all the countries by WHO.

The surveys were completed by December 1975, and reports on the results became available in January 1976. As has already been mentioned, the localities surveyed were limited to large towns or villages, well distributed

Rationale for Pockmark Surveys in Western Africa

The rationale for conducting large-scale pockmark surveys in the countries of western Africa was outlined in 1976 in a memorandum by Henderson. In it, he discussed how best to provide the information that would allow an international commission to decide whether smallpox transmission had ceased in countries in which the last reported case had occurred several years earlier, and in which intensive smallpox surveillance had ceased some 5 years before the visit by the commission. He suggested that extensive facial pockmark surveys might be useful:

"For smallpox to have persisted during the past 4 years in the 15-country African area concerned, it is evident from what we know of the epidemiology of the disease that a large number of people living in a fairly large geographical area would have had to experience illness if the chain of transmission were to persist. Two-thirds of those afflicted would still bear facial scars of the disease and most of these would be children. To determine whether or not smallpox had been absent from this area, over this extended period, it would seem to me that one might examine a large number of children in many different geographical areas. If none had facial scars resembling those caused by smallpox which had been acquired during the past 4 years, one should be able to state with reasonable confidence that continuing smallpox transmission had not occurred in the 15-country area.

"To conduct such a study on a village-by-village basis would be ideal but expensive in terms of time and manpower. Practically, however, one might undertake to examine all those up to perhaps 15 years of age who attend school. Such an examination could be quickly performed as the children are already assembled in groups and children from a wide geographical area would be represented. Some, undoubtedly, would bear facial scars acquired more than 4 years before. If these children were identified, enumerated and the information confirmed that the disease had indeed been acquired more than 4 years previously, this would be further evidence that facial scars would be identified if present.

"An assessment which would be much simpler than this would be hard to visualize. The difficulties in undertaking such an appraisal would need to be carefully considered and, as well, whether the evidence obtained (with such other data as might be compiled) would be sufficient to permit an international commission to endorse the view that smallpox had been eliminated from the 15-country area concerned."

throughout the country; small villages in remote and inaccessible areas were excluded because of the considerable time and resources that would have been required to reach them. The view was taken, and later accepted by the International Commission, that, if smallpox transmission had continued, the disease should have reached larger towns or villages at some time between 1971 and 1976, and pockmarked persons would have been seen there.

The selection of localities can be illustrated by the arrangements made in Nigeria, the largest and most populous country in the region and the major focus of smallpox during the eradication campaign (see Chapter 17). Table 25.10 shows the numbers of localities of various sizes selected for assessment and their total population; 9.5% of all inhabited localities were surveyed, accounting for 37.7% of the total population of Nigeria. The localities were widely scattered throughout the country; their geographical distribution is shown in Fig. 25.6.

The field survey teams in the 15 countries examined a total of 6.5 million persons, made up of 1.6 million preschool children, 3.7 million primary-school children and 1.2 million over primary-school age, representing over 25% of schoolchildren up to 13 years of age and 5% of the total population of 122.4 million of western Africa (Table 25.11).

Table 25.10. Nigeria: number of localities selected for facial pockmark surveys, by population size

Population size of locality	Number of localities	Total population of localities
⩾ 10 000	664	22 115 000
8 000–9 999	132	1 188 000
6 000–7 999	242	1 694 000
4 000–5 999	221	1 105 000
2 000–3 999	470	1 410 000
< 1 000–1 999	88	88 000
Total	1 817	27 600 000

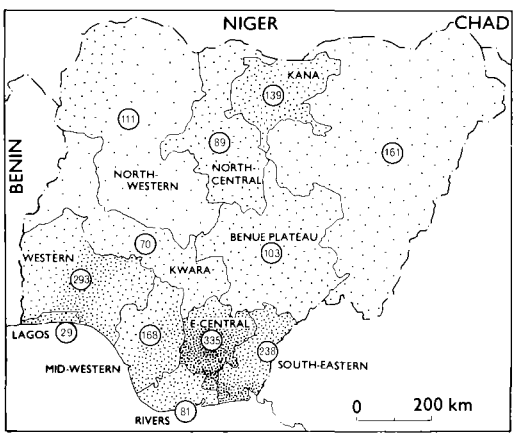


Fig. 25.6. Geographical distribution of the 1817 localities in Nigeria in which facial pockmark surveys were conducted during 1975.

Table 25.11. Western Africa: results of facial pockmark surveys carried out in 1975–1976

Country	Population (millions)[a]	Number of persons examined			
		Total	Preschool age[b]	Primary-school age[b]	Over primary-school age[b]
Benin[c]	3.0	188 722	12 881 (0)	175 841 (208)	0
Côte d'Ivoire	6.7	236 194	960 (0)	235 234 (144)	0
Gambia	0.5	24 694	2 481 (0)	11 207 (8)	11 006 (33)
Ghana	9.8	724 465	30 074 (0)	454 215 (5)	240 176 (56)
Guinea	4.3	68 263	0	68 263 (546)	0
Guinea-Bissau	0.6	28 156	1 463 (0)	26 408 (0)	285 (2)
Liberia	1.6	77 717	4 316 (0)	34 545 (5)	38 856 (31)
Mali	6.3	412 271	76 735 (0)	246 087 (75)	89 449 (93)
Mauritania	1.4	63 382	19 665 (0)	43 717 (0)	0
Niger	4.7	49 990	1 384 (0)	44 794 (71)	3 812 (5)
Nigeria	67.7	3 840 828	1 387 227 (0)	1 860 563 (2 923)	593 038 (3 789)
Senegal	4.8	257 388	2 639 (0)	82 223 (61)	172 526 (113)
Sierra Leone	3.1	230 437	68 079 (0)	162 358 (104)	0
Togo	2.3	177 221	0	177 221 (59)	0
Upper Volta[d]	5.6	117 522	24 014 (0)	74 256 (13)	19 252 (46)
Total	122.4	6 497 250	1 631 918 (0)	3 696 932 (4 222)	1 168 400 (4 168)

[a] Population data for 1975 from United Nations (1985).
[b] Number of persons with facial pockmarks shown in parentheses.
[c] Formerly Dahomey.
[d] Now Burkina Faso.

During these surveys, over 8000 individuals with facial pockmarks were identified among persons of primary-school age or older. Almost all of them had had smallpox before 1971; in a few, the lesions were due to other causes. In no case did the interrogation reveal a missed case of smallpox. There were no pockmarks among children below the age of 6 years.

Suspected smallpox cases. During the pockmark surveys the teams visited hospitals and dispensaries to ascertain whether there were any rumours of smallpox. If suspected cases were seen, specimens were taken for laboratory examination.

Between 1972 and 1976, 11 countries in the region had reported 127 cases of suspected smallpox, none of which was confirmed on investigation. In contrast to the extensive laboratory investigations in Indonesia (see Table 25.8), between 1971 and 1973, only 75 laboratory specimens had been sent to the WHO collaborating centre in Atlanta, USA, from western Africa (Table 25.12), because no special searches for suspected smallpox had been carried out. None of these specimens yielded variola virus, but in 41 of them herpesvirus particles were seen by electron microscopy.

Table 25.12. Western Africa: results of laboratory investigation of suspected cases of smallpox by the WHO collaborating centre, Atlanta, USA, January 1972–April 1976[a]

Country	Number of specimens	Herpesvirus particles seen	Vaccinia virus isolated	Negative
Benin[b]	1	1	0	0
Côte d'Ivoire	12	10	0	2
Gambia	0	0	0	0
Ghana	8	5	0	3
Guinea	0	0	0	0
Guinea-Bissau[c]	0	0	0	0
Liberia	5	2	0	3
Mali	0	0	0	0
Mauritania	1	1	0	0
Niger	5	3	0	2
Nigeria	31	12	2	17
Senegal	0	0	0	0
Sierra Leone	4	2	0	2
Togo	0	0	0	0
Upper Volta[d]	8	5	0	3
Total	75	41	2	32

[a] In no case was variola virus recovered.
[b] Formerly Dahomey.
[c] A Portuguese colony until 1974.
[d] Now Burkina Faso.

Visit of the International Commission

The International Commission met first in Abidjan, Côte d'Ivoire, from 23 to 26 March 1976, to review the country reports and survey data. Western Africa was divided into 5 zones, each of which was visited by a team consisting of members of the International Commission accompanied by temporary advisers and WHO personnel. Each team visited all the countries in the zone allocated to it. Their investigations included a review of additional records available at the national and local levels, interviews with personnel involved in various aspects of the programme, and visits to selected localities to verify the sensitivity and effectiveness of the smallpox surveillance effort, including verification of the recently completed facial pockmark surveys. The Commission finally met in Brazzaville from 12 to 15 April to consider the additional data obtained during the field visits.

A number of questions had been clarified during the field visits. Overall, the reports showed that in all the countries excellent vaccination and surveillance programmes had been conducted in 1967–1972 and good pockmark surveys in 1975. Although the surveillance and reporting systems in most countries were better than those in operation before the eradication programme began in 1967, no cases of smallpox had been reported from any country in the region since 1970. In addition, between 1970 and 1976, 8 cases of human monkeypox had been discovered in Côte d'Ivoire, Liberia, Nigeria and Sierra Leone. The disease resembled smallpox clinically but not in its epidemiology (see Chapter 29). The fact that these cases, which had occurred in remote areas, had been discovered was evidence of the efficiency of the surveillance systems.

The long period (6 years) of apparent freedom from smallpox in western Africa predisposed the Commission to believe that transmission had been interrupted, a view that was strongly supported by the fact that the very extensive pockmark survey had produced no evidence of smallpox transmission after 1971.

The Commission concluded that there was no evidence that smallpox had occurred in the 15 countries of western Africa since 1970, and certified the region as being free of smallpox. Bearing in mind that smallpox transmission persisted in Ethiopia, however, it recom-

WHO / R C. DA SILVA

Plate 25.2. Participants in the meeting of the International Commission for the Certification of Smallpox Eradication in Western Africa, 15 April 1976. *Left to right, front row:* **W. Koinange (Kenya), I.D. Ladnyi (USSR), P.F. Wehrle (USA), Lekie Botee (Zaire), S. Bédaya-Ngaro (Central African Republic), M.I.D. Sharma (India), R. Netter (France)**; *back row:* C. Algan (WHO), J.G. Breman (USA), A.N. Slepushkin (WHO), B. Guyer (USA), A. Dobrescu (WHO), E.A. Smith (Nigeria), D.A. Henderson (WHO), C.R. Jones (WHO), Z. Islam (WHO), A.K. M'Baye (Senegal), J.A. Mahoney (WHO), A.E. Delas (WHO), A.H. Abou-Gareeb (WHO), F.C. Grant (Ghana), I. Arita (WHO). The names of the Commission members are in bold type.

I.D. LADNYI

Plate 25.3. Checking schoolchildren in Nigeria for vaccination scars and facial pockmarks during the visit of the International Commission to western Africa, March 1976.

Table 25.13. Central Africa: number of reported cases of smallpox, 1965–1972

Country	1965	1966	1967	1968	1969	1970	1971	1972
Burundi	1 213	363	74	301	108	197	0	0
Cameroon	28	2	119	37	3	0	0	0
Central African Republic	0	0	0	0	0	0	0	0
Chad	73	0	86	5	0	0	0	0
Congo	89	0	0	0	0	0	0	0
Equatorial Guinea	0	0	0	0	0	0	0	0
Gabon	1	0	0	0	0	0	0	0
Rwanda	5	0	0	0	107	253	0	0
Zaire	3 783	1 913	1 479	3 800	2 072	716	63	0

mended that vaccination programmes should continue, particularly for preschool children. Continued careful surveillance, and especially the reporting and investigation of all chickenpox outbreaks in which deaths had occurred, was most important, so as to make certain that these outbreaks were not caused by smallpox introduced from an endemic area or by monkeypox or related viruses.

CENTRAL AFRICA

Following the certification of smallpox eradication in the 15 countries of western Africa, preparations for certification were organized over the period June 1976 to June 1977 for 9 countries of central Africa: Burundi, Cameroon, Central African Republic, Chad, Congo, Equatorial Guinea, Gabon, Rwanda and Zaire (Fig. 25.7). Apart from forming a geographical unit, these countries shared several features which made it reasonable to group them together for certification. As in western Africa, the USA had supported a smallpox eradication and measles control programme in certain countries in the region between 1967 and 1972—namely, Cameroon, the Central African Republic, Chad, the Congo, Equatorial Guinea and Gabon. WHO-assisted smallpox eradication programmes had been in operation in Burundi, Rwanda and Zaire. Zaire, the largest of these 9 countries, with a population of 26 million in 1977 (half the entire population of the group), developed a WHO-assisted smallpox eradication programme in 1967. The last case of smallpox in Zaire—the last in this group of countries—was recorded in June 1971, and active surveillance was continued throughout Zaire, with WHO support, until 1977.

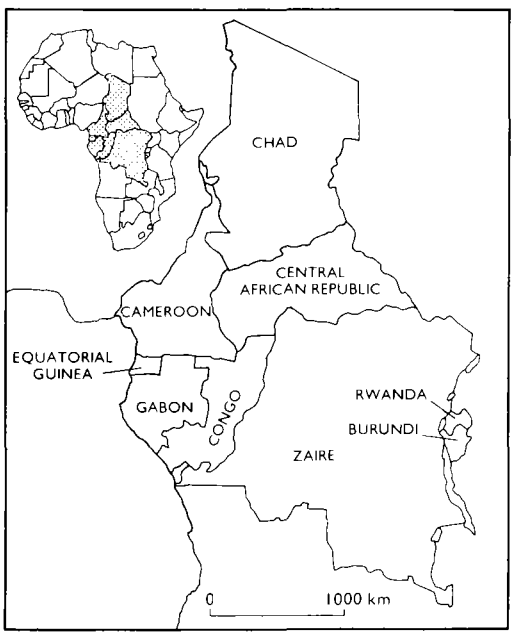


Fig. 25.7. The 9 countries of central Africa certified free of endemic smallpox by the International Commission in June 1977.

French was the official language of 8 of these central African countries,[1] making it much easier to prepare documentation and arrange meetings than in western Africa, in which both English and French had to be used.

Recent History of Smallpox

Smallpox had been endemic in most of these countries until the mid-1960s (Table 25.13). In the 1950s and early 1960s outbreaks

[1] Both English and French are official languages in Cameroon, while Spanish is that of Equatorial Guinea.

of both variola major and variola minor had been reported in Zaire, but there was some uncertainty about the validity of diagnoses (see Chapter 18). After 1962 the usual African type of variola major was the only variety of smallpox seen in all these countries, hence pockmark surveys promised to be as useful here as they had proved to be in western Africa.

Preparations for Certification

Coordination of precertification activities

It had been agreed that, in preparing for certification, activities similar to those found satisfactory in western Africa should be carried out—namely, the preparation of standardized, relatively simple country reports and the organization of pockmark surveys. Work on the preparation of country reports was begun in July 1976, and from 11 to 15 October 1976 a coordination meeting was held in Brazzaville to discuss the preliminary results and the procedures to be followed.

Representatives from the 9 countries, together with consultants and staff from the WHO Smallpox Eradication unit, attended the meeting, at which the preliminary country reports submitted by country representatives and the methodology of pockmark surveys were reviewed. WHO agreed to provide funds to cover the local travelling expenses (living allowances, petrol and oil) of mobile teams carrying out pockmark surveys. June 1977 was agreed as the date for the visit of the International Commission, since it was thought that by then all country reports and pockmark surveys would have been completed.

Dr Islam provided each country with the statistical data available at the WHO Regional Office for Africa in Brazzaville. Since such data were not always easily available in the countries concerned, this greatly facilitated the preparation of the country reports.

Zaire was treated differently from the other countries. A detailed country report was requested, but it was agreed that pockmark surveys would be carried out only in the epidemiologically critical border areas, since country-wide active surveillance for smallpox had continued ever since the discovery of the last case in 1971. A special monkeypox survey was planned as part of the precertification activities, since monkeypox was clinically indistinguishable from smallpox. It consisted of a search for unreported human monkeypox cases or smallpox-like disease in areas within a 25-kilometre radius of villages in which human monkeypox cases had occurred in the past.

Preparation of the country reports

Pockmark surveys. The field survey teams examined over 1.3 million persons, constituting 2.5% of the total population of the central African countries (Table 25.14). In all, 1.5% of preschool children and 8.8% of schoolchildren were examined. Pockmarks were found in 1420 schoolchildren and 146 adults, but there were none in the preschool age group (0–5 years).

Table 25.14. Central Africa: results of pockmark surveys, 1976–1977

Country	Population (millions)[a]	Number of persons examined			
		Total	Preschool age[b]	School age[b]	Adults[b]
Burundi	3.9	77 574	6 000 (0)	71 574 (18)	0
Cameroon	7.9	326 819	14 428 (0)	312 391 (6)	0
Central African Republic	2.1	119 277	17 920 (0)	101 357 (0)	0
Chad	4.2	158 849	13 802 (0)	130 806 (78)	14 241 (1)
Congo	1.4	93 162	7 440 (0)	80 935 (19)	4 787 (0)
Equatorial Guinea	0.3	8 942	353 (0)	8 589 (0)	0
Gabon	1.0	71 331	5 298 (0)	66 033 (55)	..[c] (1)
Rwanda	4.7	81 149	9 109 (0)	72 040 (6)	0
Zaire	26.2	396 440	48 491 (0)	264 738 (1 238)	83 211 (144)
Total	51.7	1 333 543	122 841 (0)	1 108 463 (1 420)	102 239 (146)

[a] Population data for 1977 from United Nations (1985).
[b] Number of persons with facial pockmarks shown in parentheses.
[c] . . = data not recorded.

Laboratory diagnosis. The number of specimens sent to WHO collaborating centres between 1972 and 1976 varied from one country to another (Table 25.15), but the great majority were collected in Zaire. Variola virus was not found in any of the 748 specimens examined, but 14 specimens collected in Zaire were found to contain monkeypox virus.

Visit of the International Commission

The first meeting of the Commission was held in Brazzaville from 6 to 8 June 1977. Subsequently, the Commission formed 6 teams, which between them visited all the countries in the region. The type of investigation undertaken by these teams can be illustrated by the report of the subgroup that visited Zaire, which consisted of Dr A. M'Baye and Dr J. G. Breman, Commission members from Senegal and the USA respectively, assisted by Dr Pierre Ziegler and Dr Edilberto Zanotto, former WHO staff from the Zaire smallpox eradication programme.

Between 8 and 26 June 1977 the subgroup reviewed the country report, the results of the facial pockmark survey and the special report on monkeypox, and visited 28 zones in Zaire, including some in each of the 9 regions of the country. In addition, the detailed locally prepared survey reports were reviewed and 57 government and private health units visited.

The subgroup also visited 35 schools, 16 markets and a refugee camp in order to examine preschool children and schoolchildren for facial pockmarks caused by smallpox. In all, 13 450 children were examined or re-examined. No child of less than 7 years of age showed facial pockmarks attributable to smallpox. The vaccination coverage of schoolchildren was satisfactory (about 90%). Investigations by national staff of 33 suspected cases were reviewed by the subgroup; no evidence of recent smallpox was found.

Table 25.15. Central Africa: number of specimens from suspected cases of smallpox submitted to WHO collaborating centres for laboratory diagnosis, 1972–1976

Country	Number of specimens[a]	Monkeypox virus present
Burundi	1	0
Cameroon	18	0
Central African Republic	16	0
Chad	11	0
Congo	3	0
Equatorial Guinea	0	0
Gabon	6	0
Rwanda	2	0
Zaire	691	14
Total	748	14

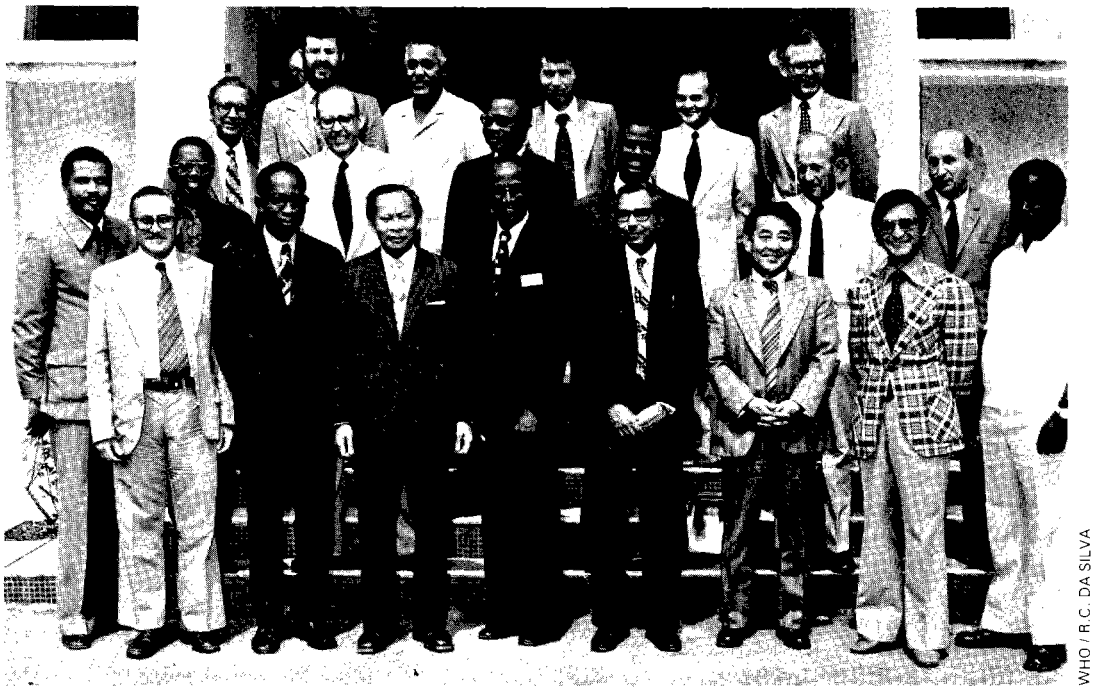
[a] All negative for variola virus.

The Commission met again in Brazzaville from 28 to 30 June 1977 and, after discussing the findings of the field visits, concluded that there was no evidence that smallpox had occurred in any of the 9 countries of central Africa since August 1971. Specific questions by the teams about variolation and laboratory stocks of variola virus elicited the information that variolation was not practised in any of these countries, nor were stocks of variola virus held in their laboratories. Since smallpox was still endemic in Somalia, the Commission recommended that careful surveillance should be continued and vaccination campaigns maintained, particularly for preschool children, in all countries until such time as the global eradication of smallpox could be certified. The Commission also recommended that active surveillance of human monkeypox should be maintained.

CERTIFICATION IN AFGHANISTAN AND PAKISTAN

Afghanistan and Pakistan, which share a border of about 1000 kilometres, were the first countries on the Asian mainland from which the eradication of smallpox was certified. In both, the national eradication programmes were started in 1967; the last cases were recorded in 1973 and 1974 respectively. The geographical features and ethnic make-up of the border areas were similar on both sides of the frontier and cases had been imported across it into Afghanistan. Smallpox was still endemic in India in 1975, but Pakistan's long border with India was closed, and population movements across it were infrequent.

In contrast to the situation in western and central Africa, in which the last outbreaks occurred in 1970 and 1971 respectively and many countries in both regions had been free of endemic smallpox for several years previously, the disease had been endemic in Afghanistan and Pakistan recently enough for the intensified surveillance of the later



WHO / R.C. DA SILVA

Plate 25.4. Participants in the meeting of the International Commission for the Certification of Smallpox Eradication in Central Africa, 30 June 1977. *Left to right, front row:* M. Altmann (WHO), **P. Agbodjan (Togo)**, Le Van Giat (WHO), **A.K. M'Baye (Senegal)**, Z. Islam (WHO), I. Arita (WHO), C. Algan (WHO), Kalisa Ruti (Zaire); *middle row:* R. Molouba (Congo), J.A. Mahoney (WHO), P. Ziegler (WHO), **M. Yekpé (Benin), E. Coffi (Côte d'Ivoire), F. Dekking (Netherlands)**, E. Zanotto (WHO); *back row:* A.H. Abou-Gareeb (WHO), **J.G. Breman (USA)**, A.W. Wilson (WHO), J.-P. Jardel (WHO), **R. Netter (France)**, J.J. Rogowski (WHO). The names of the Commission members are in bold type.

stages of the eradication programme to be carried over into the preparations for certification. For this reason reliance was placed on active surveillance and searches, rather than on the pockmark surveys used in Africa. The same international commission dealt with the certification in both countries in the latter part of 1976, a few months after the certification of western Africa and before that of central Africa.

AFGHANISTAN

The last case in Afghanistan was recorded in July 1973 but, because of the prevalence of smallpox in neighbouring Pakistan and the concern that foci of unreported smallpox might remain in remote areas of the country, surveillance was reinforced. Dr Arcot G. Rangaraj, a WHO epidemiologist, remained in Afghanistan until certification had been completed. Dr Abdul Mohammad Darmanger of the Ministry of Health played an important role in the 12-member National Committee for Smallpox Eradication, which took responsibility for the preparations for certification.

Analysis of the sources of outbreaks occurring during the last 4 years of endemic smallpox (Table 25.16) showed the need to pay particular attention, in the precertification surveillance activities, to variolation and nomadic groups.

Precertification Activities

Surveillance: 1973–1975

For operational purposes, Afghanistan was divided into 4 zones (see Chapter 14, Fig. 14.3) and subsequently into 3 zones—namely, Kabul, Kandahar and Kunduz (see Fig. 25.8). To search for and investigate suspected cases, special surveillance teams had continued work after the last case, 3 teams being located in the Kabul zone, 3 in the Kandahar zone, and 1 in the Kunduz zone. Special surveys

Table 25.16. Afghanistan: outbreaks of smallpox, 1970–1973

Source of outbreaks	1970		1971		1972		1973	
	Number	%	Number	%	Number	%	Number	%
Importations from Pakistan	11	13	13	12	18	41	3	100
Variolation	23	27	21	19	3	7	0	-
Nomads	8	10	4	4	5	11	0	-
Hospitals	5	6	2	2	0	-	0	-
Kabul city	8	10	4	4	0	-	0	-
Other endemic foci	8	10	51	48	14	32	0	-
Undetermined	20	24	12	11	4	9	0	-
Total number of outbreaks	83		107		44		3	
Total number of cases	1 044		736		236		25	

were organized in areas in which smallpox outbreaks had occurred after 1967, either through natural transmission or through variolation, and in border provinces, as well as those in which nomads were concentrated during the summer. During the period 1974–1975, 255 of the 327 administrative units of the country (78%) were visited by surveillance teams, but no new focus of smallpox infection, indigenous or imported, was detected.

About 700 villages were identified in which variolation had been practised in the past, and 90 of them—those in which it had been performed most recently—were repeatedly checked and visited. Neither practising variolators nor fresh variolation scars were detected. In addition, 155 nomad encampments were visited and searched in the Kabul, Kunduz and Kandahar zones, with the same result.

Special active search in 1976

A special active search for suspected cases in rural areas was carried out in 1976 by 7 smallpox surveillance teams and 15 combined BCG/smallpox vaccination teams. These teams checked all villages with more than 250 persons and, regardless of the size of the population, all previously affected villages and those in which variolation had been practised. The teams moved from province to province, arranging their operations according to the climatic and geographical conditions of the area to be searched. Of the 28 provinces, 22 were covered, an average of 6–8 villages being visited daily by each team. Over 8000 villages were searched, accounting for 93% of the villages with a population of more than 250 in the country. Teams also visited and interviewed people in 1548 markets, 2100 tea-shops and 1192 schools throughout the country. Two months later, the same areas were visited by assessment teams which interviewed villagers and assessed the work of the search teams in 10% of these villages. It was found that many villagers had seen searchers and 88% knew where and to whom to report suspected cases. During the search, 262 suspected cases of smallpox were found; 135 (51%) of them proved to be cases of chickenpox and 110 (42%) measles; the remaining 17 were cases of other skin diseases such as eczema, scabies and dermatitis.

A special pockmark survey was conducted among the 0–4-year-old children of nomads. Altogether, 5107 of these children were examined in 8 provinces inhabited by nomads during the summer. Only 2 children with pockmarks were found, both of whom had contracted smallpox more than 3 years earlier while travelling between Pakistan and Afghanistan.

Collaboration of the malaria control programme in the active search

During the period April–June 1976, in addition to the active searches carried out by surveillance and mobile vaccination teams, about 1000 malaria control programme workers carried out another search in densely populated areas below an elevation of 2000 metres—i.e., where malaria transmission occurred. About 13 000 villages were visited, 680 000 households searched and about 3 million people interviewed. Not only were suspicious cases detected, none of which proved to be smallpox, but the search also assisted in increasing the awareness of the

population of the need to notify suspected smallpox cases.

Hospital searches

In April–June 1976, local health staff in provincial hospitals, maternal and child health clinics and basic health centres made inquiries among visiting outpatients about any suspected cases present in their home villages or towns. The search resulted in the detection of 223 suspected cases; 55% proved to be measles and 28% chickenpox, the remaining 17% including a variety of skin diseases. Furthermore, staff of the provincial hospitals participated in searches in the towns and in villages located within a 5-kilometre radius. As an incentive, from 1976 onwards a reward of 3000 afghanis (US$51) was offered for every report of a confirmed case of smallpox. Despite these activities, no evidence was found of recent smallpox. All the results indicated that smallpox had not been present in the country during the previous 3 years.

Variolation

From the inception of the Intensified Smallpox Eradication Programme in Afghanistan, there was concern that variolators, who were especially active in the central and eastern parts of the country, might play an important role in smallpox transmission (see Chapter 14). In fact, 47 of the 237 outbreaks recorded between 1970 and 1973 could be specifically attributed to variolation (see Table 25.16). The last known variolation in Afghanistan was recorded in Dand Area of Kandahar Province in April 1976. However, none of the 57 children variolated at that time had developed any skin lesions at all. Evidently the variolation material used contained no viable virus.

Throughout the eradication programme, staff had attempted to identify variolators, to learn about their practices, and to persuade them to give up variolation. Whenever possible, they collected specimens of variolation material so that it could be assayed for the presence of viable virus. Also, intensive efforts were made to educate the population about the dangers of variolation and to vaccinate systematically throughout the country in order to demonstrate that vaccination was available to all. These measures proved to be remarkably successful.

The remaining question of concern was whether it might be possible for a variolator to retain over a period of many years scabs containing viable variola virus of sufficiently high titre to permit successful variolation. Variolators who were interviewed in 1976 claimed to have given up the practice during the previous few years, partly because villagers had gradually ceased to seek their services and partly because of pressure from the government. Most variolators asserted that the variolation material they had used was not effective for more than 1 or, at most, 2 years. Since smallpox had been absent from the country during the past 2 years it was therefore thought unlikely that many persons would attempt variolation because of the lack of effective material. Of 9 specimens collected from variolators in Afghanistan from 1969 to 1976, none had yielded viable virus since 1970, when smallpox was still endemic (Table 25.17).

Specimens were studied by virus isolation and electron microscopy, virus being isolated

Table 25.17. Afghanistan: results of laboratory tests of specimens of variolation material obtained from variolators

Age of specimen	Type of material	Date collected	Results	
			Poxvirus particles by electron microscopy[a]	Virus isolation
?	Fluid	March 1969	..	+
9 months	Scabs	May 1969	..	+
4 months	Scabs	September 1969	..	+
?	Scabs	April 1970	..	+
?	Scabs	January 1972	–	–
?	Scabs	April 1976	+	–
6 years	Powder	May 1976	+	–
6 years	Scabs	May 1976	+	–
10 years	Scabs	May 1976	+	–

[a] Virus particles may be visualized by electron microscopy, even though not viable; .. = not done.

from 4 of them. Three of the isolations were made from relatively fresh samples, 2 being between 4 and 9 months old; the third was fluid and would have dried up if it had been stored for more than 12 months. The fact that, as Table 25.17 shows, in 4 other specimens numerous poxvirus particles could be demonstrated by electron microscopic examination but virus could not be isolated suggested that viable variola virus probably did not survive under normal conditions for more than 2 years, or perhaps a much shorter period.

However, in the cold mountainous regions of Afghanistan in particular, the possibility could not entirely be ignored that one or more variolators might have been able to preserve for years material which contained variola virus with a titre sufficient to produce successful takes. One variolator from Kunar Province had stated in an interview that he (as well as a colleague in Peshawar, Pakistan) usually preserved scabs in a screw-capped container which was buried in the ground in a mountainous area. He considered this material to be effective for up to 10 years. On further questioning, however, he stated that fresh material had to be added to the basic stock each year.

Visit of the International Commission

The International Commission visited Afghanistan between 22 and 29 November 1976. After a preliminary meeting in Kabul, members of the Commission visited the 3 national smallpox eradication programme zones (Fig. 25.8) before their final meeting in Kabul.

They found that good records had been kept of smallpox control activities and that the work of the zonal smallpox eradication programme staff was of a high order. The basic health service units played a valuable role in investigating suspected cases of smallpox, but the recording and reporting of such activities was not standardized and was deficient in places. A number of recent suspected cases were reinvestigated and confirmed not to have been smallpox. The pockmark surveys of children showed that no outbreaks had occurred after the time when the zone concerned had been considered to be free from smallpox. No pockmarks were observed in children under the age of 5 years.

Checks for vaccination scars confirmed that a very high proportion of children had been vaccinated, as reported by national smallpox eradication programme staff, the major exceptions being in some nomad camps, where small groups of families were found to have been missed. The Commission teams were most impressed with the level of knowledge about smallpox, vaccination and the importance of reporting suspected cases found among all sections of the community. Knowledge of the reward was widespread in most of the provinces visited.

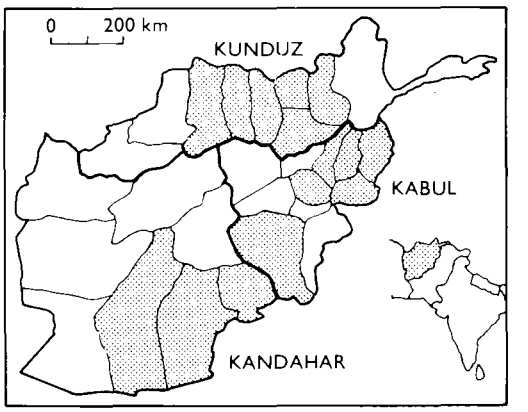


Fig. 25.8. Provinces (shaded) in the 3 zones of Afghanistan visited by members of the International Commission in November 1976.

Variolation scars, which could be distinguished from scars due to vaccination since they were on the wrists or the dorsum of the forearm (see Chapter 14), were common in adults, but there was no evidence of recent variolation other than that reported in Kandahar Province in April 1976, already mentioned.

The Commission certified smallpox eradication in Afghanistan on 30 November 1976, noting that the energetic and thorough surveillance activities carried out since 1972 would have been adequate to disclose cases of smallpox if they had occurred. Because some parts of Asia had still to be certified and the transmission of smallpox was still occurring in the Horn of Africa, the Commission recommended that surveillance and vaccination should be continued until global eradication had been certified.

As far as variolation was concerned, the Commission concluded that, although it was unlikely that scabs containing live virus remained in the possession of variolators, the possibility that variolation might cause future outbreaks could not be completely

excluded. The Commission was concerned about this prospect and strongly recommended that vigilance should be maintained. In fact, a further 3 years elapsed after the Commission's visit before the Global Commission finalized its report, during which time no case of smallpox was reported. This strengthened the belief that viable variola virus did not survive in variolators' material.

PAKISTAN

The last case of smallpox occurred in Pakistan in September 1974 (Table 25.18) and eradication was certified in December 1976.

Precertification Activities

As in Afghanistan, surveillance measures were further strengthened in all provinces after eradication because of the concern that foci of unreported cases might still be present, especially in "problem areas"—i.e., areas not easily accessible for geographical or political reasons. First priority was given to active search operations.

Country-wide searches

In 1975 several active searches were carried out by various categories of staff: vaccinators, searchers, malaria and family planning field staff and other health workers. In 1976 the searches were extended to the entire country, covering the majority of the rural areas. Three complete search operations were carried out in January, May and August 1975, usually for periods of 2 weeks each, although this was extended to 21 working days in many areas to ensure the best results. After each search operation, an independent assessment was made by the district and provincial surveillance teams, covering 5% of randomly selected localities in the territory already searched.

Similar search operations were carried out in urban areas throughout Pakistan. The administrative organization and health services available in the towns made it necessary for these searches to be carried out independently of those in rural areas. In general, municipal vaccinators and general health staff, supported by volunteers, carried out house-to-house searches in all slums, sweeper colonies (areas to which migrants normally went), other poor socio-economic areas, cantonment areas, railway settlements, the areas in which the last 20 outbreaks of smallpox had occurred, and the areas on the outskirts of towns in which nomads usually settled. In June and July 1976 a special all-Pakistan urban search was carried out in towns with a population of over 50 000, and in all district headquarter towns, regardless of their size. An intensified health education campaign was also carried out in these towns before search activities commenced.

Searches in problem areas

Provincial and district surveillance teams, assisted by local health staff, organized repeated special searches in the problem areas previously mentioned, which might not have been properly searched in the course of eradication activities. As a rule, randomly selected villages and settlements in such areas were visited, and information on the occurrence of smallpox cases during the past 2 years was collected and checked; in addition, vaccination scar and pockmark surveys were carried out among children under 5 years of age.

These special searches were intensified during the first half of 1976, when particular attention was paid to parts of Azad Kashmir, the areas bordering on China, remote areas of Baluchistan inhabited by nomads, mountain-

Table 25.18. Pakistan: number of reported cases of smallpox, 1970–75, by province or area

Province or area	1970	1971	1972	1973	1974	1975
Azad Kashmir	0	0	0	0	9	0
Baluchistan	80	291	559	801	202	0
North-west Frontier	525	2 654	1 338	194	163	0
Punjab	1 480	2 036	1 495	415	1 503	0
Sind	1 107	827	3 661	7 848	5 982	0
Total	3 192	5 808	7 053	9 258	7 859	0

ous parts of Punjab, flood-affected riverine areas in Sind and on the border with India, and the Thar desert (Fig. 25.9).

Active searches in areas in which the last outbreaks occurred

During 1975 and again in March–April 1976, a special team composed of the most competent vaccinators, sanitary inspectors and health assistants, together with district surveillance teams, visited the areas in which the last 20 outbreaks had occurred in each district, reassessed the previous reporting, case-finding and containment activities, and carried out an active case search in all the localities within a 5-mile (8-kilometre) radius of the previously affected areas. Pockmark surveys were conducted on a large scale, particularly among children under 2 years of age, in an effort to find undisclosed cases, but none was found in that age group.

In the districts in which smallpox incidence had been low and the number of outbreaks small, all localities which had had smallpox outbreaks in 1974 were visited and the epidemiological situation rechecked in an effort to disclose possible continuing transmission.

To assess surveillance independently, surveillance teams from one province visited another province or area for periods varying from a few weeks to 2 months. Thus, in 1976, provincial and district teams from Punjab assessed the efficacy of the programme operations in Azad Kashmir, Baluchistan, and North-west Frontier Province; Sind provincial and district teams did the same in Baluchistan and Punjab.

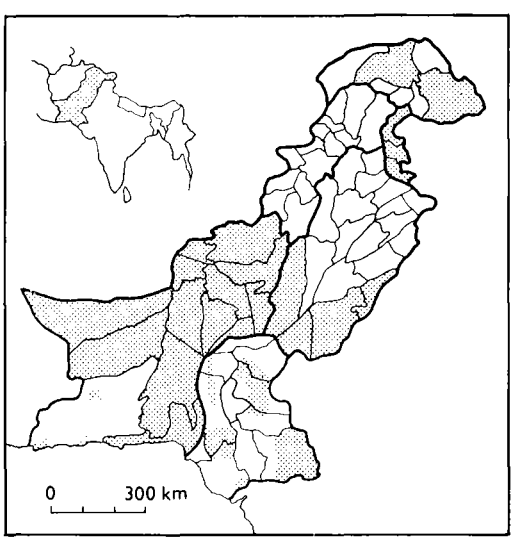


Fig. 25.9. "Problem areas" in Pakistan (shaded), in which special searches were carried out during pre-certification activities in 1976.

Rewards

The cash reward offered for finding smallpox cases was increased from 100 rupees (US$10) to 200 rupees, and in July 1975 to 500 rupees. The reward was publicized as widely as possible by means of the radio, press and wall posters in order to encourage the public to report suspected cases.

In November 1975, the following new system of rewards was introduced:

— 1000 rupees to anyone who reported an active case of smallpox;

— 100 rupees to any health worker who discovered a child with facial pockmarks that originated from a smallpox-like disease which had occurred after October 1974;

— 1 rupee to search workers for every chickenpox case visited and recorded during the all-Pakistan search operation in January 1976.

The participation of the local administrative authorities was sought. A special postcard, signed by the Deputy Commissioner, was sent to each *numberdar* (village leader), asking him to question, within a week, all the inhabitants of his village as to the presence of smallpox cases and, if any existed, to report them immediately to the district authorities.

Results

As a result of all these activities, 49 874 cases of fever with rash were detected, reported and investigated by November 1976. The reporting of cases of chickenpox during the search periods was encouraged (Table 25.19), on the assumption that a surveillance system sufficiently sensitive to detect them would almost certainly detect smallpox outbreaks. Altogether, 27 703 chickenpox cases were reported. Laboratory specimens were collected from 157 cases in which the diagnosis was in doubt and tested by WHO collaborating centres for the presence of variola virus, with negative results. No focus of smallpox infection, indigenous or imported, nor any recent case of smallpox was detected. All the information obtained in

Table 25.19. Pakistan: number of cases of fever with rash investigated and number of cases of chickenpox reported between October 1974 and September 1976, by province or area

Province or area	Number of cases of fever with rash	Number of cases of chickenpox
Azad Kashmir and northern areas	608	524
Baluchistan	242	184
North-west Frontier	6 878	3 196
Punjab	31 267	16 658
Sind	10 979	7 141
Total	49 874	27 703

1975–1976 served to confirm that the disease had not been present in the country since October 1974.

Variolation

Variolation had been practised in Pakistan both in North-west Frontier Province and to a lesser extent in Punjab, but on nothing like the scale found in Afghanistan. Material was collected from several variolators during 1975. In 1976, local health staff throughout the country were asked to inquire about variolations performed in the last 12–18 months, to visit the areas concerned, and to try to locate the variolators and collect variolation material from them. Examination of 11 specimens by electron microscopy revealed poxvirus particles in 9, none of which yielded viable virus (Table 25.20). One specimen collected in 1975 showed numerous herpesvirus particles, suggesting that a professional variolator, desperate to find a smallpox patient from whom he could replenish his material, took specimens from a chickenpox patient, either deliberately or after misdiagnosis.

Visit of the International Commission

The International Commission for the Certification of Smallpox Eradication in Afghanistan was also responsible for certification in Pakistan. It travelled to Islamabad after completing its visit to Afghanistan, and remained in Pakistan from 6 to 18 December 1976, members visiting 37 of the 71 districts or agencies in the country (Fig. 25.10).

Field visits

Evidence of the recent occurrence of smallpox was sought by means of pockmark surveys, especially among children, and by questioning people. A number of recent suspected cases were reinvestigated and confirmed not to have been smallpox. The areas selected for special searches included some of those in which smallpox had occurred late in 1974. Scar surveys were carried out to assess vaccination coverage and the extent of variolation. Where possible, known variolators were traced and interviewed and sites of outbreaks due to variolation were revisited. Inquiries were made among different sections of the population to determine the extent of

Table 25.20. Pakistan: results of laboratory tests of specimens of variolation material obtained from variolators

Province	Age of specimen (years)	Type of material	Date collected	Results	
				Electron microscopy[a]	Virus isolation
North-west Frontier	3–6	Scabs	March 1976	+	–
	4–5	Scabs	April 1976	+	–
	3–8	Scabs	April 1976	+	–
	4	Scabs	May 1976	+	–
	3	Scabs	July 1976	+	–
	?	Scabs	August 1976	+	–
	?	Scabs	August 1976	+	–
Punjab	1	Scabs	March 1975	*b*	–
	4	Scabs	April 1975	+	–
	2	Scabs	May 1975	+	–
	?	Scabs	May 1975	*c*	–

[a] + = orthopoxvirus particles seen.
[b] Not done.
[c] Herpesvirus particles seen.

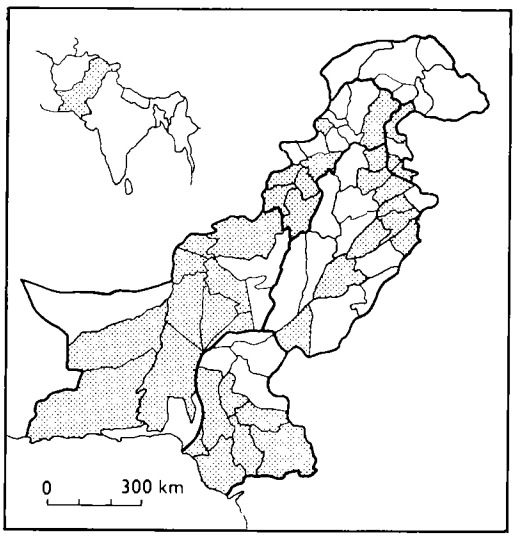


Fig. 25.10. Districts of Pakistan (shaded) visited by members of the International Commission in December 1976.

their knowledge of smallpox and of the reward offered for its detection.

Results of searches

The Commission's teams found pockmarks in 99 out of more than 7000 children under the age of 15 (1.4%). Only 5 children under 5 years of age were found to have pockmarks; all were recorded cases from outbreaks which had occurred before October 1974. No undisclosed outbreaks were discovered during the Commission's surveys. A substantial number of recent outbreaks were reinvestigated and details of the cases verified in the records. No missed cases were discovered. The checks for vaccination scars showed that a very high coverage had been achieved among adults and older children, somewhat less satisfactory levels being found in some areas among children under 5 years of age.

The evidence of variolation scars in adults confirmed that this practice had been common many years previously in parts of Baluchistan, in certain of the tribal areas of North-west Frontier Province and in a few communities in other provinces. Variolation scars were seen in children in 2 of the areas associated with documented episodes in 1974 but, despite careful searches, not in children elsewhere. Ten former variolators were interviewed. They stated that variolation material did not remain potent for more than a year at the most and that the practice had been abandoned. Signs advertising the reward for

Plate 25.5. Vaccination scar and facial pockmark survey being conducted by members of the International Commission for the Certification of Smallpox Eradication in Pakistan, December 1976.

	Population (millions)	Year 1973	1974	1975
BANGLADESH	76.6	32 711	16 485	13 798
BHUTAN	1.2	6	3	—
BURMA	30.8	—	—	—
INDIA	618.8	88 114	188 003	1 436
NEPAL	13.0	277	1 549	95

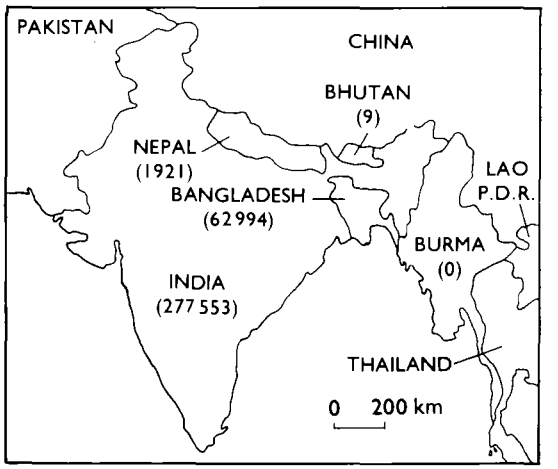


Fig. 25.11. Numbers of cases of smallpox reported from 4 countries in the Indian subcontinent and Burma, 1973–1975. Population data for 1975 from United Nations (1985).

reporting smallpox were seen in many of the places visited and, although their distribution was uneven, knowledge of the reward was widespread.

Conclusions

The Commission concluded that the smallpox eradication programme had achieved its goal in October 1974 and that there had been no smallpox transmission in Pakistan since that time. Although population movements across the long border between Pakistan and India were very limited, the Commission recommended that primary vaccination should be continued at least until the whole of Asia had been certified to be free of smallpox.

CERTIFICATION IN THE REST OF THE INDIAN SUBCONTINENT AND BURMA

Bangladesh, Bhutan, Burma, India and Nepal, contiguous countries in a vast area (Fig. 25.11) in which smallpox had been endemic for centuries, with frequent transmission across the international boundaries, were dealt with next. The last case of smallpox in India was reported in May 1975. Nepal and Bhutan experienced a number of importations from northern India as late as 1974 and 1975. In Bangladesh, freed from smallpox in 1971, major epidemics developed from 1972 onwards as a consequence of importations from West Bengal and Bihar. The last outbreaks of smallpox in Burma occurred in 1969, when an importation from Bangladesh resulted in 68 cases. Thus, in these 5 countries, continuing freedom from the disease depended very much on whether the adjacent country was smallpox-free. Because of India's large size and vast population, the smallpox situation in that country greatly influenced that in the others. Bhutan recorded its last smallpox case in February 1974, Nepal in April 1975 and India in May 1975 (Table 25.21). For certification purposes, these 3 countries were treated as a group and certified by international commissions in April 1977. Bangladesh recorded its last case in October

Table 25.21. Number of reported cases of smallpox in 4 countries of the Indian subcontinent and Burma, 1967–1976

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Bangladesh	6 648	9 039	1 925	1 473	0	10 754	32 711	16 485	13 798	0
Bhutan	14	0	0	0	0	0	6	3	0	0
Burma	2	181	68	0	0	0	0	0	0	0
India	84 902	35 179	19 281	12 773	16 190	24 407	88 114	188 003	1 436	0
Nepal	110	249	163	76	215	399	277	1 549	95	0

Plate 25.6. Planning workshop for precertification activities in India and Nepal, held in Kathmandu, Nepal, 29 January – 2 February 1976.
Left to right, front row: N.A. Ward (WHO), R.N. Basu (India), Than Win (Burma), A.J. Hajian (WHO), E. Shafa (WHO), S.O. Foster (WHO), P.N. Shrestha (Nepal), A.K. Joarder (Bangladesh), D.A. Henderson (WHO), M.I.D. Sharma, (India), D.J.M. Tarantola (WHO), M. Sathianathan (WHO), Z. Ježek (WHO), R. Thapa (Nepal), L.B. Brilliant (WHO);

1975 and was certified in December 1977. Because of its contiguity, Burma was certified together with Bangladesh.

INDIA, NEPAL AND BHUTAN

India

The last case of smallpox in India occurred in May 1975 and the country was certified to be free of smallpox in April 1977. Precertification activities were recognized as an essential follow-up to eradication, and WHO support in terms of personnel and funds (provided by Sweden) was continued. About 60 epidemiologists (20 international and 40 national) participated in the 2-year preparation for certification, a detailed account of which is given in Basu et al. (1979). Ježek, Dr Lev Khodakevich and Dr Nicholas Ward were responsible for coordinating the activities on behalf of WHO. At the national level, Dr R. N. Basu took full responsibility for certification preparations. Detailed planning was discussed at an informal workshop held in Kathmandu, Nepal, from 29 January to 2 February 1977 (Plate 25.6).

Precertification activities

A thorough programme was undertaken, consisting of the following components: intensified surveillance for cases of fever with rash, active searches for possible cases of smallpox, laboratory testing of suspected cases of smallpox, and finally a comprehensive assessment of all this work by a national assessment commission.

Surveillance of outbreaks of fever with rash. A system for the surveillance of all cases of fever associated with a rash was introduced throughout India in January 1976. This required each health worker to report all such cases, as well as cases of and deaths from chickenpox, in addition to all cases suspected of being smallpox. Special registers for cases of fever with rash were established at each basic reporting unit—namely, 5323 primary health centres, 1005 municipal health offices, 1050

DAS PHOTO STORE

Back row: A. Nasiruddin (Bangladesh), K. Rahman (Bangladesh), M. Bari (Bangladesh), A. Moazzem (Bangladesh), M.C. Appa Rao (India), W. Hardjotanojo (WHO), A.G. Achari (India), M. Dutta (India), R.R. Arora (India), V.A. Moukhopad (WHO), C.K. Rao (India), P. Kunasol (Thailand), C. Sthapit (Nepal), M.K. Al Aghbari (WHO), B. Rana (Nepal), M.K. Singh (India), K. Dixit (Nepal), L.N. Khodakevich (WHO), Unidentified person, I.B. Khatri (Nepal), D.P. Olsen (WHO), J.S. Weisfeld (WHO), T. Chettri (Nepal), Y. Selivanov (WHO), T.S. Jones (WHO), D.A. Breach (WHO), H.D. Mehta (WHO), A.M. Monnier (WHO), A.M. Scardaci (WHO), J.S. Friedman (WHO).

selected hospitals and 797 other peripheral notification posts, as well as 428 smallpox eradication programme offices based in district and state health establishments.

Active search operations. Active search operations, initiated as part of the eradication campaign in the autumn of 1973 (see Chapter 15), continued throughout the period from May 1975, when the last case was discovered in India, until April 1977, when the International Commission visited the country. The frequency of these active search operations is shown in Fig. 25.12.

Compared with the searches in 1973 and 1974 during the eradication programme, those carried out in 1975 and 1976 were both much more extensive and more intensive, and included 3 country-wide searches conducted in the autumn of 1975, the spring of 1976 and the autumn of 1976. These involved some 110 million households in more than half a million villages and 2600 urban areas. The major national search operations aimed at recording not only suspected cases of smallpox, but also any cases of fever with rash, including chickenpox, measles and certain skin diseases. In addition, individual states intermittently carried out their own searches. Diagnoses were verified only by higher-level health officers. A reward of 1000 rupees (US$100), introduced in July 1975, was offered to both searchers and health officers and the general public, and provided a strong incentive for the searchers to discover cases of smallpox, if they did occur (Plate 25.7).

More than 95% of all the villages in India were searched during each country-wide search. No smallpox cases were found although tens of thousands of cases of chickenpox were seen. The results of the subsequent assessment of some 10% of the villages already searched indicate that about 70% of the families knew about the smallpox reward and where to report the disease should they find it. Fig. 25.13 shows the percentages of households assessed as having seen the searchers in each survey, by district. The coverage by searchers was good in the 1975 search and improved still further in those carried out in 1976 (Table 25.22).

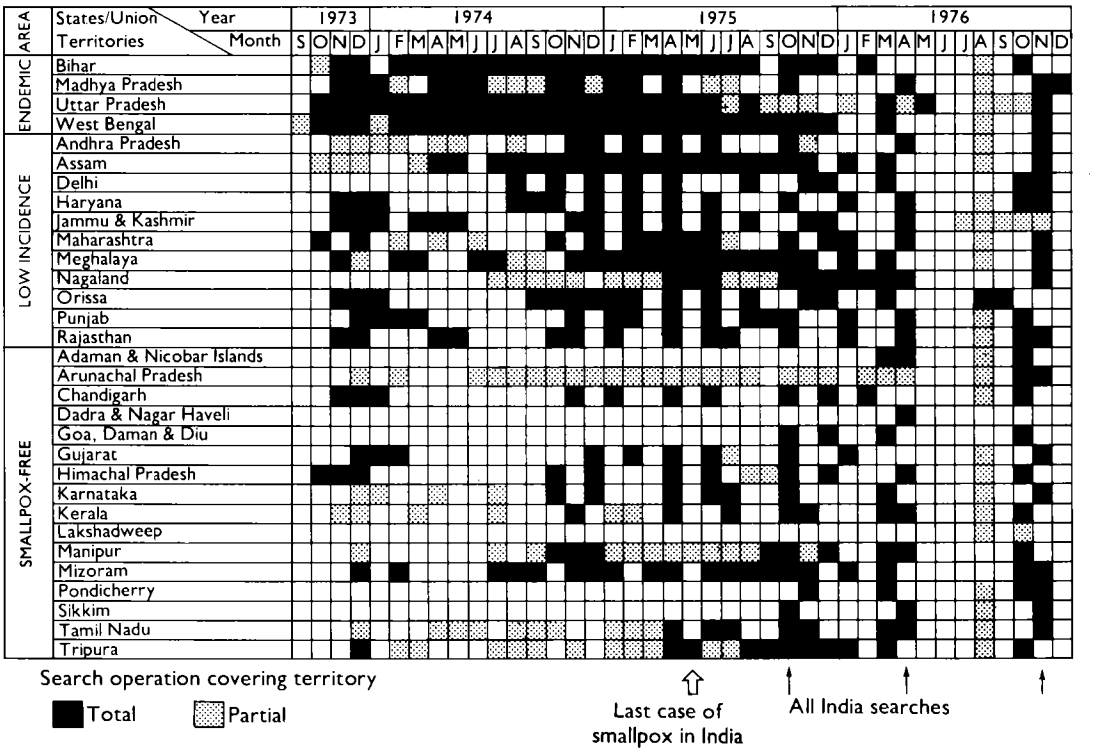


Fig. 25.12. Frequency of active search operations in India, 1973–1976. (From Basu et al., 1979.)

Table 25.22. India: country-wide searches, 1975–1976

	October–November 1975	March–April 1976	October–November 1976
Target area:			
Total number of villages	615 919	692 189	674 491
Number of villages searched	604 459	682 151	668 332
Percentage searched	98.1	98.5	99.1
Search findings:			
Number of smallpox cases	0	0	0
Number of chickenpox cases	29 682	379 297	41 485
Number of chickenpox outbreaks	15 721	118 642	20 076
Numbers of personnel employed:			
Searchers	98 103	106 142	115 347
Supervisors	21 383	28 060	29 046
Assessors	5 163	7 974	8 048
Total	124 649	142 176	152 441
Assessment:			
Number of villages assessed	71 504	81 686	107 409
Number of villages found searched	68 551	77 193	104 596
Percentage searched	95.8	94.5	97.0
Number of households questioned	1 950 613	1 867 594	3 051 753
Percentage that saw searchers	94.0	79.3	86.0
Percentage that knew of reward	73.0	80.4	83.0

During 1976, altogether 1 951 487 cases were recorded in the registers for cases of fever with rash, 60% of them following active searches, 36% following routine village visits by health staff, reports by members of the public or through the secondary surveillance system, and 4% as a result of market searches. All cases were examined by experienced health supervisors and none was found to be smallpox. The data on cases

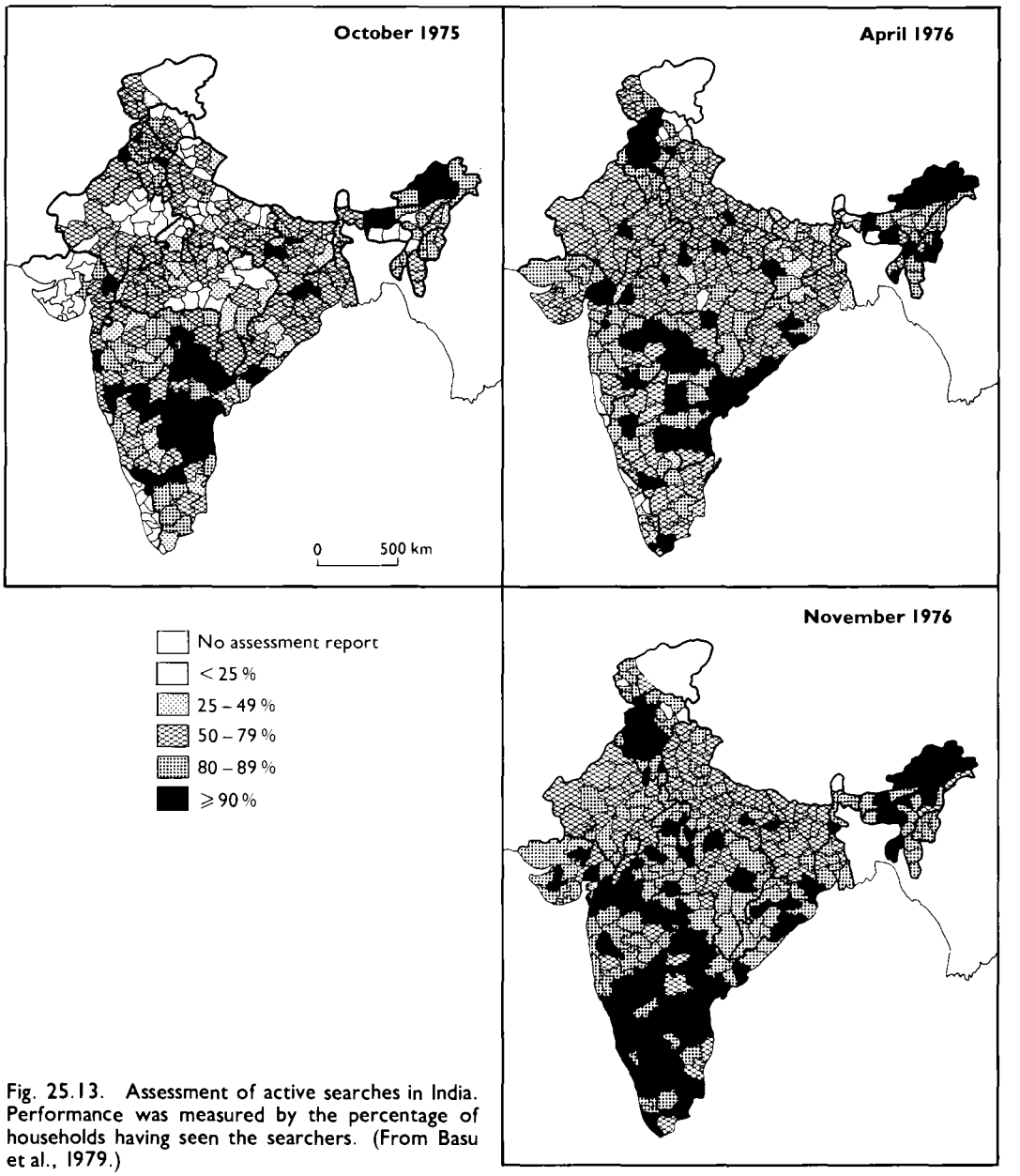
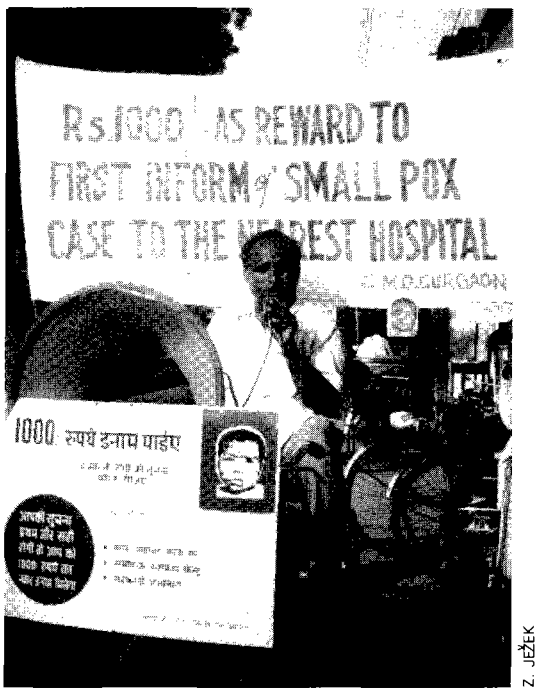


Fig. 25.13. Assessment of active searches in India. Performance was measured by the percentage of households having seen the searchers. (From Basu et al., 1979.)

entered in the registers are analysed in Table 25.23. In the same year, 519 651 localities in which these cases had occurred were visited by experienced senior health workers (37% of them by medical officers); in the first quarter of 1977, a further 322 526 localities were visited. The number and thoroughness of these investigations made it difficult to believe that smallpox could have persisted in India for 2 years without being detected.

Furthermore, 520 cases (102 suspected clinically to be smallpox and 418 deaths in chickenpox outbreaks) were investigated in 1976 by experienced epidemiologists associated with the smallpox eradication programme (Ježek et al., 1978e) and 63% of the suspected smallpox cases were found to be due to chickenpox; none was smallpox.

As would be expected from the known seasonal incidence of the disease, by far the largest number of chickenpox outbreaks and cases occurred during the spring search (March–April 1976). In April 1976, a special study was carried out in the state of Kerala,



Z. JEŽEK

Plate 25.7. During the eradication programme in India the reward had gradually been increased from 10 to 100 rupees by the end of 1974. In July 1975, after smallpox was believed to have been eradicated from India, the reward was increased to 1000 rupees.

in which chickenpox deaths appeared to be unusually frequent, especially in adults (White, 1978). The investigation revealed that deaths attributed to chickenpox had been correctly diagnosed.

Special searches. In addition to the search operations just described, special searches were carried out in certain parts of the country which, for geographical reasons, were relatively inaccessible. These had posed problems for surveillance during the eradication campaign and required special attention during the precertification activities. First, surveillance activities were reinforced in the Andaman and Nicobar Islands, Ladakh, Mizoram and Sikkim (Ježek & Kanth, 1978; Ježek et al., 1978b). Secondly, 353 sites of outbreaks at the end of 1974 and in 1975, dispersed over 55 districts located in 20 states or Union territories, were systematically reinvestigated in the latter part of 1976 (Ježek et al., 1978c). Investigations that included interviews with more than 128 000 households and the physical checking of over a quarter of a million persons yielded no evidence of hidden foci or missed outbreaks.

Laboratory diagnosis. During the Intensified Smallpox Eradication Programme, the diagnosis of smallpox had been confirmed by laboratory investigations mainly in suspected cases which had occurred in smallpox-free areas or areas of low incidence. The number of such investigations was substantially increased during the precertification activities, especially in the first quarter of 1977 (Table 25.24). From January 1976 onwards, special instructions were issued calling for specimens to be collected from a representative patient in every outbreak of suspected smallpox, from every chickenpox outbreak in which deaths occurred, and from every outbreak of a vesicular disease in which containment action was taken, even if by mistake. The last instruction was based on the fact that, before the active searches in 1973, vaccinators and health officials had occasionally concealed smallpox cases but carried out containment vaccination in the hope that the outbreak would subside.

In January 1975, the government of India arranged that the National Institute of Communicable Diseases should take sole responsibility for testing smallpox specimens from India; for this purpose, the Institute used both gel precipitation and virus isolation on the chorioallantoic membrane. The WHO collaborating centres in Atlanta and Moscow also tested many specimens and carried out electron microscopic examinations in addi-

Table 25.23. India: entries in registers of cases of fever with rash during 1976 and the first quarter of 1977[a]

Period	Total number of cases	Chickenpox		Measles		Other skin diseases		Miscellaneous cases[b]
		Cases	Deaths	Cases	Deaths	Cases	Deaths	
1976	1 951 487	862 155	433	519 597	3 122	146 855	175	422 880
1977 (to end of March)	1 189 072	638 060	105	481 743	619	31 417	..[c]	37 852

[a] Based on Ježek et al. (1978g).
[b] Malaria, diarrhoeal diseases, false alarms.
[c] .. = data not recorded.

Table 25.24. India: results of laboratory tests for variola virus, January 1975–April 1977

Year	Number of cases in which virus or specific antibodies were detected[a]				
	Total	Variola virus	Vaccinia virus	Varicella–zoster virus	Herpes simplex virus
1975	702	141	2	45	1
1976	640	0	4	106	4
1977 (end end of April)	1 385	0	..	..	..

[a] .. = data not recorded

tion to the other two methods. In principle, duplicate specimens were collected from each suspected case, one being tested by the National Institute of Communicable Diseases and the other by one of the WHO collaborating centres. For virus isolation, the results obtained were in full agreement. Laboratory investigations of 2025 specimens provided no evidence of smallpox in India during 1976 and 1977.

Variolation and laboratory stocks. In contrast to the situation in Afghanistan and Pakistan, variolation had not been a problem in India during the past few decades and no special inquiries were required. However, the situation with regard to laboratory stocks of variola virus was carefully evaluated and steps were taken in 1976 to ensure that all such material was destroyed.

The national commission

Before the International Commission's visit to India, scheduled for April 1977, the Indian government organized a national commission for the assessment of the smallpox eradication programme in India (Basu & Khodakevich, 1978a). This consisted of 32 members from the Union government of India and 12 state governments and from WHO (Plate 25.8). Both Dr Jan Kostrzewski (who was to be chairman of the International Commission shortly to be set up) and Arita also attended a coordination meeting of the national commission in January 1977, since successful certification of smallpox eradication in India by the International Commission was clearly an important milestone in certification in the world as a whole and thorough preparation was essential. The national assessment took place over the period from 13 December 1976 to 8 January 1977.

After a preliminary assessment of the situation, teams from the national commission investigated selected districts to assess their surveillance activities (Fig. 25.14). Although their observations might not be seen as completely impartial by observers outside India, the members of the national commission teams were extremely critical in assessing what had been accomplished since, if they failed to discover any deficiencies, they would be held responsible.

The national commission found no evidence of continuing smallpox transmission and India was considered ready to receive the International Commission in April 1977.

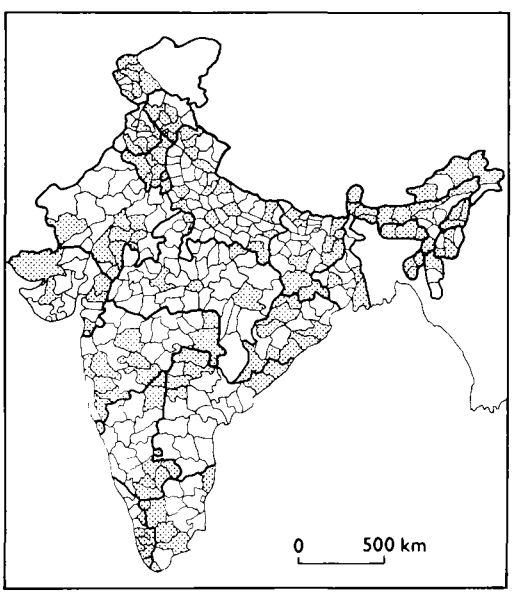


Fig. 25.14. Districts of India (shaded) visited by the National Commission for the Assessment of the Smallpox Eradication Programme, 13 December 1976 – 8 January 1977.

WHO

Plate 25.8. WHO personnel participating in the meeting on 20–21 January 1977 of the National Commission for the Assessment of the Smallpox Eradication Programme in India. *Left to right:* N.A. Ward, Z. Ježek, L.N. Khodakevich, J.S. Friedman.

Nepal

After what was regarded as the last case of smallpox in Nepal had been recorded in April 1975, surveillance was continued until the International Commission visited the country in April 1977. During the eradication programme, the country had been divided into 3 areas (see Chapter 15): (1) densely populated areas of low altitude adjacent to the Indian states of Uttar Pradesh and Bihar—i.e., the areas most vulnerable to smallpox importations; (2) high Himalayan mountainous areas with sparse populations and the least likely to experience importations; and (3) areas intermediate between (1) and (2). This subdivision was retained throughout the precertification surveillance period.

A similar surveillance strategy was adopted in all areas, active searches being carried out by means of house-to-house visits. The 3 main groups of surveillance workers were: smallpox eradication programme staff, malaria control staff, and health workers assigned to integrated health activities. Dr P. N. Shrestha, director of the national smallpox eradication programme, ensured that the best use was made of available health workers in order to strengthen the surveillance activities. Mr Jay Friedman, a WHO technical officer who had been located in Nepal since 1972, remained there until the International Commission visited the country, and contributed to the success of the undertaking. No evidence of smallpox transmission was found at any time during the precertification activities.

In 1975 a special pockmark survey was conducted among 2350 Tibetan refugees; this found no evidence of smallpox transmission in Tibet (Xizang Autonomous Region) more recently than 1961 (see Chapter 27). This was extremely important, since little was known of the incidence of smallpox in China at that time. The survey indicated that the chance of smallpox importation from Tibet was extremely small.

Bhutan

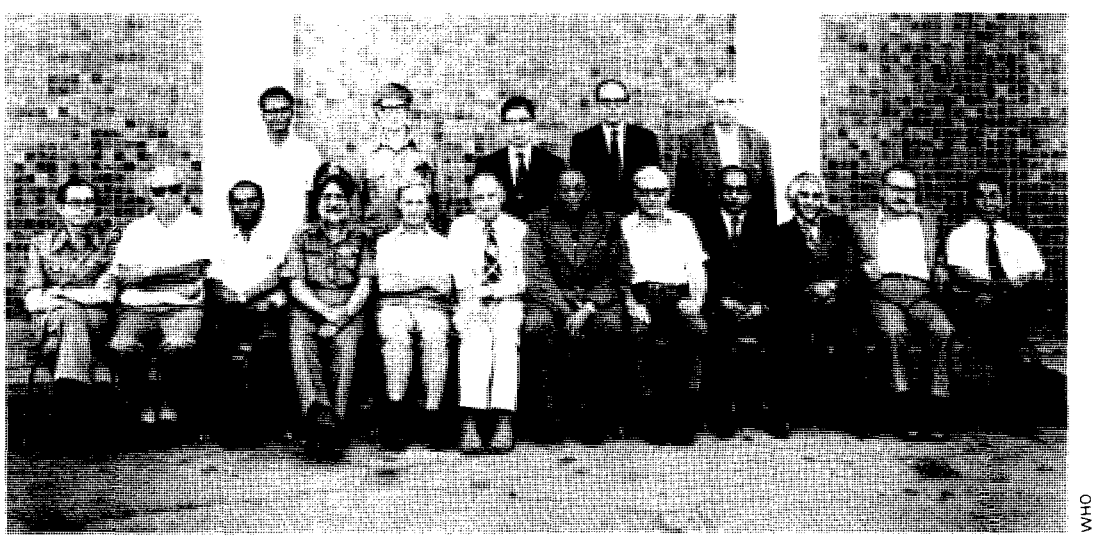
The last known case of smallpox in Bhutan occurred in February 1974, when 3 cases were introduced from Assam, India. In 1976 the

governments of Bhutan and India began discussions on the development of a special surveillance programme in preparation for certification. In August 1976 an Indian team, headed by Dr Basu, visited Bhutan to finalize the surveillance plan. An active search by means of house-to-house visits was carried out between September and December 1976, concentrated on the southern part of the country, where people moved freely across the border with India. A total of 23 surveillance workers visited about 800 villages; out of 45 000 persons seen, 11 were pockmarked. However, there was no indication of smallpox transmission after the last case in 1974.

Visit of the International Commission

An International Commission consisting of 16 members from 16 countries visited Bhutan, India and Nepal in March–April 1977; groups of Commission members visited Bhutan from 28 to 30 March, Nepal from 6 to 13 April and India from 6 to 20 April. For political reasons, Bhutan and India were certified separately. Since at that time only persons of Indian nationality were allowed to visit Bhutan, Lieutenant General R. S. Hoon, an epidemiologist serving in the Indian Defence Forces and a member of the International Commission, visited Bhutan together with Dr Basu, after which he participated in the investigation of the adjacent Indian state of Arunachal Pradesh.

All 16 members of the International Commission met first in New Delhi to assess the situation and plan field visits. During the field visits, each member was accompanied by national and WHO personnel who had either been members of the Indian national commission or were WHO epidemiologists who had worked in India during the precertification activities. In order to achieve maximum coverage, each member visited different areas in one or two states or union territories over a period of some 2 weeks (Fig. 25.15) before all the members of the Commission reassembled in New Delhi. Dr Kostrzewski with 2 members of the Commission and Ježek, who had been engaged in certification activities in India, visited Nepal, and then resumed their Indian field investigations. During the field visits, the Commission members concentrated on assessing the extent



WHO

Plate 25.9. Members of the International Commission for the Certification of Smallpox Eradication in India and Bhutan, and Nepal, 23 April 1977, with the Director of the WHO Regional Office for South-East Asia. *Left to right, front row:* H. Flamm (Austria), J. Červenka (Czechoslovakia), W.A.B. de Silva (Sri Lanka), R.S. Hoon (India), F. Fenner (Australia), J. Kostrzewski (Poland), V.T.H. Gunaratne (WHO Regional Director), D.M. Mackay (United Kingdom), A.M. Mustaqul Huq (Bangladesh), R. Roashan (Afghanistan), V.M. Zhdanov (USSR), U Thein Nyunt (Burma); *back row:* W. Koinange (Kenya), H.B. Lundbeck (Sweden), T. Kitamura (Japan), D.J. Sencer (USA), M.F. Polak (Netherlands).

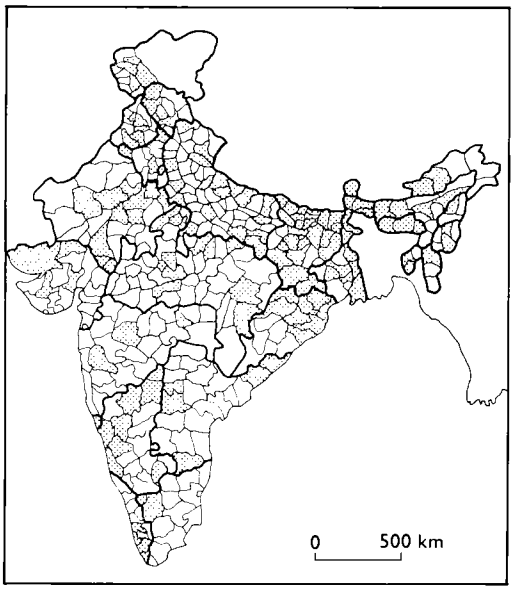


Fig. 25.15. Districts of India (shaded) visited by members of the International Commission, 4–23 April 1977.

and quality of the search and surveillance activities by examining records and interrogating several categories of staff at state, district, municipal, primary health centre and subcentre levels. They independently assessed the validity of statements about community awareness of smallpox by visiting villages, schools, urban areas, bazaars, places of pilgrimage and international ports. Brief reports were produced by the various Commission members or teams and these were discussed by the Commission at a plenary session from 21 to 22 April 1977.

In Nepal, 2 teams were formed, one covering the east and the other the west, special attention being paid to areas bordering on India. The members of the Commission were unable to visit the Tibetan border, but information collected from nearby mountainous areas indicated that Tibet was smallpox-free.

On 13 April 1977 Nepal was certified by the International Commission to be free of smallpox; this was followed, on 23 April, by the certification of Bhutan and India.

WHO

Plate 25.10. J. Kostrzewski, Chairman of the International Commission, presents the Commission's report to the Minister of Health and Family Welfare of India, Shri Raj Naraian, on the occasion of the certification of eradication in that country on 23 April 1977. Shri Rajeshwar Prand, Secretary of the Ministry, is in the centre.

BURMA AND BANGLADESH

Burma

Indigenous transmission in Burma had been interrupted in 1966 by a systematic mass vaccination campaign that began in 1954 and was intensified in 1963, using locally produced vaccine of acceptable potency and heat stability. Smallpox was then reintroduced from the Chittagong Hill Tracts in Bangladesh (then East Pakistan) into the neighbouring Burmese state of Arakan, in which it caused an outbreak with 181 reported cases in 1968 and 68 in 1969. This was controlled by intensive vaccination. In 1970 a WHO team had declared Burma to be free of endemic smallpox, and no further cases had been reported since then.

Between 1968 and 1975, 51 suspected cases of smallpox were investigated by field staff and specimens examined for variola virus in the laboratory, with negative results. In 1976–1977 the government of Burma established 4 national assessment teams, which visited every state and division in Burma, carried out pockmark surveys among children in the age group 5–14 years, and assessed the vaccination coverage and evidence relating to cases of suspected smallpox. The reports of these national assessment teams provided the basis for the investigations by the International Commission. In order to coincide with certification in Bangladesh, the Commission's visit was arranged for November 1977.

Bangladesh

The last case of smallpox in the Asian continent occurred in Bangladesh in October 1975; it was also the last case of endemic variola major in the world. As in India, the smallpox eradication programme retained its personnel and organization for the next 2 years in order to continue surveillance and determine whether the supposed last case really was the last one. Precertification activities in Bangladesh have been described by Joarder et al. (1980). Between October 1975 and May 1976, a large number of international and national staff were engaged in the search operations (Table 25.25). Among the many dedicated persons who contributed to the certification activities in Bangladesh, special mention may be made of Dr A. M. Mustaqul Huq, who had promoted the eradication programme since 1967, initially as programme manager and later as Director of Health Services (Preventive), and Dr Daniel Tarantola, a WHO epidemiologist, who stayed in Bangladesh until certification had been completed.

Active searches

Between October 1975 and October 1977 active country-wide searches for unreported cases, based on house-to-house visits, were organized on 8 occasions (Fig. 25.16). In each search, 50 000–60 000 health workers were mobilized. In the searches in December 1976–January 1977 and May–June 1977, deaths from chickenpox or measles were also investigated by interviewing a family member and/or taking specimens from other cases in the outbreak. A total of 56 deaths from chickenpox and 480 deaths from measles were investigated, as well as 63 deaths known only to have been caused by a disease in which there was fever with rash (Table 25.26). None of the fatal cases was due to smallpox.

After the search had been completed, the assessment team visited villages selected at random. They found that coverage by the search team varied between 78% and 87% (Table 25.26). More than 80% of the people interviewed knew about the smallpox reward.

Special searches were organized in the Chittagong Hill Tracts. The area was differ-

Table 25.25. Bangladesh: numbers of international and national epidemiologists engaged in surveillance, 1975–1977

Period	Number of WHO staff in Dhaka	Number of international field epidemiologists	Number of national epidemiologists	Total
July 1975	10	65	15	90
January 1976	7	21	20	48
July 1976	3	9	24	36
January 1977	3	7	32	42
July 1977	3	9	31	43

ent from other parts of Bangladesh in that the population was sparse, communications were poor and the health infrastructure was rudimentary. No evidence of smallpox was found.

Surveillance in Dhaka and urban areas

The active searches just described were carried out mainly in rural areas. However, it was in the major urban areas, including Dhaka in which housing was extremely congested and into and out of which tens of thousands of rural inhabitants flowed daily, that smallpox transmission had been maintained in the past, unknown to the central health services (see Chapter 16). In Bangladesh, moreover, the municipal health services were administratively independent of the district or regional health authorities, those responsible for smallpox eradication being no exception.

Surveillance in the municipalities therefore became an extremely important pre-certification operation. The methods employed were daily visits to infectious diseases hospitals and cemeteries to check on the causes of recent admissions, deaths and burials, and the use of surveillance teams, of which there were 2 in Dhaka and 1 in each of the other 5 major municipalities. They made regular visits to high-priority areas, including the bustees (the shanty towns, whose inhabitants were usually unfamiliar with the urban health facilities and, of course, with the reporting of information on rashes), areas of low literacy in which written publicity probably failed to reach the people, and places where the population congregated daily or intermittently in large numbers. House-to-house searches were conducted periodically in all municipalities, usually immediately after the national house-to-house searches in rural areas.

This schedule allowed surveillance teams and epidemiologists to devote additional time to the supervision and assessment of urban searches. None of these search activities disclosed evidence of continuing smallpox transmission after the case in October 1975.

Pockmark survey

A facial pockmark survey of 465 892 persons aged 0–19 years, based on 1550 sampling sites all over Bangladesh, was conducted in July–December 1976. None of the 939 persons with facial pockmarks who had

Table 25.26. Bangladesh: house-to-house searches, May 1975–October 1977

Date	Search schedule		Results of investigation[a]					Assessment (random)			Percentage of households aware of:	
	Number of villages	Number of outbreaks	Total number of cases of fever with rash	Smallpox	Chickenpox	Measles	Other types of rash	Number of villages assessed	Number of houses assessed	Percentage of houses visited during search	reward	where to report
October 1975	62 690	10 909	10 652	0	2 376	.. *b*	8 276	1 749	34 362	78	79	72
Nov.–Dec. 1975	61 453	16 039	16 428	0	4 688	.. *b*	11 760	1 688	32 867	84	81	80
January 1976	62 204	31 372	33 283	0	19 007	9 543	4 733	1 515	32 111	85	87	79
March 1976	60 619	16 998	58 130	0	43 204	13 714	2 212	1 455	28 737	84	87	78
May–June 1976	60 562	11 337	28 929	0	17 038	9 436	2 505	1 378	27 301	87	90	80
Dec. 1976–Jan. 1977	61 604	8 131	20 312	0	11 835 (15)	6 654 (245)	1 823 (24)	1 466	29 095	83	86	76
May–June 1977	57 041	9 564	23 212	0	11 839 (41)	8 557 (235)	2 816 (39)	1 481	28 161	85	90	81
October 1977	57 780	?	3 266	0	1 334 (4)	1 069 (23)	863	1 442	28 763	82	88	81

[a] Numbers of deaths shown in parentheses.
b .. = data not recorded.

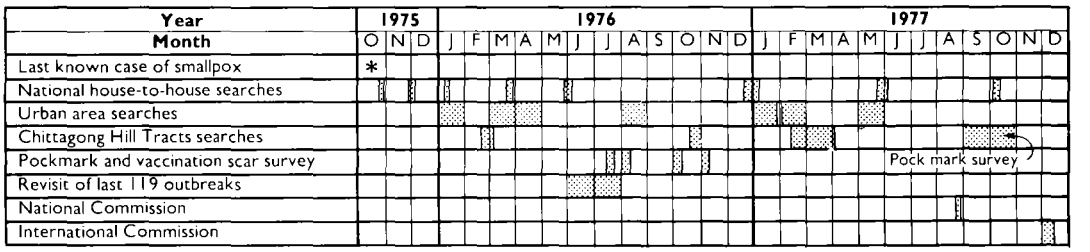


Fig. 25.16. Precertification and certification activities in Bangladesh between October 1975 and December 1977. August 1977: active searches, visits by members of the National Commission; December 1977: visits by members of the International Commission. (From Joarder et al., 1980.)

contracted smallpox after 1971 had been infected after 1975 (Table 25.27).

Laboratory diagnosis

Between January 1976 and November 1977, 2462 specimens were investigated by the smallpox diagnostic laboratory in the Institute of Public Health, Dhaka, and 698 were tested by WHO collaborating centres in Atlanta and Moscow (Table 25.28). In none was variola virus found, although vaccinia virus was recovered from vaccination scabs and herpesvirus particles were seen in many of the specimens examined by electron microscopy in the WHO collaborating centres.

Table 25.27. Bangladesh: results of pockmark survey, 1976[a]

Date of attack	Number of persons with pockmarks
Before 1972	3 367
1972	417
1973	329
1974	139
1975	54
1976	0

[a] Target population: 0–19 years; sample: 1% random cluster sample; number examined: 465 892.

The national commission

A national commission of 52 members met in August 1977 to assess the smallpox eradication programme in Bangladesh. Teams from the national commission visited all districts, 54 subdivisions, 81 *thanas* and each of the 4 major municipalities in Bangladesh. After meeting again in Dhaka, the national commission expressed its satisfaction with the evidence that had been assembled to support the contention that there had been no smallpox transmission in Bangladesh after October 1975.

Visit of the International Commission

After a briefing session at the WHO Regional Office for South-East Asia, in New Delhi, a 9-member International Commission visited Burma from 21 to 30 November 1977 and Bangladesh from 1 to 14 December 1977. One representative from Burma and one from Bangladesh were included in the Commission because two politically disturbed areas—Chin State in Burma and the Chittagong Hill Tracts in Bangladesh, with a common border—could be visited only by nationals of the country concerned. In addition, the representative of each country was expected

Table 25.28. Bangladesh: results of tests of specimens from suspected cases of smallpox by the Institute of Public Health, Dhaka, and WHO collaborating centres, 1976–1977

Year	Institute of Public Health, Dhaka			WHO collaborating centres			
	Number examined	Number positive for variola virus	Number positive for vaccinia virus	Number examined	Number positive for variola virus	Number positive for vaccinia virus	Number with herpesvirus particles
1976	406	0	16	163	0	7	32
1977	2 056	0	9	535	0	1	211

WHO

Plate 25.11. Participants in the National Commission for Smallpox Eradication, Bangladesh, 21–27 August 1977. *Left to right, front row:* H.D. Mehta (WHO), A.U.M. Khairul Bashar, Sarafat Ali, A.S.M.A. Hakim, A.E. Suliman (WHO), M. Khabiruddin, A.J.M. Mizanur Rahman, A.K.M. Kefayetullah, M. Abul Hossain, Nayeb Ali, V. Zikmund (WHO); *middle row:* S.M. Nuruzzaman, Nayeb Ali, D.J.M. Tarantola (WHO), M. Sathianathan (WHO), A.M. Mustaqul Huq, M. Zakir Husain, A.K. Joarder, K.M. Rahman, A.A. Miah, Serajul Haque; *back row:* Sarder Alauddin, Mozammel Huq, S.N. Ray (WHO), A.K.M. Lutfar Rahman Talukder, C.-T. Chong (WHO), A.I. Gromyko (WHO), M. Moizuddin, A.M.H. Nurul Alam, N.M.P. Mendis (WHO), Golam Nabi, G.R.A. Taylor (WHO), M. Shahidullah, Subrata Chakma, A.A. Stroganov (WHO), Mustafizur Rahman, Anwarul Islam, A.I.M.M. Islam, M.Q. Elahi, M.A. Latif Mia, Mobarak Ali, M. Asaduzzaman, Aung Myat (WHO), A.B.M. Mofizur Rahman, A. Mannan, M.A. Fattah Khan, A.J.R. Wylie (WHO), M. Serajul Islam, M. Aftabuddin Khan, Mofazzal Hussain, R.N. Basu (WHO).

to be particularly vigilant about the evidence of eradication in the other country.

Burma

Field trips by Commission members covered an area with a population of more than 4 million in addition to the city of Rangoon (population 3.2 million). Together, International Commission members and national teams covered all the states and divisions of Burma. One of the main activities of the Commission members during their field visits was a pockmark survey, in which more than 58 000 persons were seen (5000 preschool children, 29 000 schoolchildren and 24 000 adults), among whom 399 pockmarked persons were identified. The majority of these (96.5%) had suffered from smallpox before 1963, the most recently infected being a person who had contracted the disease during the outbreak in Arakan in 1968. Extensive questioning found no evidence of the occurrence of smallpox in Burma after 1969.

Earlier in 1977 national assessment teams had examined 1.97 million children aged 5–14 years without finding any with facial pockmarks. That the International Commission found 399 and the national commission none is explained in part by the fact that only 14 of those with facial pockmarks were under 14 years of age. It is also possible, however, that the definition of pockmarks was misunderstood during the national survey so that it did not give a truly representative picture of the prevalence of pockmarked persons.

Apart from this inconsistent result, the Commission was satisfied with the surveillance activities carried out by the Burmese health staff and found no evidence of smallpox transmission after 1970. Burma was certified to be free of smallpox.

Bangladesh

After completing its work in Burma, the Commission met in Dhaka for 2 days at the beginning of December for briefing, then divided into 9 teams, each consisting of a Commission member, a WHO smallpox eradication programme officer, a national

epidemiologist and the local officers concerned. These teams travelled extensively throughout Bangladesh (Fig. 25.17) and made thorough investigations, particularly in vulnerable areas in which transmission of smallpox might be continuing. Extensive questioning revealed that the people's knowledge of the reward and of where to report suspected cases was very good. Pockmark surveys of some 50 000 persons under 20 years of age, of whom 2000 were less than 2 years old, found 575 pockmarked persons, none of whom had contracted smallpox later than 1975.

Scrutiny of documentation and supporting records showed that, with few exceptions, a high level of surveillance had been maintained by the national authorities throughout the period since the last known case.

The results of the field visits by the Commission were consistent with the national records, and on 14 December 1977 Bangladesh was certified to be free of smallpox. This action formally set the seal upon the end of endemic variola major in the world.

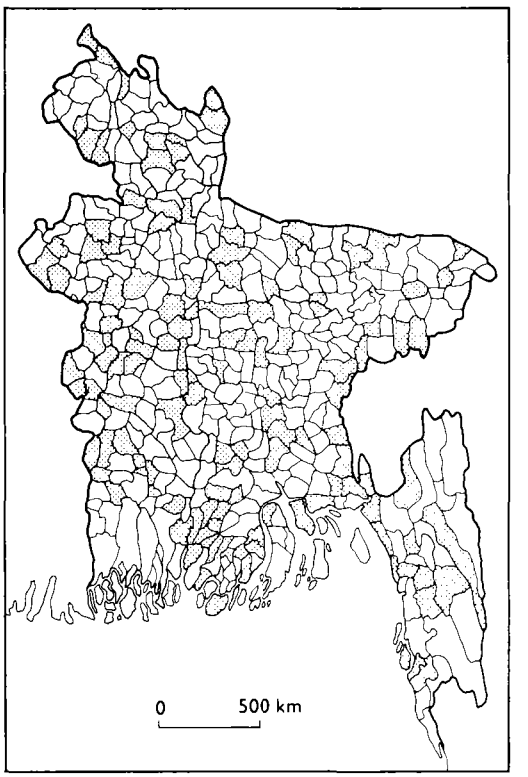


Fig. 25.17. *Thanas* in Bangladesh (shaded) visited by members of the International Commission, 1–14 December 1977. (From Joarder et al., 1980.)

CONCLUSIONS

These certification activities, which dealt with several of the former major endemic countries in the world, provided detailed information about the elimination of smallpox in the countries concerned and the methodologies for obtaining the data required by international commissions so that they could properly evaluate the likelihood that smallpox had been eliminated, both from countries in which it had recently been endemic and from those in which the last outbreak had occurred several years earlier. At the time the Consultation on the Worldwide Certification of Smallpox Eradication was held, in October 1977, preparations were well advanced for international commissions to visit other regions of Africa and Asia. It was on the basis of the knowledge and experience of certification gained between 1973 and 1977 that the Consultation was able to plan a logical series of operations that would ultimately provide the World Health Assembly with the information that would allow it to declare that smallpox had been eradicated from the world.