

A CHRONOLOGY OF PROGRESS, 1967-1980

Introduction

This section presents a year-by-year summary of progress in smallpox eradication (Fig. 10.4) to provide a frame of reference for the chapters describing the eradication programmes in individual countries or groups of countries (Chapters 12-23) and the certification of eradication (Chapters 24-27).

In compiling the data on the incidence of smallpox over the years, we have reviewed the available and sometimes conflicting reports and have made use of the figures that in our opinion most accurately reflect the situation at the relevant time. Some figures differ from those previously published and from those in the official national and international records. The differences are greatest for the early years of the programme, when notifications of reported cases were most delayed and incomplete. The reader who wishes to refer to the contemporaneous figures may consult the *Weekly epidemiological record*, which provided a compilation of the most recent information every 2-3 weeks and a summary of the status of the programme as a whole twice a year.

Throughout the course of the Intensified Smallpox Eradication Programme, particular importance was attached to defining which countries had endemic smallpox and which did not. Although this might seem a straightforward task, it was not so, especially during the first few years and for the smaller countries. The first summary of the situation in this period was provided in a report by the Director-General of WHO to the forty-first session of the Executive Board, which met in January 1968. In that report, 29 countries or territories were identified as being "endemic" (30 if East Pakistan, which later became Bangladesh, and West Pakistan are considered separately). Later information led to Cameroon, Southern Rhodesia and Yemen being added to the list; each had reported only a few cases in 1967 and these were at first assumed to represent importations, but they were not. However, 2 small countries—Lesotho and Swaziland—were mistakenly shown as having endemic smallpox in 1967 because of their proximity to infected areas in South Africa and their rudimentary reporting systems. Subsequent information suggests that both were smallpox-free. In later years, other countries were mistakenly identified as non-endemic because of government suppression

of smallpox notifications. This occurred for Iran from 1970 to 1972, for Iraq from 1971 to 1972 and for Somalia in 1976. Later information received from government and other sources served to clarify the situation.

The Situation at the Start of the Intensified Programme, 1967

The first year of the Intensified Smallpox Eradication Programme saw a substantial acceleration of activities compared with previous years. This was primarily the consequence of greater financial resources and more staff becoming available from WHO and of the implementation of the regional programme in western and central Africa that received direct support from the USA. Certainly this enhanced effort started none too soon, for the number of reported cases of smallpox in the world rose in 1967 to 131 776, one of the highest totals for a decade. Little of this increase can be attributed to better reporting since few countries had yet improved their case-notification procedures. Indeed, it soon became evident that reporting was even less complete than had been feared; it had been thought that perhaps 1 case in 20 was being notified, but experience in the field began to indicate that a figure of 1 in 100 was probably nearer the mark.

The 31 countries or territories classified as having endemic smallpox (see box) were in 4 epidemiological zones sufficiently separate to make it unlikely that if one was freed from smallpox, it would become reinfected from another. These were: (1) Brazil, (2) Indonesia, (3) Africa south of the Sahara, and (4) a contiguous group of southern Asian countries extending from Afghanistan through West Pakistan, India and Nepal to East Pakistan. The eastern borders of East Pakistan and India were taken as the eastern limit of endemic smallpox on the Asian mainland, although Burma had imported cases from 1967 to 1969. The People's Republic of China was not in relations with WHO in 1967 and provided no official information, but reports by visitors suggested that smallpox was not present there; the government confirmed this in 1973.

Programme implementation

Basic strategies and principles were issued in July in a WHO *Handbook for Smallpox Eradication in Endemic Areas*, and these were endorsed in September by the WHO Scienti-

fic Group on Smallpox Eradication. Surveillance reports giving epidemiological information and documenting progress in the countries were widely distributed by WHO from September on.

WHO gave priority to the eradication programmes in the smaller of the major epidemiological zones—Brazil and Indonesia—in the expectation that success there would free resources that could be concentrated on the larger and probably more difficult zones. Brazil's programme had started in 1966, and Indonesia and WHO agreed in December 1967 on one to start in 1968. Eradication programmes began or were under way in 12 of the other 29 endemic countries at the end of 1967. Programmes in Cameroon, Dahomey, Ghana, Mali, Niger, Nigeria, Togo and Upper Volta were included in the regional western and central Africa programme supported by the USA; a programme in the Democratic Republic of the Congo started late in the year; and WHO-supported programmes were continuing in Afghanistan, Nepal and Zambia, although only the last of these represented a meaningful effort.

Many other countries decided to undertake programmes and developed plans of operations with advice from WHO; the procurement of supplies began as each plan was finalized. In India, however, a serious problem was posed by the government's decision in December 1966 to terminate its 5-year-old vaccination campaign. That country was then reporting more than one-third of the world's cases. Appealed to by WHO, it agreed that a joint India-WHO team should undertake a field assessment of the situation late in 1967 and develop an alternative plan.

Other developments

In May the first annual meeting of WHO regional and Headquarters officers responsible for smallpox eradication was held to discuss and agree upon plans, needs and priorities. In December there was held in Thailand the first of many intercountry meetings at which the staff of programmes in different countries and their WHO counterparts exchanged experiences and debated strategies.

The supply of potent, stable vaccine being crucial to success, arrangements were made for laboratories in Canada and the Netherlands to test vaccines and to help countries to develop their own production. At the same time, WHO initiated a survey of the vaccine quality and production capacity of laboratories throughout the world. More than 200 batches of vaccine were tested under WHO's auspices in 1967 (43 batches in 1966, 12 in 1965). All countries were asked to contribute vaccine and by the end of the year 15 million doses had been distributed by WHO, 4 times as many as in 1966. Over and above this, the USSR provided more than 75 million doses, mainly to Afghanistan, India and Burma, and the USA about 25 million doses for use in Africa.

After trying and rejecting several cheaper variants of the jet injector, which had come into operational use in 1967, WHO assessed the capability of the bifurcated needle—a new device by which a very small amount of vaccine could be introduced almost painlessly into the skin by multiple punctures. By the end of the year it had proved to be the instrument of choice.

Countries or Territories with Endemic Smallpox in January 1967

Africa, eastern and southern: Burundi, Democratic Republic of the Congo (Zaire from 1971), Ethiopia, Kenya, Malawi, Mozambique, Rwanda, South Africa, Southern Rhodesia (Zimbabwe from 1980), Uganda, United Republic of Tanzania, Zambia.

Africa, western and central: Cameroon, Dahomey (Benin from 1975), Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Sierra Leone, Togo, Upper Volta (Burkina Faso from 1984).

Americas: Brazil.

Asia: Afghanistan, East Pakistan (Bangladesh from 1971) India, Indonesia, Nepal, Pakistan (West Pakistan until 1971), Yemen.

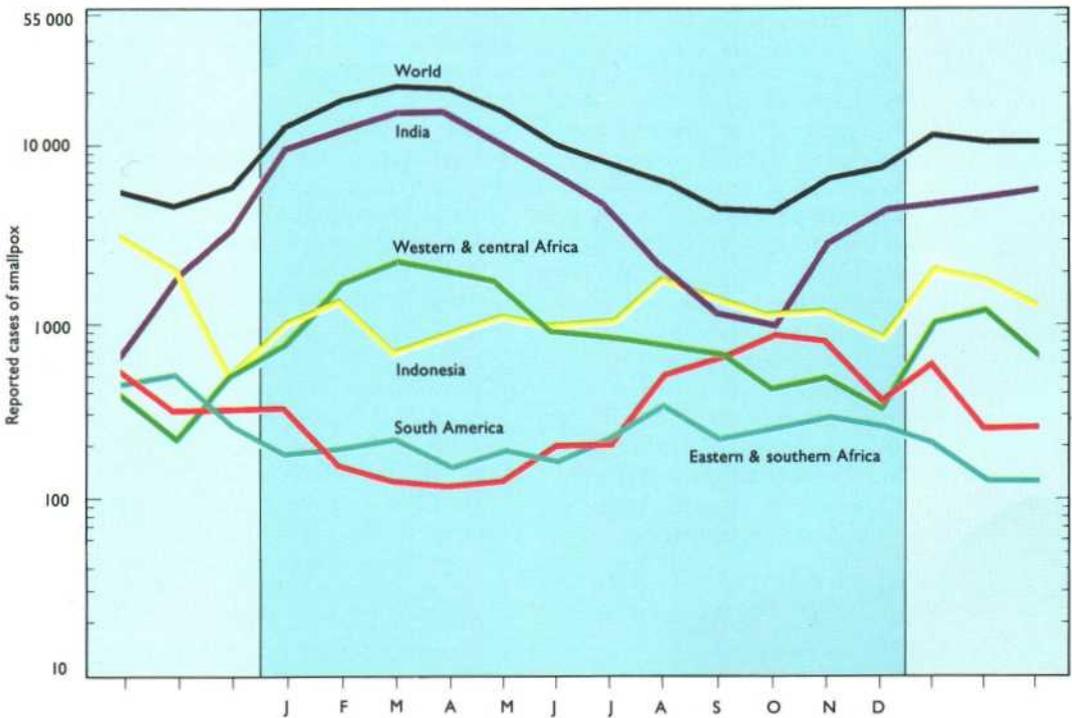
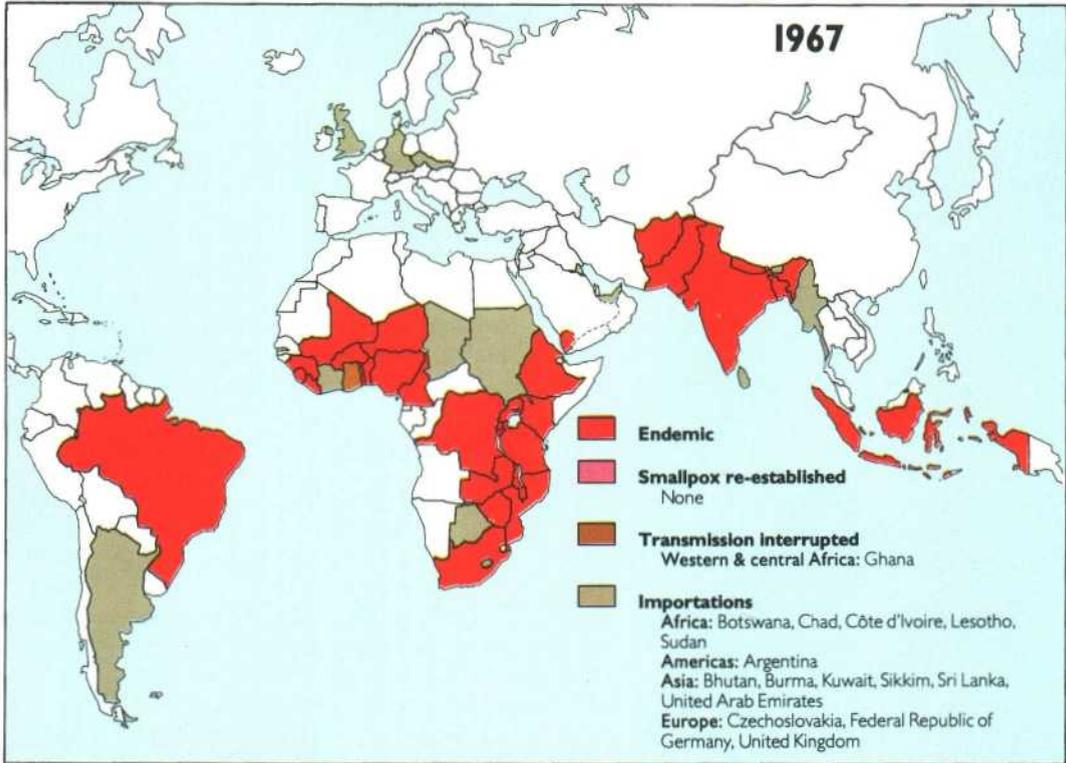


Plate 10.42. Smallpox in the world, 1967: endemicity in 31 countries or territories.

The Situation in 1968

During the second year of the Intensified Programme, the number of endemic countries with special eradication programmes increased from 12 to 19, and agreements were reached or appeared imminent for the commencement of programmes in 8 others. However, 4 remained as problems—Southern Rhodesia, South Africa, Mozambique and Ethiopia. The first two, with which WHO had no official contact, caused little immediate concern as they reported few cases and had a reasonably extensive health infrastructure. However, civil war in Mozambique precluded an extensive programme there, and Ethiopia declined to initiate a programme.

The number of countries with endemic smallpox in 1968 remained at 31, transmission having stopped in Ghana in 1967 but Sudan becoming infected following importations from Ethiopia. The number of reported cases diminished from 131 776 to 79 951 but this was almost entirely accounted for by a decrease in India (from 84 902 to 35 179 cases). Whether this represented better smallpox control in India or simply a longer-term cyclical trend in the incidence was unknown.

Africa

The most heartening progress was made in the regional programme in western and central Africa, which included some of the world's poorest and most heavily infected countries. By the end of 1968, 62 million persons had been vaccinated—almost 60% of the total population; in September special surveillance—containment programmes began in many of the countries. There was a sharp drop in the number of cases reported and 6 of the 10 remaining endemic countries interrupted transmission. However, civil war in Nigeria, the most populous country, threatened to extend throughout the country. In eastern and southern Africa, Uganda and Zambia also stopped transmission.

South America

Brazil, the only endemic country in the Americas, made notable progress in its vaccination campaign and, by the end of the year, was vaccinating 1.3 million persons each month. There was little improvement, however, in the notifications or the surveillance programme. Neighbouring countries in

South America also conducted vaccination campaigns but cases—all due to importations from Brazil—were detected only in French Guiana and Uruguay.

Asia

The programme in Indonesia began in 1968 and within 6 months transmission was interrupted throughout East Java, a province with more than 25 million persons. Although special vaccination campaigns were begun or intensified throughout Indonesia and other endemic Asian countries, progress was generally poor and reporting was little improved.

Other developments

The lack of attention to surveillance was a matter of special concern and surveillance was stressed as being "as important as the vaccination programme itself" at the Twenty-first World Health Assembly in May and emphasized again at an intercountry seminar in Kinshasa in November. Special training materials were developed to foster an understanding of the principles and methods involved.

The bifurcated needles, introduced for general use, alleviated some shortages of vaccine, but it became apparent that the endemic countries would soon need to produce much more vaccine. WHO convened experts in vaccine production to develop a manual on production methodology, and the Organization sent consultants to 24 laboratories and provided equipment and reagents to 30.

The dissemination of information about the programme and about field observations was facilitated as reports about the programme began to be published every 2–3 weeks in the *Weekly epidemiological record* from May onwards and other documents were distributed regularly to senior eradication staff throughout the world.

Activities during the first 2 years of the Intensified Programme laid a sound foundation but how this could be built upon in the field was uncertain. Although the progress in western and central Africa was encouraging, the resources made available there by the USA were greater than could then be foreseen for other countries; progress elsewhere was made primarily in the countries with the more advanced health services. At the end of 1968, the feasibility of global smallpox eradication was by no means certain.

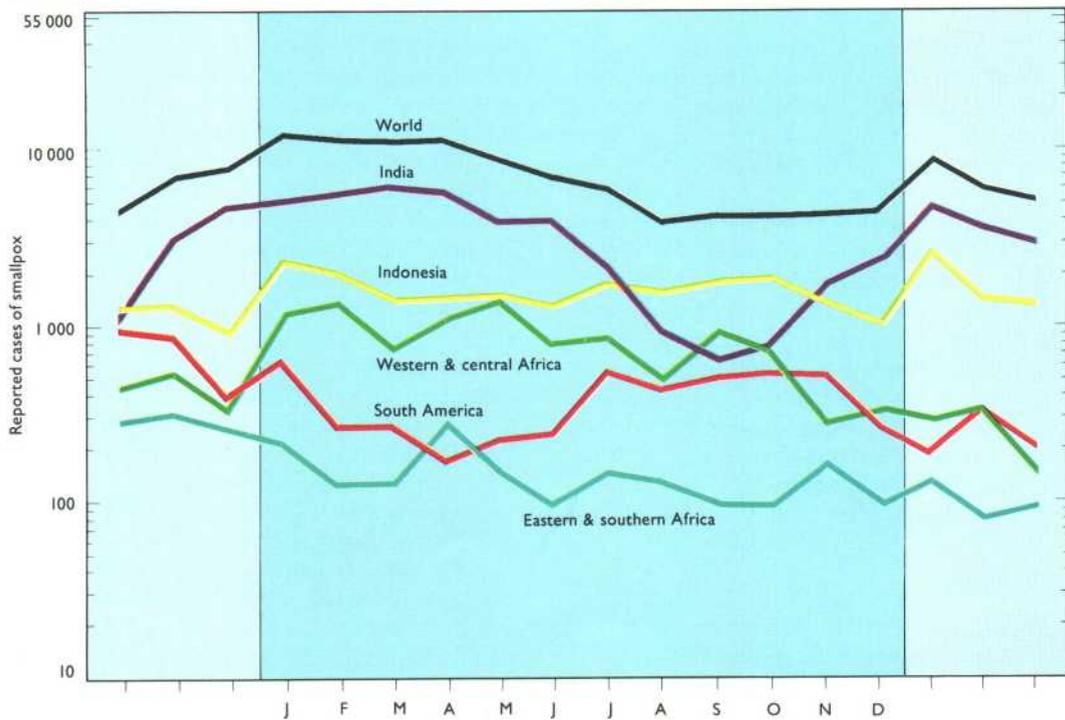
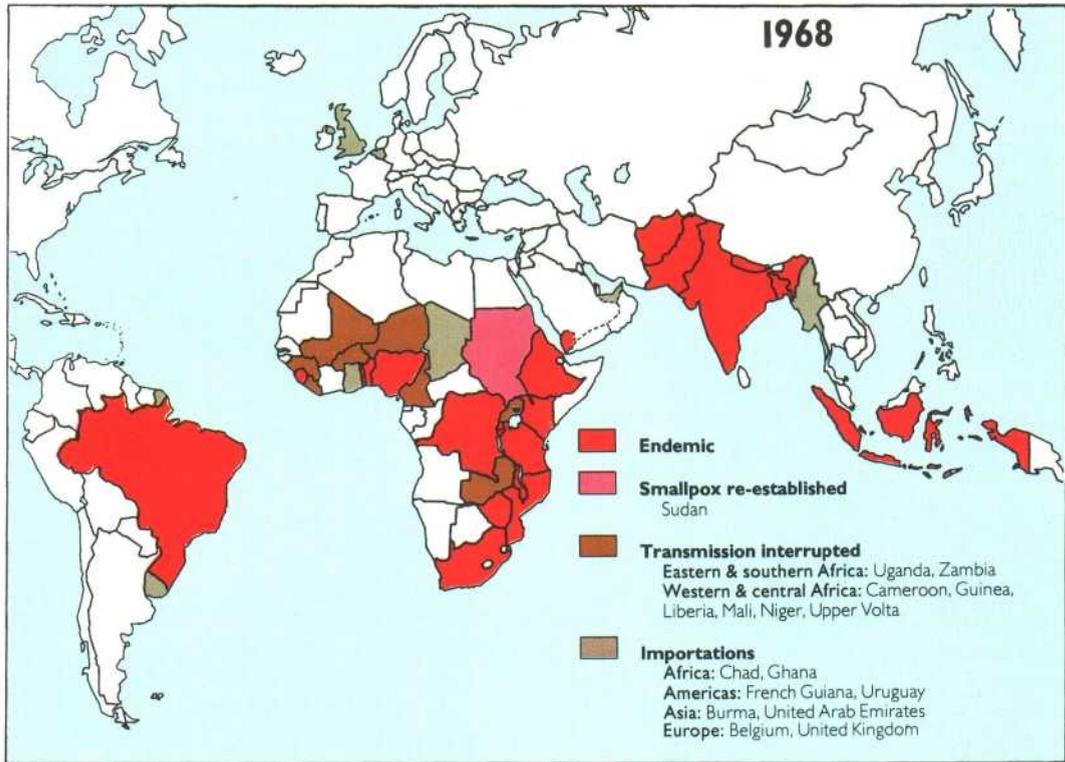


Plate 10.43. Smallpox in the world, 1968.

The Situation in 1969

Certain evidence of progress came during the third year of the Intensified Programme. Only 23 countries recorded endemic cases that year—8 fewer than in 1968—and in 5 of them transmission was interrupted. Thus, during a period of only 3 years, 15 countries successfully eliminated smallpox. Except for Yemen, they were all in Africa, and 10 of them were in western and central Africa where, at the end of 1969, smallpox persisted only in northern Nigeria. Kenya and Mozambique also ceased to report cases but because surveillance was inadequate there, the absence of cases was viewed with scepticism at first.

Although improved notification procedures led to more complete reporting in several countries, the total number of cases reported in the world declined to 54 199, the lowest figure that had ever been recorded. The optimism this gave rise to was tempered, however, by the realization that none of the countries in which transmission had been stopped was large, only Kenya having a population of as many as 10 million persons.

Africa

The successes in Africa were encouraging but 4 of the largest countries still presented serious problems. The programme in the Democratic Republic of the Congo progressed well but the country was one of the largest in Africa, transport presented formidable problems and smallpox was prevalent everywhere. In the Sudan, smallpox spread widely after being imported and civil war throughout its southern provinces made activities impossible there. In November, Ethiopia, which presented the greatest logistic challenge, reluctantly agreed to a programme but it could not begin until 1971. About South Africa, little was then known except that the number of reported smallpox cases increased from 43 in 1967 to 246 in 1969.

South America

Brazil intensified its vaccination campaign and began surveillance programmes in 4 states. Because of this, notifications improved and the number of reported cases increased from 4372 in 1968 to 7407 cases in 1969. Near the end of the year, however, the principal surveillance officers were discharged and the director of the programme resigned.

Asia

The programmes in Afghanistan, Indonesia and Nepal were substantially strengthened during 1969 but there was little progress to report in either India or Pakistan. Mass vaccination campaigns in East and West Pakistan were far behind schedule and surveillance activities were nominal, at best. India postponed the signing of an agreement to strengthen its programme and, in 1969, reported more births than primary vaccinations. India's decision that year to begin using the bifurcated needle and to terminate the use of liquid vaccine was almost the only encouraging news from a country which each year continued to report one-third to one-half or more of the world's cases of smallpox.

Other developments

Vaccine production increased in a number of the endemic countries in 1969, but shortages could be foreseen as the year progressed and more programmes began. Despite appeals for additional donations of vaccine, the quantities contributed in 1969 were smaller than in 1968.

The attainment of global eradication rested on the premise that there was no animal or other natural reservoir of the virus, but firmer evidence of this was required. In March 1969, the first of a series of biennial meetings of an informal group of research workers was convened by WHO in Moscow to plan and implement a collaborative research programme to discover whether any reservoir of variola virus existed and to elucidate the behaviour of the closely related monkeypox virus.

The promotion of surveillance-containment activities continued to meet with limited success and so the Director-General presented a special report to the WHO Executive Board which recommended for every country the "*immediate investigation of every reported case of smallpox by trained investigators, the tracing of the source of infection and the prompt application of containment measures*". In May, a seminar for the countries of western and central Africa provided important documentation of this approach, and another, held in Pakistan in November, for participants from 11 countries of the Eastern Mediterranean and South-East Asia Regions, stressed its importance. Translation of the methods into practice, however, continued to progress slowly.

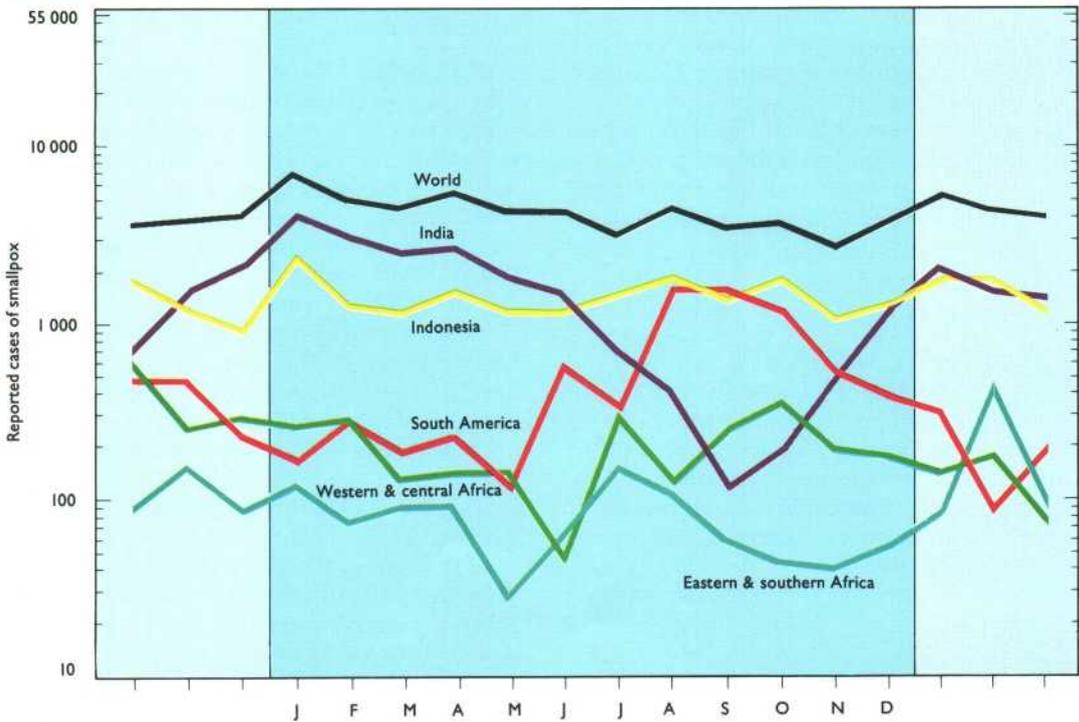
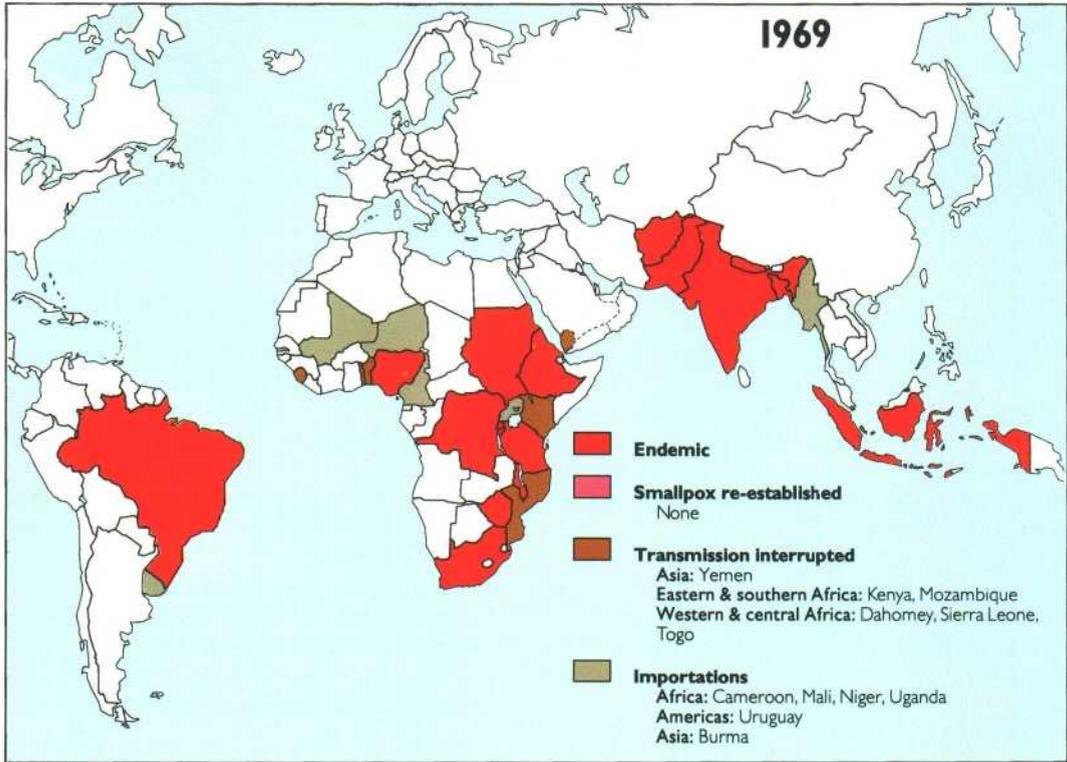


Plate 10.44. Smallpox in the world, 1969.

The Situation in 1970

Developments in 1970 gave grounds for genuine optimism that global smallpox eradication could be achieved: only 18 countries recorded endemic cases during the year and in 6 of these transmission was interrupted—5 in Africa and 1 in Asia. Large populations were involved. With the containment of the last cases in Nigeria in May, more than 100 million persons in western and central Africa were in a smallpox-free region. Wholly unexpected was the elimination of smallpox from the densely populated area of East Pakistan (population in 1970, almost 66 million) following a brief but effective surveillance-containment programme. The reported cases of smallpox in the world during 1970 numbered only 33 693, a decrease of 38% from the record low of the previous year.

Africa

At the end of 1970, smallpox was considered to be endemic in only 5 countries in the whole of Africa: the Democratic Republic of the Congo, Ethiopia, Malawi, South Africa and the Sudan. Excellent progress was made in the Democratic Republic of the Congo during the year and South Africa embarked on a special vaccination campaign. Sudan's programme, however, progressed slowly in the accessible areas and nothing could yet be done in the strife-ridden southern provinces. Ethiopia's programme had not yet started, and the epidemiological situation in Malawi was unclear.

South America

The increased incidence of smallpox reported during 1969 had brought additional resources and support to Brazil's programme; its vaccination campaign accelerated and by the end of 1970 it appeared to be on the verge of interrupting transmission. Programmes in other countries were proceeding adequately and only 1 outbreak was detected, in an Argentinian town on the Brazilian border.

Asia

Indonesia conducted a successful surveillance-containment programme and estimated that by the end of the year 85% of its population resided in smallpox-free areas. Although transmission had been interrupted

in East Pakistan and programmes in Afghanistan and Nepal were progressing well, those in India and West Pakistan were not. In West Pakistan, a poorly conducted mass vaccination campaign lagged far behind schedule. India agreed to strengthen its national structure with WHO assistance, but otherwise remained confident as the number of reported cases continued to decrease, only 12 773 cases being reported in 1970 compared with 84 902 cases in 1967. Late in the year, however, it became evident that this was partly an artificial decrease, changes in the national notification system serving to inhibit reporting.

To encourage surveillance-containment activities in Asia, a seminar was held in New Delhi in December 1970 for countries throughout the South-East Asia Region. West African and Indonesian staff described their successes with this strategy but few changes followed.

A significant event, although it was not recognized until a year later, was the reintroduction of endemic smallpox into Iran. Major epidemics were to follow, with spread of the disease to neighbouring countries and eventually to Europe.

Other developments

With more eradication programmes in progress, increasing resources were required. Efforts to obtain additional donations met with little success, and an attempt to have WHO funds that were available in the Americas reallocated for use in Asian countries also failed. Vaccine was short throughout 1970 and donated vaccine frequently had to be dispatched on the very day it was received in Geneva. Towards the end of the year, it became apparent that it would be far more difficult to eradicate smallpox from the remaining endemic countries than it had been in those which had already been freed of the disease.

Another unexpected problem occurred when, in the second half of the year, human cases of monkeypox, clinically indistinguishable from smallpox, were discovered in Liberia, Sierra Leone and Zaire. Although monkeypox was not caused by the variola virus, the question arose whether it might behave like smallpox and be sustained by human-to-human spread. Extensive field and laboratory investigations began immediately but not until the late 1970s could the fears be fully allayed.

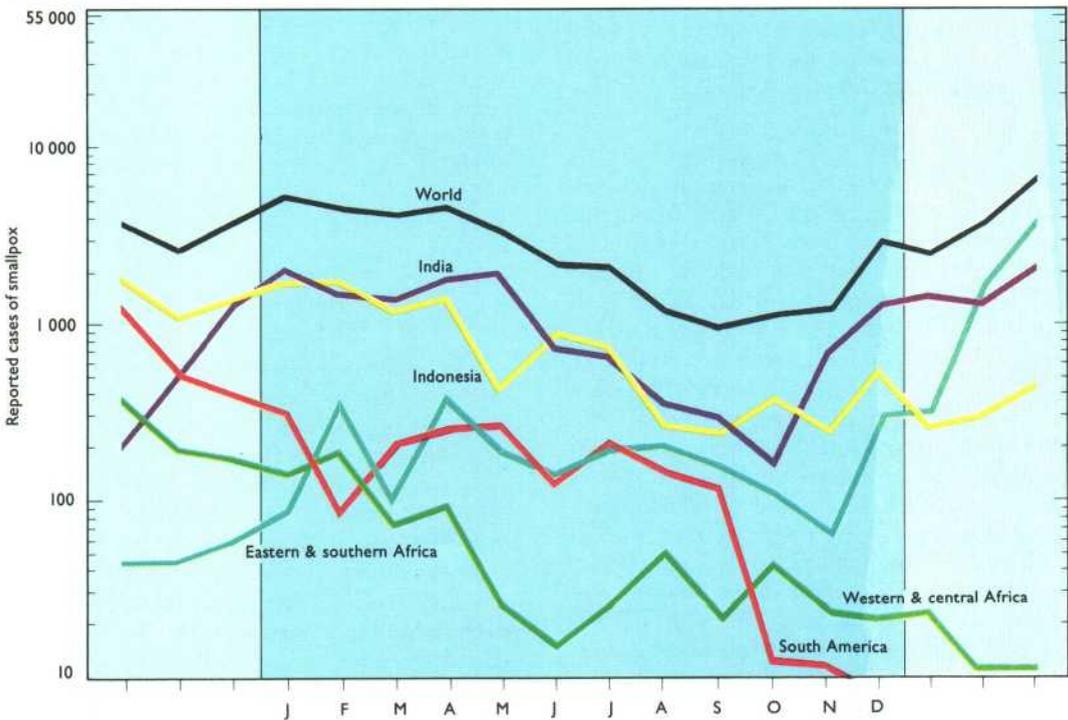
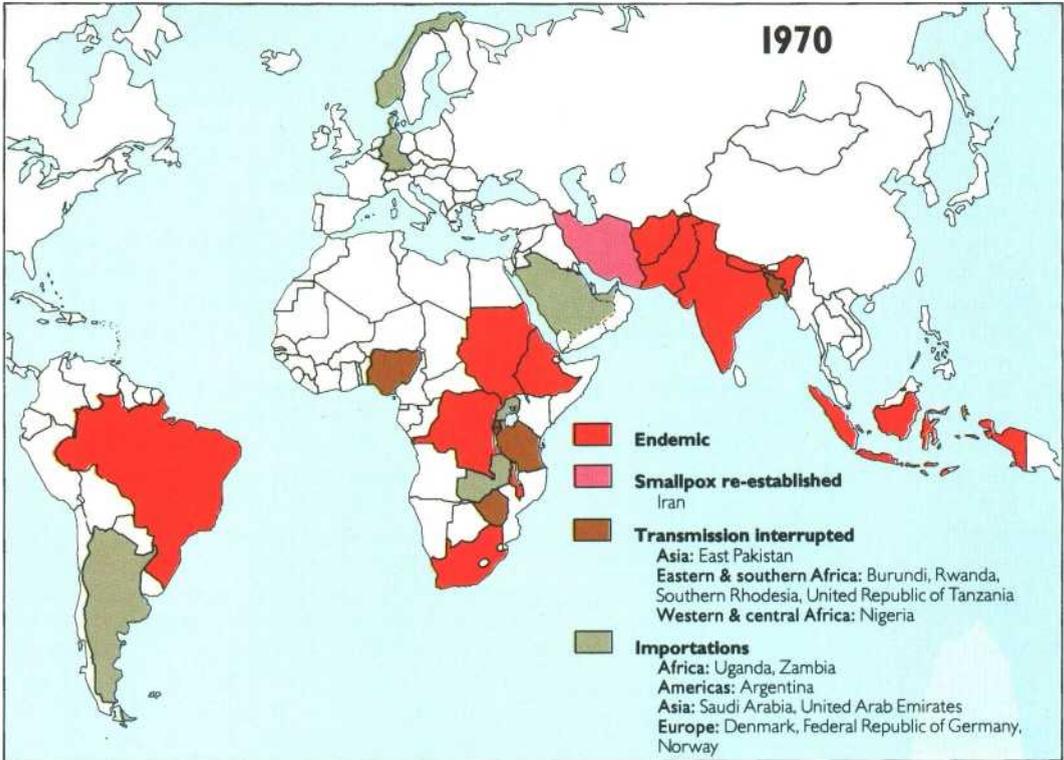


Plate 10.45. Smallpox in the world, 1970.

The Situation in 1971

The fifth and sixth years of the Intensified Programme, 1971 and 1972, were years of transition between the remarkably successful period 1967–1970—when smallpox was successfully eliminated from large areas of the world with few resources—and the succeeding years, 1973–1977, when ever larger resources and more heroic measures were required to stop transmission in the few remaining endemic countries. In some parts of the world remarkable progress was made during 1971, but in others there were setbacks and portents of future problems. The year 1971 began with endemic smallpox in 12 countries, 4 of which interrupted transmission during the year, but 2 others became reinfected—Botswana and Iraq. For the first year since the programme began, the number of reported cases increased, from 33 693 in 1970 to 52 807 in 1971.

Americas

In April, the last cases in Brazil, and in the Western Hemisphere, were detected. Thus, the first of the 4 major epidemiological zones became smallpox-free. A plan of work was immediately developed for investigations and reports that would permit the certification of eradication after 2 years.

Africa

After transmission had been interrupted during the year in Malawi, South Africa and Zaire (formerly the Democratic Republic of the Congo), smallpox was endemic in only 3 African countries at the end of 1971—Ethiopia, the Sudan and Botswana (where it spread widely after having been reintroduced just as the last cases were occurring in South Africa). The programme that started in Ethiopia in 1971 found smallpox to be a far greater problem than had been expected. A staff of fewer than 80 persons detected 26 329 cases, compared with the 722 cases reported in 1970. In the Sudan, smallpox continued unabated in the southern provinces affected by civil war. It was apparent that eradication throughout Africa would need a greatly intensified effort, accompanied by a measure of good fortune, to surmount the problems of civil war.

Asia

In Asia, too, both successes and setbacks occurred. The programmes in Afghanistan, Indonesia and Nepal progressed so satisfacto-

rily that, by the end of the year, each appeared to be on the verge of eliminating smallpox. One western state of India (Gujarat), which had been reporting 10% of the world's cases, mounted a highly effective surveillance–containment programme and succeeded in stopping transmission within a year. Epidemic smallpox, however, erupted in adjacent Indian states and, there, satisfactory programmes were slow to begin. During 1971, civil war in smallpox-free East Pakistan (which became Bangladesh in December) caused some 10 million refugees to flee to India, where most of them were housed in special camps in areas in which smallpox was prevalent. Although all persons were supposed to be vaccinated on arrival, this precaution was not taken in several camps, including one of the largest. There, smallpox broke out at the end of the year and spread throughout the camp. In West Pakistan, an unsatisfactory programme was further compromised when the country was divided into 4 largely autonomous provinces and separate programmes had to be re-established in each.

It was in the course of 1971 that the presence of smallpox in Iran first became known through numerous unofficial reports, and the government eventually acknowledged that 29 cases had occurred, all of which were said to have been importations. Much later, it was learned that smallpox had in fact been introduced from Afghanistan in October 1970 and that hundreds of cases had occurred in 1971. Subsequently, it was discovered that the disease had also spread to Iraq in November 1971.

Other developments

Sufficient progress had been made in eradication to cause the authorities in both the United Kingdom and the USA to cease their programmes of routine vaccination in 1971. However, a WHO Expert Committee on Smallpox Eradication, convened in November, presciently observed that “an effort at least equal to that made in the past 5 years” would be required to interrupt transmission in the remaining endemic areas. Although few countries were now involved, they posed difficult problems. To encourage national governments and their smallpox personnel, the WHO Headquarters staff began to spend an increasing amount of time in the field, but additional resources were not forthcoming and vaccine remained in critically short supply.

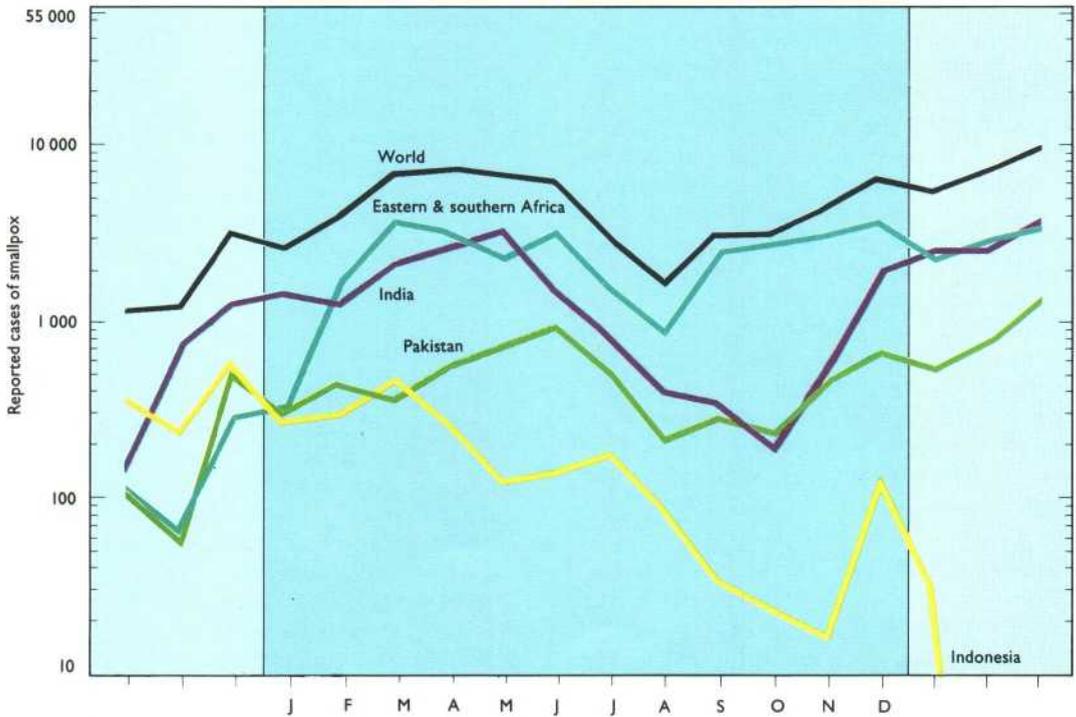
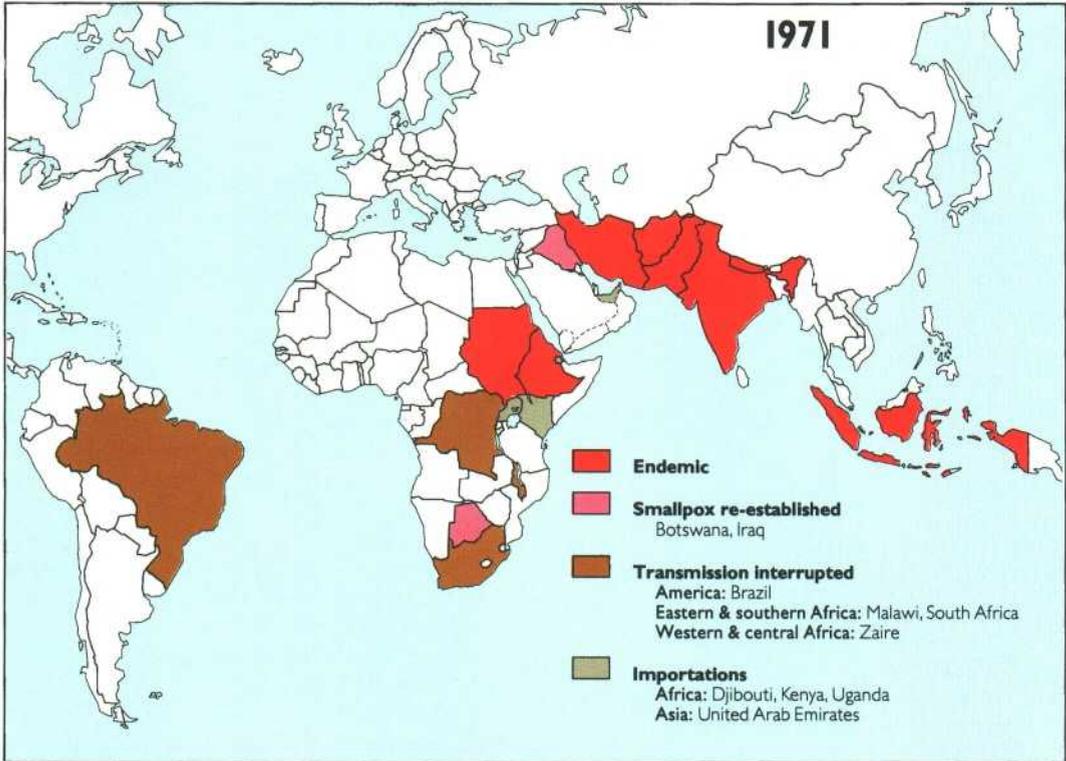


Plate 10.46. Smallpox in the world, 1971: eradication from Brazil.

The Situation in 1972

Like the preceding year, 1972 was marked by notable successes and unexpected setbacks. Overall, the progress was encouraging. There were 10 endemic countries as the year began, but transmission was stopped in 5 of them in the course of the year. Successes in 3 of these—Afghanistan, Indonesia and the Sudan—represented exceptional achievements. The other 2 were Iran and Iraq, for which the true situation was not known with certainty until a year later. The number of cases of smallpox recorded in the world as a whole increased for the second successive year—65 140 cases in 1972 compared with 52 807 cases in 1971—but reporting was more complete and, by the summer, surveillance programmes of some sort were in place for the first time in all countries.

During the first quarter of the year, however, 3 serious problems emerged. In February, epidemics of smallpox began to spread across the newly independent country of Bangladesh as refugees returning from camps in India brought the infection with them. In March, Iraq and the Syrian Arab Republic officially acknowledged the presence of smallpox and soon thereafter a major outbreak occurred in Yugoslavia, imported from Iraq. Finally, in April, a WHO epidemiologist, on arrival in Botswana, confirmed that smallpox had already spread widely there.

Despite these problems, the geographical extent of the infected areas continued to diminish and it was proposed that "the final phase" should begin in September, the objective being a nil incidence by June 1974. Intercountry seminars were held in Ethiopia (September), India (November) and Pakistan (November) to launch this special effort, referred to for the first time as "Target Zero" in an issue of the WHO magazine *World health* and in the first of a series of fortnightly reports circulated by the WHO Smallpox Eradication unit.

Africa

The progress in 1972 in the 3 endemic African countries exceeded expectations. In the Sudan, the civil war in the southern provinces ceased and an effective surveillance-containment programme succeeded in interrupting transmission in December, more than a year earlier than WHO staff had expected. Botswana rapidly mobilized its resources and by the end of the year the interruption of transmission seemed immi-

nent. As Ethiopia's programme gained momentum, the number of reported cases decreased by 35%, from 26 329 in 1971 to 16 999.

Asia

The second of the world's major epidemiological zones became free of smallpox in January, when transmission ceased in Indonesia. This was achieved in less than 4 years and with only a modest amount of international assistance. Afghanistan, where formidable geographical and cultural problems were compounded by the practice of variolation, had once been thought the country in which attempts to eradicate smallpox were the least likely to succeed. Yet it recorded its last endemic cases in October. These successes provided some much-needed encouragement to the other endemic countries of Asia, whose situation was very different. Emergency assistance had been promptly provided to Bangladesh to stem the epidemic of imported cases but, in the post-war chaos, the health services were unable to cope. More than 10 000 cases were recorded, but it is estimated from later studies that more than 100 000 cases occurred. During the autumn, major epidemics began along the densely populated Indo-Gangetic plain in southern Pakistan, India and central and western Bangladesh. Because of the very large numbers of health staff in the Asian countries and the greater interest in eradication taken by the national authorities, hope remained high that the problems might yet be surmounted, but far more serious difficulties were to develop.

Other developments

An epidemic in Yugoslavia, the first in that country for 41 years and one of the largest in Europe since the Second World War, reminded donor countries of the severity of the disease and emphasized the importance of global smallpox eradication. Increased donations of vaccine were received and the debate at the Twenty-fifth World Health Assembly was the most extensive ever, praise for the achievements being mingled with expressions of concern about setbacks in Bangladesh, Botswana and western Asia. Despite the sentiments expressed, however, voluntary financial contributions remained at much the same level as before and WHO even decreased its regular budget allocation for the programme for the following year.

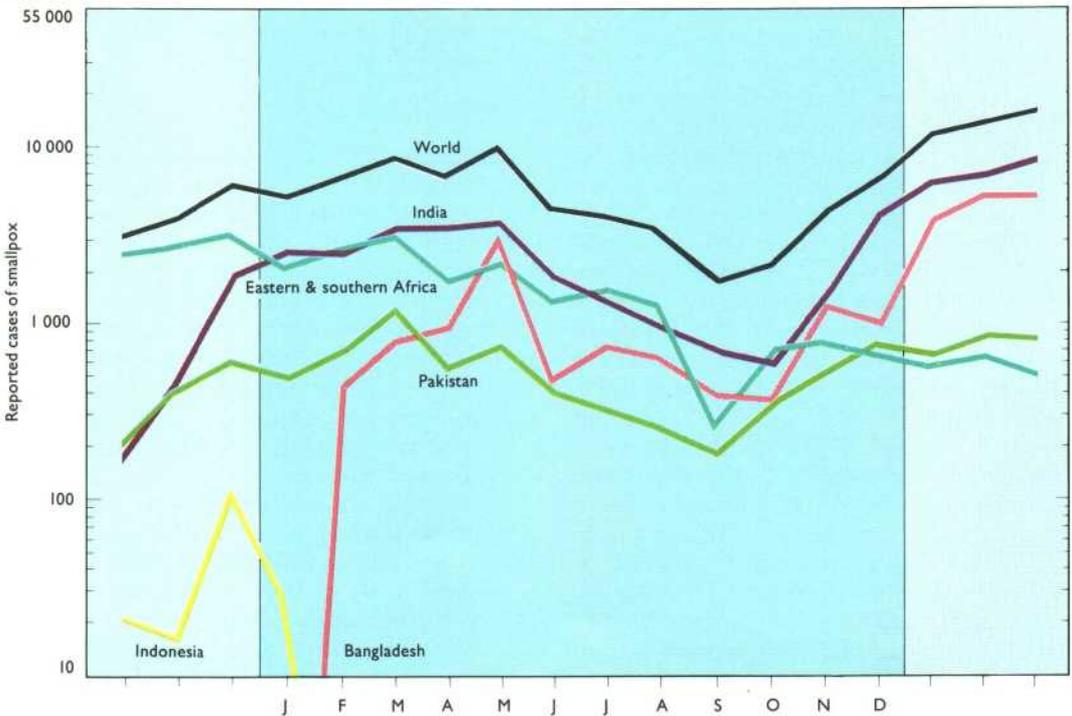
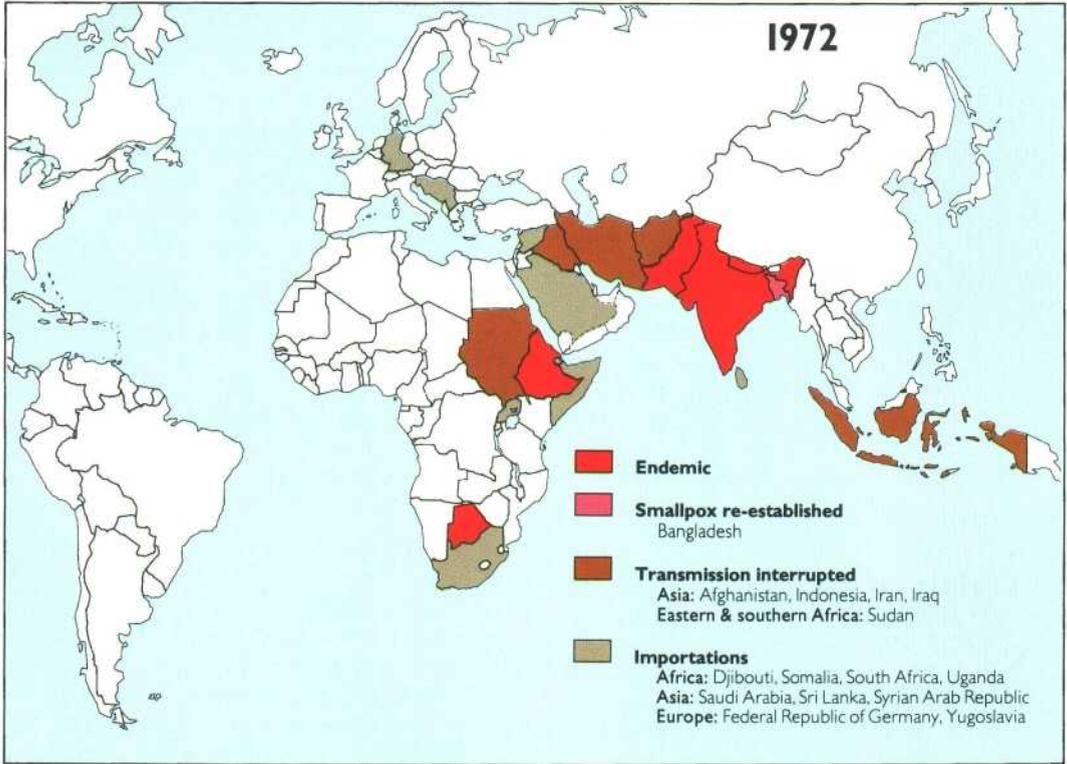


Plate 10.47. Smallpox in the world, 1972: eradication from Indonesia.

The Situation in 1973

The year 1973 marked the beginning of a greatly intensified effort, which steadily increased in tempo from the autumn. As the year began, only 6 endemic countries remained. Among these, Botswana recorded only 27 cases before successfully stopping transmission in November and Nepal reported 277 cases, almost all of which could be shown to have occurred following importations from India. Although the other 4 countries (Bangladesh, Ethiopia, India and Pakistan) reported large numbers of cases, large areas within each of them were free of smallpox or nearly so. It was calculated that 90% of all cases in 1973 occurred over only 10% of the land area of the 4 countries.

Asia

During the first 6 months of the year, the number of cases reported in Asia rose sharply. Although some of this increase was thought to represent more complete notification of cases, surveillance was still by no means fully satisfactory anywhere and epidemics were being discovered of a size not seen since the beginning of the Intensified Programme. By the end of June, almost 83 000 cases had been reported, including some 49 000 in India, 27 000 in Bangladesh and 6000 in Pakistan—totals which were all higher than during the comparable period in 1972.

For these countries, it appeared that a different strategy would be required to eliminate smallpox. The comparatively simple measures for case detection and containment which had previously been effective in Africa were proving inadequate in Asia. The solution proposed was to detect cases more promptly so that they could be contained before further spread occurred. In July, therefore, Indian and WHO staff decided to mobilize all health staff in India to undertake 1-week, village-by-village searches in October, November and December in the 4 states which were then reporting 93% of all cases. In other Indian states 1 or 2 searches would be conducted during this 3-month period. A similar effort was decided upon in Pakistan. The hope was to eliminate most smallpox foci during the autumn, when smallpox spread slowly, and thus to prevent widespread dissemination during the period of rapid transmission from January to April. If this was successful, it was believed that

smallpox could be eliminated during the summer of 1974. In Bangladesh, many additional surveillance teams were provided to search for smallpox in schools and markets.

The results were encouraging in Bangladesh and Pakistan, each country reporting an incidence similar to that of the year before despite much more intensive surveillance. In India, however, more than 30 000 cases were discovered between October and December, almost 5 times as many as had been found during the same period in 1972 and, indeed, more cases than had been reported in the whole country during any of the 4 preceding years. The numbers were scarcely believable but the eradication programme staff continued to be optimistic because of the commitment of government officials, the extent of activity and the interest of the health staffs.

Africa

Ethiopia remained the only endemic country in Africa and there, as in Asia, more intensive measures were taken through the addition of staff and the provision of helicopters to help cope with the rugged terrain. The number of reported cases continued to decline despite more complete notifications but logistic difficulties were increasingly exacerbated by mounting civil unrest.

Other developments

During 1973, the first of the international commissions for the certification of eradication examined the programmes in the Americas and confirmed that smallpox had been eradicated from the Western Hemisphere.

A new concern emerged, however, about a possible natural reservoir of smallpox. This arose from the isolation—from monkey kidney tissue cell cultures in the Netherlands and from animal specimens collected near monkeypox cases in Zaire—of what were termed "whitepox" viruses, which were indistinguishable from smallpox virus. The WHO informal research group held its third biennial meeting in 1973 and developed a new agenda of work, but not for several years was this concern finally laid to rest and the "whitepox" viruses shown to be inadvertent laboratory contaminants.

During 1973, the number of recorded cases in the world—135 904—was the highest for 15 years, but the ultimate goal, "Target Zero", appeared none the less to be just over the horizon.

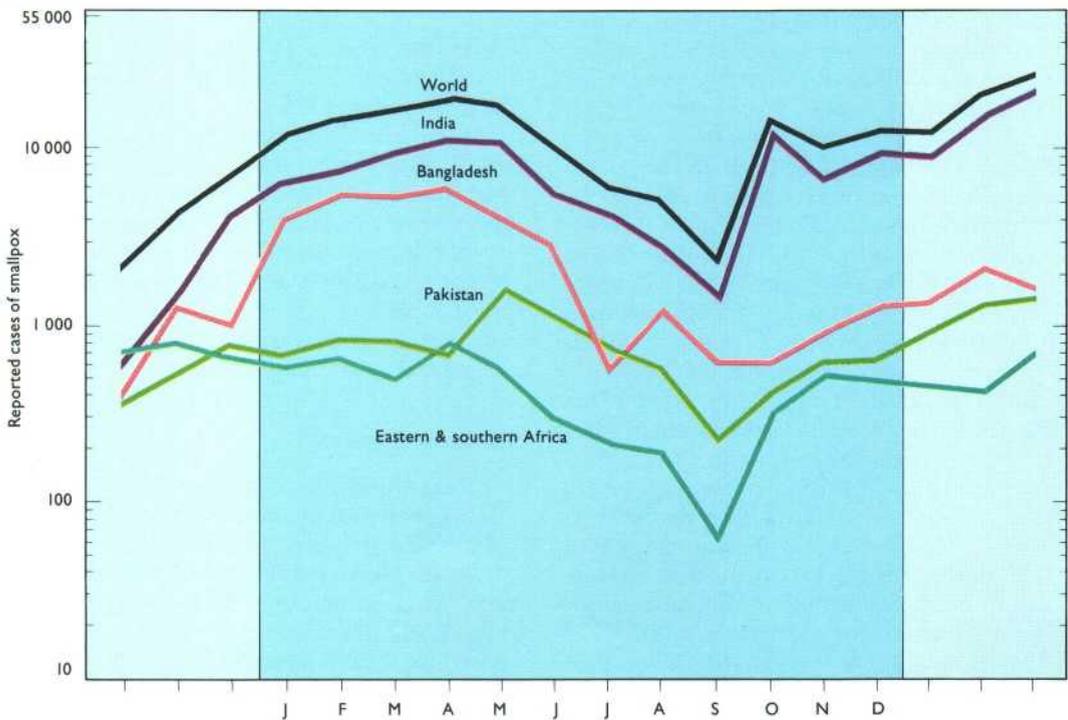
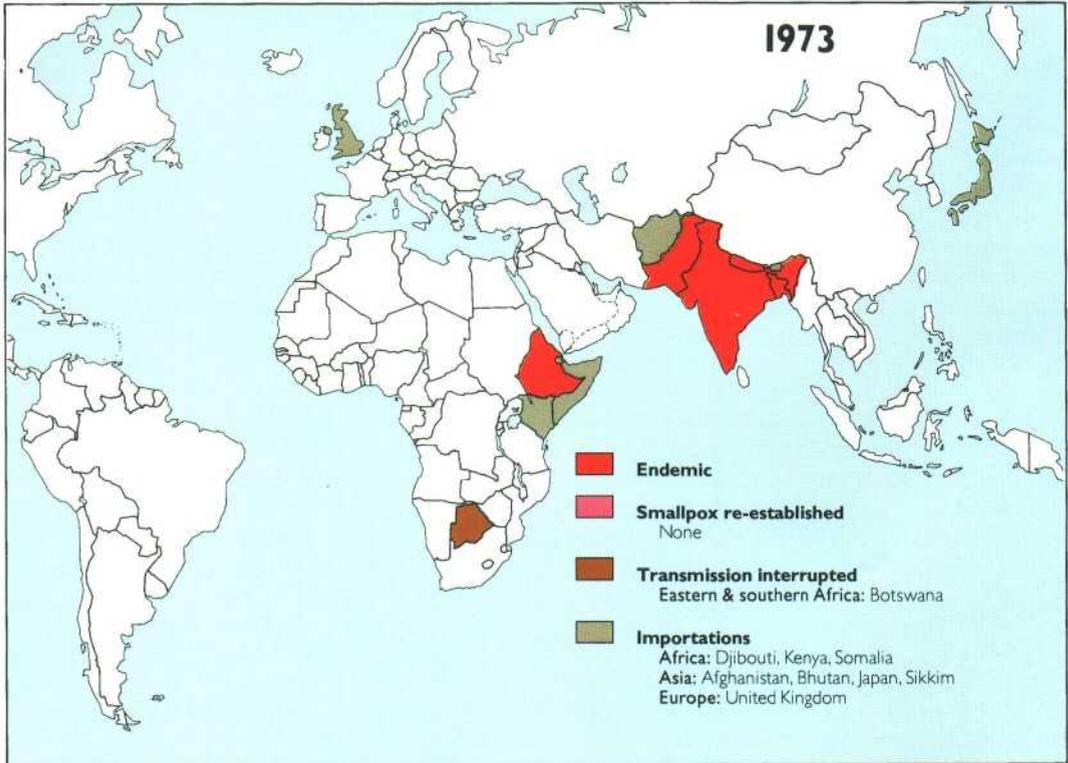


Plate 10.48. Smallpox in the world, 1973.

The Situation in 1974

Throughout 1974, the programme as a whole steadily grew in intensity and accelerated in tempo. Successes in the 1973 autumn campaigns had encouraged the belief that a concerted effort of no more than 6–12 months would see the realization of global smallpox eradication. Additional national and international personnel as well as increased quantities of supplies and equipment supported this effort. It was concentrated on the shrinking endemic areas which in aggregate were smaller than the land area of Pakistan, one of the 5 countries concerned. With eradication apparently imminent, programme staff worked feverishly, driven partly by the fear that unanticipated natural or man-made catastrophes might thwart the achievement just short of the goal. Indeed, this concern proved well founded in 4 of the 5 countries.

Asia

In India, during the first 3 months of the year, intensified search programmes resulted in much more complete reporting but no more cases than in 1973. In May, however, explosive epidemics began, nearly 50 000 cases being detected that month and the worst affected state (Bihar) reporting more than 8000 cases in a week. Work was severely hampered by petrol shortages as well as by strikes which immobilized rail and air transport. Bihar State was further affected by devastating floods in the north, severe drought in the south, and civil disorder. These difficulties were compounded by a major epidemic in an urban industrial centre which resulted in the spread of smallpox to hundreds of distant villages in India and Nepal.

In Pakistan and Bangladesh, other problems occurred. Surveillance in Pakistan's largest province (Punjab) was suspended prematurely by over-optimistic provincial health authorities and an undetected epidemic in its capital, Lahore, quickly spread throughout the province. Bangladesh decided to restructure the health care system, resulting in the suspension of most activities, including those for smallpox, for many weeks. In the summer, monsoon rains brought the worst floods for many years to northern Bangladesh, displacing tens of thousands of persons.

During the first 6 months of 1974, more cases were recorded in Asia than had been reported annually throughout the world for

more than 15 years. By June, however, greatly expanded and better organized programmes were functioning and progress began to be measured in terms of the numbers of existing outbreaks (villages or town areas in which 1 case or more had occurred in the preceding 4 weeks). Asia had 8086 outbreaks in June.

Throughout the hot summer monsoon period, all staff were urged to maintain the pace of their work in order to take the fullest advantage of the seasonal decline in incidence. The effort proved successful. Pakistan detected its last case in November, and by the end of the year there were only 517 known outbreaks in all of Asia.

There was optimism that transmission would be interrupted by the summer of 1975. The only doubtful areas were those in which refugees were crowded in Bangladesh. The number of outbreaks in that country, which had been only 78 at the end of October, had tripled by the end of December. More than half, however, consisted of only 1 or 2 cases and hope persisted that, with the planned addition of health staff and temporary workers, the problem could be managed.

Africa

As more support became available, the programme in Ethiopia made steady progress in many areas of the country. The number of reported cases decreased from 5414 in 1973 to 4439 despite more complete notifications; in December, only 166 cases were discovered. In increasingly large areas of the country, however, field operations were severely hampered by the revolution that led to the deposition of the Emperor, by hostilities with Somalia in the Ogaden desert, and by the insurrection in Eritrea.

Other developments

The eradication of smallpox from Indonesia was certified by an international commission in April, but certification elsewhere was deferred pending further progress in Africa and Asia. Increasing efforts were made to recruit suitable international staff and consultants for the intensified campaign and to obtain sufficient contributions of vaccine and funds to permit the work to be sustained. At the end of the year WHO, for the first time, convened a meeting of potential donors to request contributions of US\$3.3 million, but only US\$2.1 million were pledged.

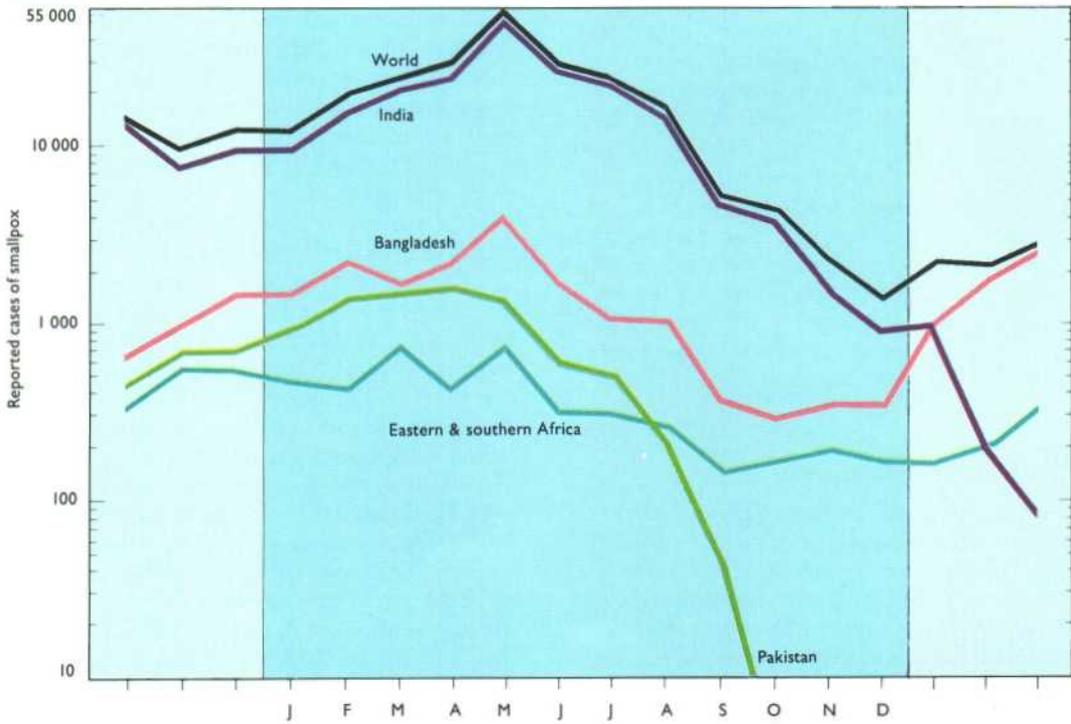
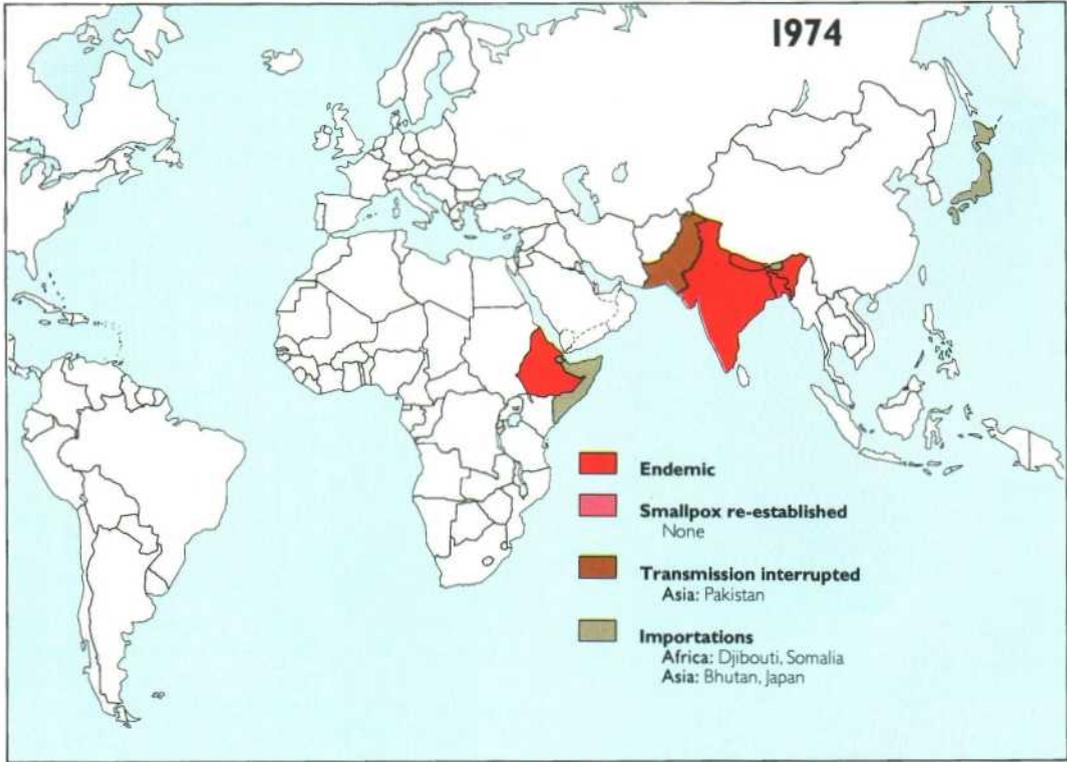


Plate 10.49. Smallpox in the world, 1974.

The Situation in 1975

In 1975, the eradication of smallpox from Asia was achieved and, with it, the end of transmission of variola major virus, which caused the most severe form of smallpox. By the end of the year, endemic smallpox persisted only in Ethiopia, which had 66 known outbreaks, all of which were of variola minor, the mild form of smallpox.

Asia

In India and Nepal, the incidence of smallpox and the number of outbreaks decreased steadily. Nepal detected its last case in April and India in May. Bangladesh, however, was the site of yet another catastrophe as smallpox spread rapidly among the hundreds of thousands of persons displaced by floods and famine and from them to settled populations. Despite heroic efforts, the number of outbreaks increased from 78 in October 1974 to 1280 in mid-May 1975. India strengthened activities in border areas and quickly contained the 32 importations that occurred. Emergency funds made available by Sweden and several other countries permitted the recruitment of additional international staff for Bangladesh, and national mobilization by the Bangladeshi authorities resulted in 12 000 persons being fully engaged in eradication work. From May to August, the incidence in Bangladesh diminished rapidly but work had to be partially suspended in August, when the President of the country was assassinated. Officials feared civil war and yet another mass exodus of refugees. Fortunately, the country remained calm, smallpox eradication activities could be resumed, and on 16 October 1975 the last case occurred.

Africa

In Ethiopia, it had been expected that the eradication of smallpox would follow the same pattern as in other African countries, with transmission being interrupted 2-3 years after the programme began. By 1975, however, the Ethiopian programme had been

in operation for 4 years and although the staff were few in number, they were capable and strongly motivated. Surveillance-containment activities had been conducted since the start of the programme and more than 10 million persons had been vaccinated—nearly half of Ethiopia's estimated population. Although the population density was low and the habitations widely scattered, the mild variola minor continued to spread. The principal problem area was the rugged highland plateau, where resistance to vaccination was great and where large areas were periodically inaccessible owing to civil war. As a result of the eradication of smallpox from Asia, additional resources could be provided, permitting a 5-fold increase in staff, but the hostilities within the country hampered their efforts.

Other developments

Rumours of cases of suspected smallpox began to be received with considerable frequency from countries considered to be free of the disease. Even though they proved false, arrangements had to be made to investigate each rumour thoroughly and to publicize the findings in order to maintain confidence in eradication. Another emerging problem was that of designing and implementing an appropriate strategy to permit eradication to be certified in the African countries, some of which had detected no smallpox for many years and had consequently stopped their smallpox eradication activities. Certification of eradication in Africa had been deferred until the continent as a whole had become smallpox-free. In 1975, however, it was decided that because of the continent's vast size, the large number of countries, and the diminishing level of smallpox eradication activities, preparations for certification should commence as soon as possible. In February, the first of a number of planning meetings was held, this one being concerned with methods for certification in western and central Africa. This implied that eradication in Africa would be achieved, if not within the year, at least soon thereafter. At the end of 1975, however, that was by no means certain.

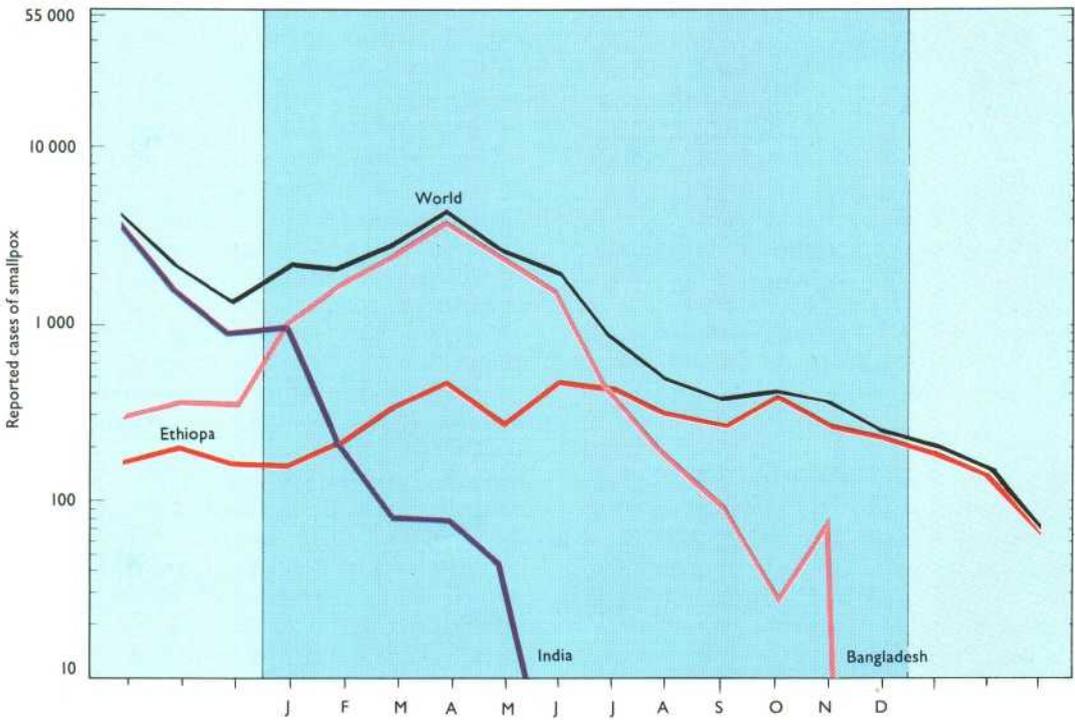
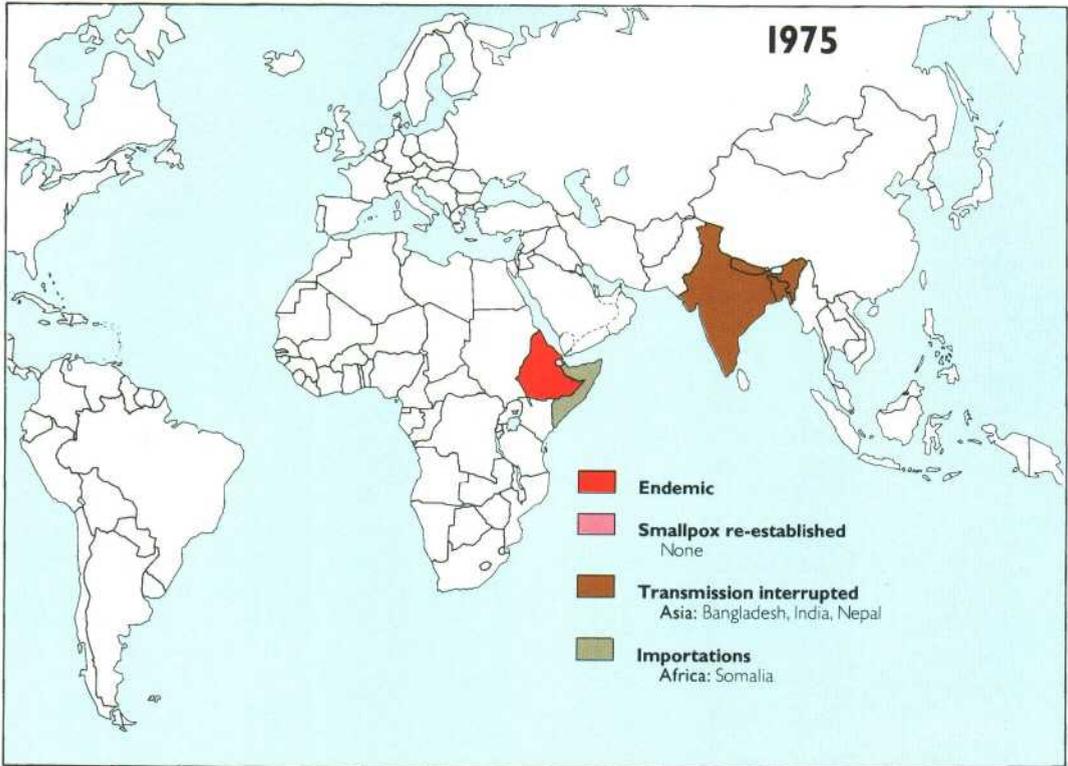


Plate 10.50. Smallpox in the world, 1975: eradication from continental Asia.

The Achievement of Global Eradication, 1976–1977

As 1976 began, smallpox was known to exist in only 66 villages in Ethiopia but the interruption of transmission there and in Somalia, where it became re-established later that year, proved to be as difficult as it had been in mainland Asian countries in 1974–1975. Not until October 1977 was smallpox finally eradicated. A broad range of problems hampered the effort, from difficulties of topography and transport, civil war and eventually war between Ethiopia and Somalia, socio-cultural problems posed by nomads, variolators and large groups who resisted vaccination, to the suppression of reports of cases by the authorities in Somalia.

Ethiopia

Through mid-1976, the resources in Ethiopia were concentrated in the central and northern highland plateau areas in which civil war was raging and most outbreaks were occurring. At great personal risk to the staff concerned, these were gradually contained. Smaller numbers of staff worked in the sparsely settled south-eastern desert, where the few outbreaks occurred primarily among nomads. From past experience in similar areas of western Africa, it had been assumed, erroneously, that smallpox transmission could not long persist in such a scattered, mobile population. In the Ethiopian Ogaden desert, however, variola minor proved to be remarkably tenacious, and operations were frequently interrupted by warfare, the kidnapping of teams and the destruction of vehicles and helicopters. In August 1976, however, the last known outbreak in Ethiopia was contained and, for 7 weeks, no cases were reported from anywhere in the world.

Somalia

From 1972 until February 1976, Somalia had regularly reported importations from Ethiopia, but each was said to have been promptly detected. Late in September 1976, Somalia again reported several imported cases, this time in Mogadishu, the capital. It was learnt later, however, that these were but a few of many cases which were known to the authorities. WHO staff and consultants were quickly sent to help but they were not permitted to visit patients' houses or to travel outside the capital. Repeated mass vaccination campaigns throughout the city failed to

stop the spread of smallpox and fully 6 months elapsed before an effective national programme could be established. By then, the disease had spread widely throughout southern Somalia. A large-scale emergency effort was mounted that started in March 1977 and involved adjacent areas of Djibouti, Ethiopia and Kenya. More than 3000 cases were documented before the last case occurred on 26 October 1977.

Other developments

During 1976–1977, certification activities were organized in Asian and African countries, often requiring special studies lasting a year or more before a WHO international commission could be invited to assess the programme and to certify eradication. In April 1976 eradication was certified in 14 countries of western and central Africa, and in December in Afghanistan and Pakistan; in April 1977 in Bhutan, India and Nepal, in June in 9 countries of central Africa, and in December in Bangladesh and Burma.

It became apparent in 1977 that an independent body would be needed to advise on the measures that should be taken to give health authorities throughout the world sufficient confidence in global eradication to be willing to cease vaccination. A group of international experts, which was convened by WHO in October 1977, recommended a number of measures, including the designation by the Director-General of a Global Commission for the Certification of Smallpox Eradication. The Commission was to provide continuing guidance and oversight to the certification process and to report to the Director-General when it was satisfied that global eradication had been achieved.

The question of what should be done about the stocks of variola virus retained in laboratories around the world had long been a troublesome one. The destruction of most, if not all, such stocks was desirable but this required the full cooperation of national governments and of the laboratories concerned. As a first step, a register of the laboratories that held variola virus was prepared. Then, in 1977, the World Health Assembly requested that all variola virus stocks should be destroyed, excepting those held by WHO collaborating centres with maximum containment facilities. Many laboratories soon complied and events in 1978 served to speed the process.

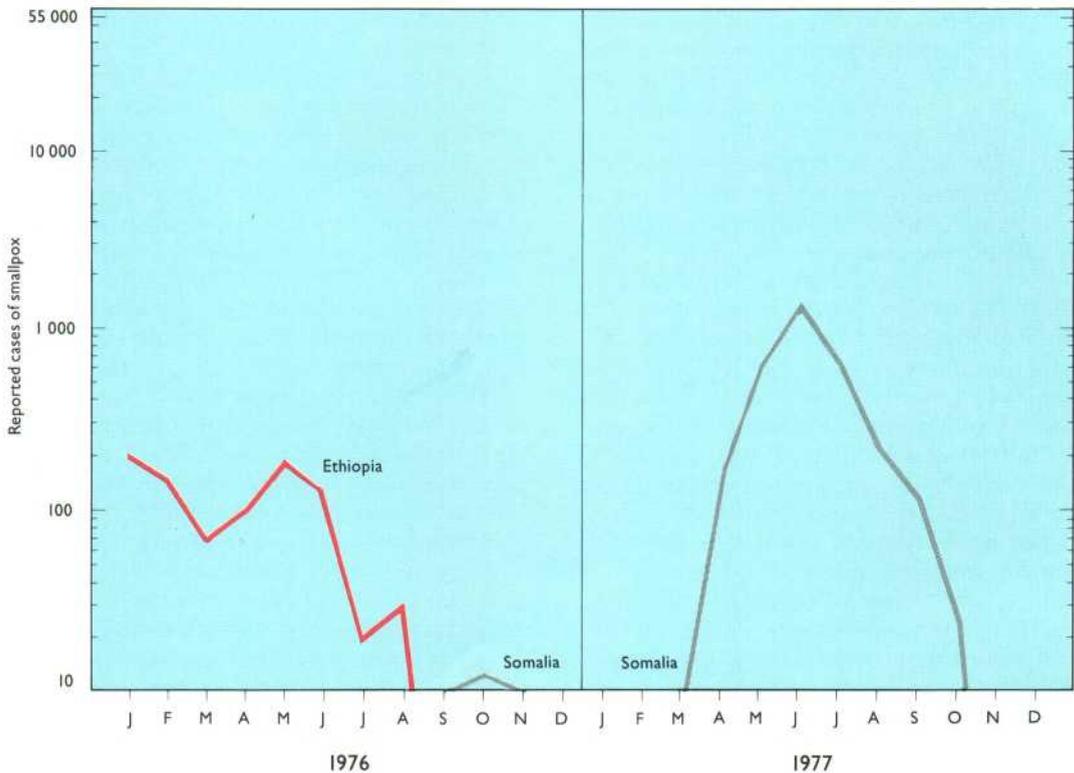


Plate 10.51. Smallpox in the world, 1976-1977: global eradication.

The Certification and Formal Declaration of Global Eradication, 1978–1980

The period between the containment of the last known outbreak and agreement by the Thirty-third World Health Assembly (1980) that global eradication had been achieved was as important but as difficult as had been the preceding years. The world community had to be confident of the attainment of eradication and had to know of the measures which had been taken to certify this. Laboratories had to be persuaded of the need to destroy their stocks of variola virus or to transfer them to WHO collaborating centres. Rumours of possible cases of smallpox had to be investigated and the findings publicized. Research was required to determine the nature of the viruses resembling variola virus which appeared to have been recovered from animals. An assessment of the risk of monkeypox to those living in the tropical rain forests was required as well as a determination of whether that virus could persist by human-to-human spread. Provision also had to be made for the long-term storage of vaccine reserves and for the preservation of records.

However important and substantial the activities which remained, the disappearance of smallpox quickly resulted in a diminished interest in the programme. Only with difficulty were national governments persuaded of the need to assign resources for certification activities, and WHO's budget for smallpox decreased sharply. Remarkably, however, a rigorously scheduled array of activities was completed almost as planned.

During 1978, certification activities were completed in 19 countries, including most of those in southern Africa and western Asia. This brought to 64 the total of countries where eradication had been certified by international commissions. In December, the Global Commission decided that special activities were needed in 15 additional countries. It also recommended that an official attestation be sought from all other countries to the effect that the country concerned had been free of smallpox for at least 2 years. Difficult diplomatic relationships, national sensitivities, civil disturbances and inertia caused serious problems in implementing the recommendations, but one by one the problems were overcome. On 9 December 1979, the Global Commission concluded that the global eradication of smallpox had been achieved and

approved a report that was presented to the Thirty-third World Health Assembly in May 1980.

The urgency for laboratories to destroy or transfer their stocks of variola virus became apparent when, in August 1978, 2 cases of smallpox with 1 death occurred as a result of a laboratory infection in Birmingham, England. National authorities took a greater interest in ensuring the safety of their own populations and the number of laboratories retaining stocks of variola virus decreased to 6 by May 1980, and eventually to 2.

In 1978, WHO announced a reward of US\$1000 for the report of any new case which could be confirmed as smallpox, and some 50 rumours a year were evaluated in 1978 and 1979 by field investigation and laboratory study. Most proved to be chickenpox; none was a case of smallpox.

Collaborative research on monkeypox and the "whitepox" viruses, conducted in laboratories in Japan, the United Kingdom, the USA and the USSR, revealed the troublesome "whitepox" viruses to have been laboratory contaminants. Field and laboratory studies of monkeypox virus provided increasing evidence that human infections were infrequent and that human-to-human transmission seldom occurred.

Reserves of smallpox vaccine were established and a protocol was developed for the periodic testing of samples to ensure their continuing potency.

Throughout this period, a special public information effort was undertaken to make widely known what had been accomplished and how, so that when the World Health Assembly agreed that eradication had been achieved, the general public would accept the fact more readily.

The declaration on 8 May 1980 by the Thirty-third World Health Assembly that smallpox eradication had been achieved concluded an historic chapter in medicine. Twenty-two years had elapsed since the USSR had first proposed to the Health Assembly that global smallpox eradication should be undertaken, and 14 years since the Assembly had committed special funds to a programme which it hoped would interrupt transmission within 10 years. In fact, 10 years, 9 months and 26 days elapsed from the beginning of the Intensified Smallpox Eradication Programme until the last case in Somalia.