Smallpox eradication in West and Central Africa*

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In 1966, a programme to eradicate smallpox and control measles began in West and Central Africa. With WHO and US bilateral technical and financial assistance, the 20 countries mounted a coordinated campaign of mass vaccination, assessment, surveillance, and maintenance activities. The last cases of smallpox occurred in May 1970. The introduction of epidemiologically directed surveillance-containment activities and their rapid success resulted in interruption of smallpox transmission much sooner than anticipated. The area has remained free of smallpox. From 1966 to 1972, over 28 000 000 children 1–6 years of age also received measles vaccination. The campaign established or strengthened structures for preventive health care services in all the countries.

In May 1970, the last cases of smallpox were reported in West and Central Africa, 3½ years after the start of a coordinated regional programme to eradicate smallpox from the 20-country area. This report describes the development and results of the West and Central African regional smallpox eradication programme.

BACKGROUND

History of the programme

Since Jenner introduced vaccination in 1796, smallpox has been gradually eliminated from the industrialized world. However, the thermolability of glycerinated lymph vaccine posed a severe logistical barrier to widespread mass vaccination, especially in the tropics and in areas with limited medical services. Moreover, the efficacy of vaccination was compromised by vaccinators using suboptimum multiple pressure and scarification techniques. Global eradication of smallpox under such conditions was a fantasy. The years after the Second World War witnessed a revolutionary change—the large-scale production of thermostable lyophilized smallpox vaccine (1). Teams of vaccinators could now range far from refrigeration facilities and yet administer a highly potent vaccine. The later introduction of the bifurcated needle [a] and intradermal jet injector largely eliminated the problem of variability of vaccination technique while reducing the quantity of vaccine needed to achieve good results.

In 1950, a regional smallpox eradication programme began in the Americas under the leadership of the Pan American Health Organization (PAHO) (2). By 1958, this programme had achieved significant success; several previously endemic countries had eliminated the disease by mass vaccination campaigns. In addition, PAHO's support stimulated the establishment of large-scale freeze-dried vaccine production centres in several of the countries.

In 1958, the USSR proposed that a programme of global eradication be undertaken under the auspices of the World Health Organization (3), with primary responsibility for implementation of the programme to be left to the countries concerned. India, on the advice of an expert committee of the Indian Council of Medical Research, decided to undertake a programme of total smallpox eradication; pilot projects started in 1960 and 1961 (4). A number of other smallpox-endemic countries also began eradication campaigns.

Following the introduction of a measles vaccine by Enders (5), a trial of immunization against measles was held in Upper Volta in 1961 (6). Its

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success led the Ministry of Health of Upper Volta to conduct a nationwide programme of immunization in 1963 with the assistance of the United States Agency for International Development (USAID) (7). Six additional countries received assistance from the USA to conduct nationwide measles immunization programmes in 1965, and further requests soon brought the number of countries conducting mass immunization against measles to 11. Medical epidemiologists from the Center for Disease Control (CDC), Atlanta, GA, USA, provided part-time technical assistance for these programmes.

During the years 1961-66 CDC investigated mass vaccination techniques, especially the use of jet injection in smallpox vaccination. Beginning in 1963, with the support of PAHO and WHO, a series of trials was conducted in Brazil (11), Jamaica, Tonga (R. R. Roberto, unpublished observations, 1964), and the USA (8-10) to test techniques of mass vaccination, principally jet injection, under a variety of circumstances.

During 1965, a series of discussions and planning meetings, held principally between Dr A. C. Curtis, Chief, Public Health Division, Office of Institutional Development, USAID, and one of us (D.A.H.), then on the CDC staff, laid the financial and technical groundwork for regional assistance to eliminate smallpox and control measles in the 20-country area of West and Central Africa within 5 years. In January 1966, an interagency agreement was signed and the " West and Central African Smallpox and Measles Control Programme " came into being. It was funded by USAID and staffed and managed by CDC. During the next several months, agreements with the individual countries were reached and planning began.

In May 1966, the Nineteenth World Health Assembly, after considering a report outlining a 10-year plan for the development of the WHO smallpox eradication programme (12), decided to initiate a major coordinated programme for the world-wide eradication of the disease under the Organization's auspices.

The individual ministries of health in West and Central Africa moved quickly to begin or intensify their various national eradication programmes, field activities under the coordinated programme beginning in January 1967.

The area and its people

The 20-country area of West and Central Africa constitutes a single contiguous geographic unit

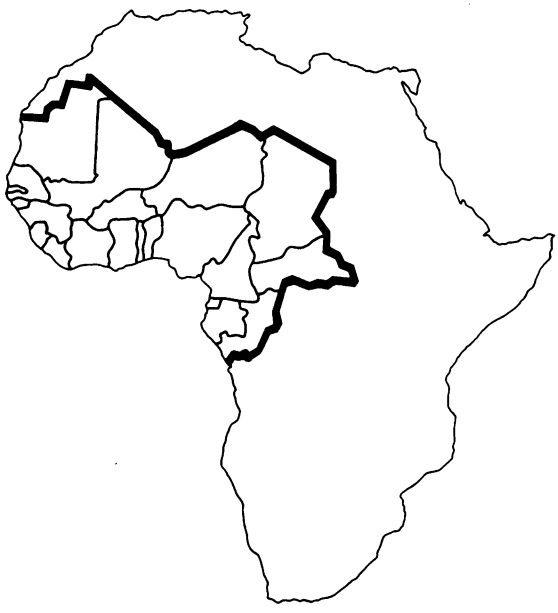

Fig. 1. Regional smallpox eradication/measles control programme, 20 African countries.

stretching from Mauritania to the Congo (Zaire) River, and from the Bight of Benin to the Sahara (Fig. 1). Over 120 million people inhabit the area, which is larger than the contiguous states of the USA. The ecology of the region embraces a range of extremes from the coastal rain forest to the arid Sahara, with widely varying traditions and modes of living. Nomadism and transhumance are prominent in the savannah grasslands and predominant in the northern regions of the area. The inhabitants include hundreds of tribal groups who speak a variety of local languages and are organized into various tribal and theocratic societies. In the northern area, Islam is the predominant religion, and social organization conforms to Islamic traditions.

Health structures in the countries reflect the influence of the recent colonial powers. In French-speaking areas, mobile medicine, both curative and preventive, has been predominant. In English-speaking areas, establishment of fixed medical facilities has traditionally received priority, with mobile disease control teams a relatively recent phenomenon. Two regional health unions, the Organization for Coordination and Cooperation in the Control of Major Endemic Diseases (OCCGE) and the Organization for Coordination in the Control of Endemic Diseases in Central Africa (OCEAC), unite the

medical services of countries that formerly constituted French West and French Equatorial Africa. Their primary function is to coordinate the activities of the various mobile health services in these countries.

Notable, though it was only one of many problems, was the existence in Western Nigeria, Dahomey, and Togo of a smallpox cult, known variously as Sakpata or Soponna, which attracted devotees who perceived smallpox as a visitation of unappeased gods. Priests or medicine-men of the cult erected fetishes to the appropriate spirits, received those who died of smallpox (and their possessions), and practised variolation, the inoculation of material containing smallpox virus.

Smallpox in West and Central Africa

The reported number of cases of smallpox, by year, for the 20-country area is shown in Fig. 2. In most years from 1940 to 1970, between 10 000 and 20 000 cases of smallpox were reported. However, retrospective surveys (S. O. Foster, unpublished observations, 1970; 13) showed reporting efficiency in recent years to have been less than 5%. Therefore, it is likely that at least 200 000 to 400 000 cases of smallpox actually occurred in West Africa during most years.

Smallpox incidence in West and Central Africa followed a seasonal pattern, reaching a low point in September and October, during the rainy season, and rising to a peak in March and April, the late dry season (Fig. 3). This pattern was less pronounced in coastal areas and exaggerated in the dry savannah or Sahel. Undoubtedly it can be explained in part by the effect of climate on social activities. Planting during the rainy season results in dispersion of the population to the fields, and there are fewer social events. The dry season, on the other hand, is characterized by festivals and social contacts in agricultural areas and transhumance in sub-Saharan areas.

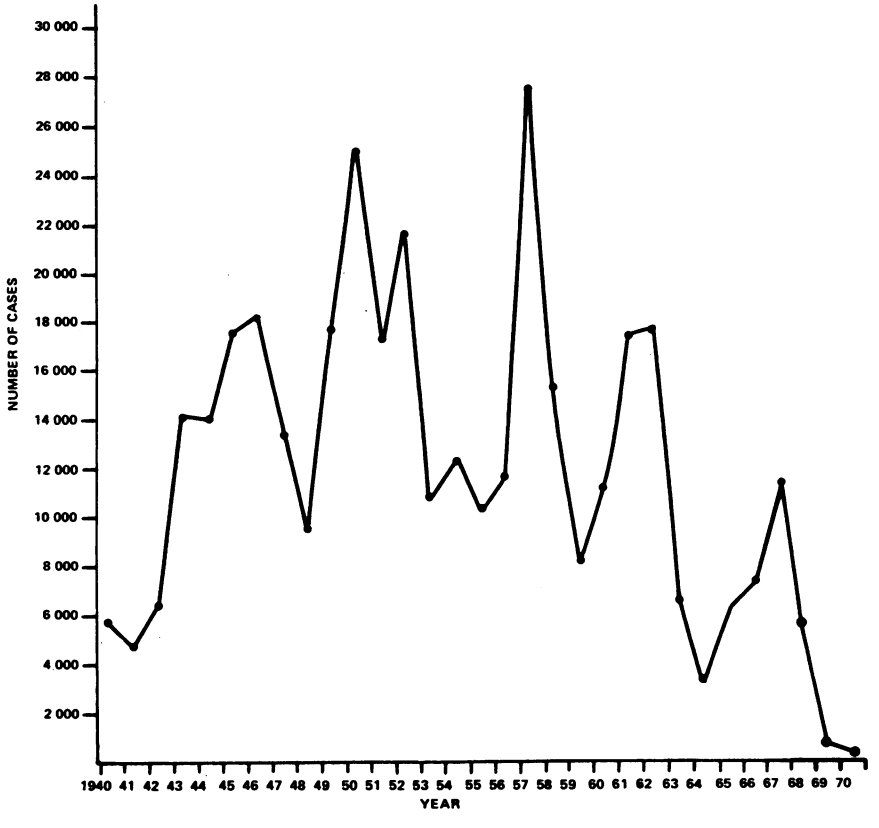

Fig. 2. Reported smallpox cases in West and Central Africa, 1940-67. Source: World Health Organization.

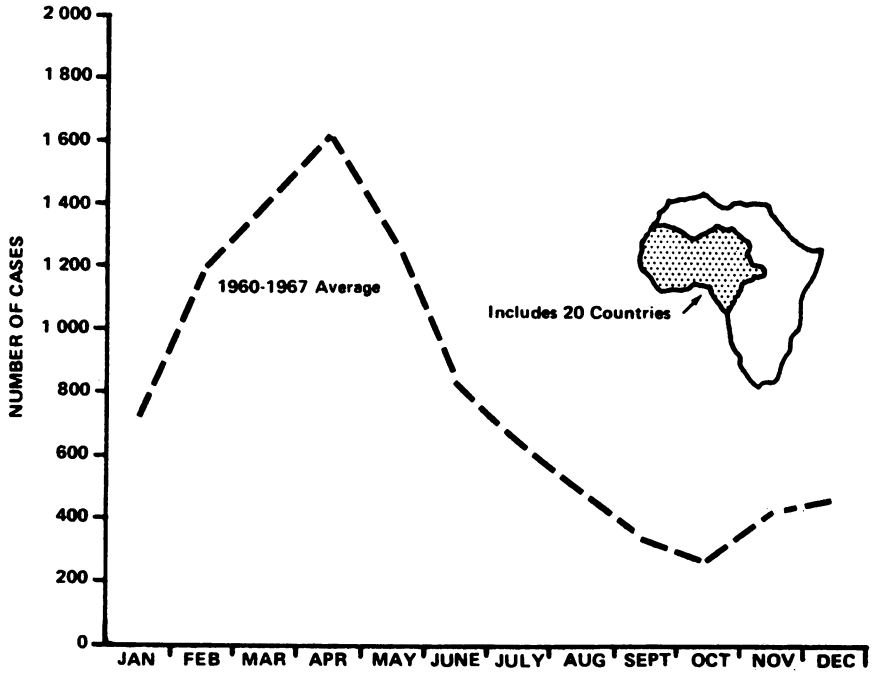

Fig. 3. Average number of reported smallpox cases in West and Central Africa by month, 1960-67. Source: World Health Organization.

In Asia, the highest attack rates for smallpox occur among children. While some outbreaks in West Africa have followed this pattern, the age distribution of smallpox cases in West and Central Africa has, in general, followed closely the age distribution of the population (Table 1). Moreover, case fatality ratios were observed to be lower than in the Asian subcontinent. Table 2 summarizes the ratios for 2 125 smallpox patients studied in 1968 in West and Central Africa. While the overall case fatality ratio is 14.2%, the ratios for children under the age of 1 year and persons aged over 45 years were twice the average.

As in other parts of the world, the great majority of smallpox cases occurred in persons who did not have a smallpox vaccination scar. Smallpox case investigations initially revealed that 10% of all those afflicted reported having been vaccinated at some time in their lives. Later, however, more detailed studies revealed few smallpox patients to have a

Table 1. Age distribution of 3 855 smallpox cases in West and Central Africa, January 1967–February 1969

Age	Number of cases	Distribution of cases (%)
< 1	126	3.3
1–4	704	18.3
5–14	1 006	26.1
15–44	1 684	43.7
45 +	335	8.7
Total	3 855	100

Table 2. Case fatality ratios for 2 125 smallpox patients, West and Central Africa, 1968

Age	Cases	Deaths	Case fatality ratio (%)
<1	102	30	29.4
1–4	417	48	11.5
5–14	494	38	7.7
15–44	1 009	153	15.2
45 +	103	33	32.0
Total	2 125	302	14.2

Table 3. Vaccination status of smallpox cases [a]

A. Vaccination status by history of investigated smallpox cases

Age	Number of cases	History of vaccination	Percentage
< 1	30	1	3.3
1–4	179	5	2.8
5–14	255	11	4.3
15–44	158	41	25.9
45 +	17	10	58.8
Total	639	68	10.6

B. Vaccination status by examination for scar of investigated smallpox cases

Age	Number of cases	Patients with vaccination scar	Percentage
< 1	3	0	—
1–4	46	0	—
5–14	75	2	2.7
15–44	60	4	6.7
45 +	1	0	—
Total	185	6	3.2

[a] From outbreak investigations in Cameroon, Dahomey, Ghana, Mali, Niger, Nigeria and Sierra Leone.

vaccination scar (Table 3). The marked discrepancy between vaccination histories and the presence of vaccination scars may be due to confusion in referring to other injections as " vaccinations ", or it may reflect the use of impotent vaccine in the past.

PROGRAMME STRATEGY AND RESULTS

The basic strategy of the programme as developed in 1966 (14) conceived of an attack phase consisting of (*a*) mass vaccination of the entire population against smallpox within 3 years, and (*b*) assessment of vaccination coverage actually achieved. This was to be followed by a maintenance phase consisting of vaccination of incoming susceptible persons, principally newborn infants, the strengthening of surveillance techniques, and other tactics that might be dictated by evaluation.

The USA agreed to provide commodities, lyophilized smallpox vaccine, jet injectors, and vehicles. Also provided were medical epidemiologists to assist in the planning and development of campaigns in the countries, and nonmedical operations officers to assist in the development of logistic and operational resources necessary to carry out a nationwide programme of disease control. The first such staff from the USA, 15 medical officers and 22 operations officers, arrived in Africa late in 1966. The ministries of health provided personnel at all levels to execute the programme and assumed responsibility for local costs. WHO assisted the countries in financing certain local costs. The programmes were coordinated in their respective areas by the two regional health organizations, OCCGE and OCEAC.

Mass vaccination

Each of the countries capably executed campaigns of mass vaccination by jet injection using collecting points rather than a house-to-house approach. Countries that had mobile immunization systems prior to the regional programme continued to use them vigorously. Other countries developed such systems to a high degree of effectiveness. Between January 1967 and December 1969, 100 million persons were vaccinated for smallpox in the 20-country area. This followed very closely the pre-programme estimates as to the number of vaccinations that would be given per month (Fig. 4). Smallpox vaccinations for both attack and maintenance activities up to December 1972 are shown by country and year in Table 4. During this same period, 28 163 000 children between 6 months and 6 years of age were simultaneously given measles vaccine.

Assessment

Assessment of vaccination coverage and efficacy was used operationally in 13 of the 20 countries. In general, all countries conducting systematic assessments confirmed that their programmes of mass vaccination reached 80% or more of the population in most age groups. Assessment proved especially useful in identifying poorly vaccinated groups, the age group over 45 years being consistently shown to be the most difficult to reach.

Assessment also confirmed the invariably high vaccination take rates achieved with the jet injector, even under suboptimum conditions. Countries that used assessment found it invaluable for judging the adequacy of vaccination programmes and guiding them in making decisive operational changes.

Surveillance–containment activities

In the original strategy, surveillance was seen as a vital part of the programme, but it was anticipated

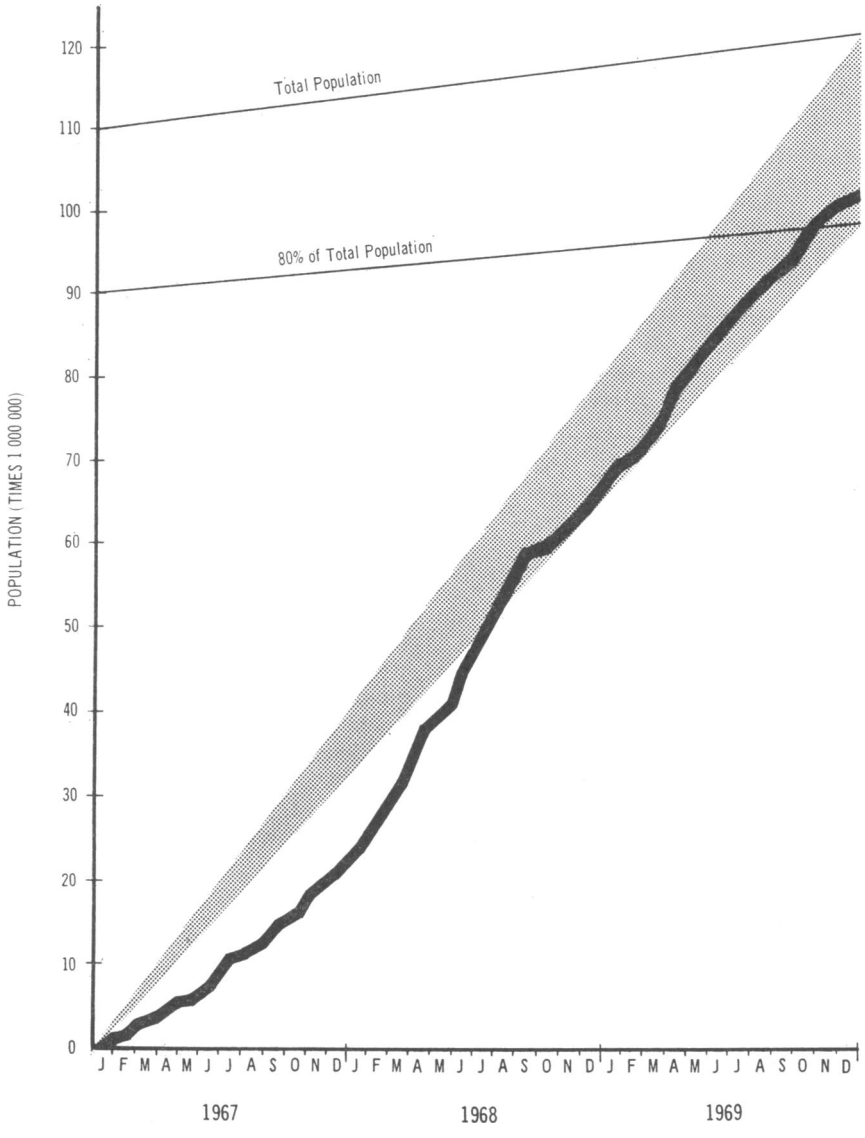

Fig. 4. Cumulative smallpox vaccinations as related to the estimated total population, West and Central Africa smallpox eradication/measles control programme area. Shaded area shows pre-programme estimates of cumulative number of vaccinations that would be given; thick line shows cumulative number of vaccinations actually given.

that it would be most useful during the maintenance phase. Several early observations of smallpox in Africa and accumulating evidence from smallpox workers elsewhere soon suggested that surveillance and containment activities were of greater importance than mass vaccination even during the attack phase.

The first observation of this sort occurred during a smallpox outbreak of 43 cases in Ogoja Province, Nigeria. On 4 December 1966, smallpox was reported by a missionary in the Yache language area of Ogoja Province. An investigation was started the same day. With the help of missionaries in the area, a surveillance system was immediately instituted

Table 4. Smallpox vaccinations (in thousands), Smallpox Eradication Programme, West and Central Africa

Country	Year						Cumulative vaccinations Jan. 1967–Dec. 1972
	1967	1968	1969	1970	1971	1972	
Central African Republic	381	405	477	508	558	427	2 756
Chad	1 387	1 345	1 322	1 182	977	666	6 879
Congo	162	581	312	617	288	73	2 033
Dahomey	702	990	934	849	448	184	4 107
Equatorial Guinea	NA [a]	NA	82	238	15	6	341
Gabon	225	146	175	201	105	138	990
Gambia	231	147	40	40	20	3 [b]	481
Ghana	1 342	1 988	2 094	1 909	1 052	481 [b]	8 866
Guinea	1 068	2 063	1 434	1 453	1 200	1 100 [b]	8 318
Ivory Coast	1 580	1 756	1 582	548	619	67	6 152
Liberia	44	231	398	191	120 [b]	268 [b]	1 252
Mali	1 043	1 472	1 193	516	56	111	4 391
Mauritania	NA	NA	430	288	193	297	1 208
Niger	1 610	1 166	936	1 297	850	776	6 635
Nigeria	9 560	23 494	16 155	8 702	5 362	5 454	68 727
Senegal	383	1 468	762	330	507	124	3 574
Sierra Leone	0	965	1 154	258	93 [b]	100 [b]	2 570
Togo	605	608	922	467	507	166	3 275
United Republic of Cameroon	1 611	1 996	1 693	1 443	3 250	2 215	12 208
Upper Volta	2 040	2 208	1 338	1 026	1 568	632	8 812
Total [c]	23 972	43 030	33 431	22 062	17 788	13 288	153 575

[a] NA = not available.
[b] Incomplete and/or provisional.
[c] Totals do not sum up because figures are rounded off.

which identified 6 cases and delineated the infected area. During the first week after the outbreak was detected, 4 new cases of smallpox occurred and vaccination activities proceeded within the immediate area of the cases (Fig. 5). During the second week of the outbreak, 12 additional cases were reported and during the third week, 9 new cases were reported (Fig. 6 and 7). However, within 4 weeks after the outbreak was reported, control methods had successfully interrupted transmission. The key factors appeared to be a surveillance system that quickly identified the infected areas and control activities that focused on rapid vaccination of family and village contacts of cases. Except for 2 individual cases of smallpox in persons who had been missed or unsuccessfully vaccinated, smallpox transmission was interrupted in each geographic area within 3 weeks after control activities were started (Fig. 8). It was evident that even in smallpox endemic areas with low levels of population immunity, individual outbreaks could be quickly and effectively contained.

A second observation concerned the transmissibility of smallpox virus. Although textbooks even today continue to describe smallpox as one of the most highly contagious of the infectious diseases,

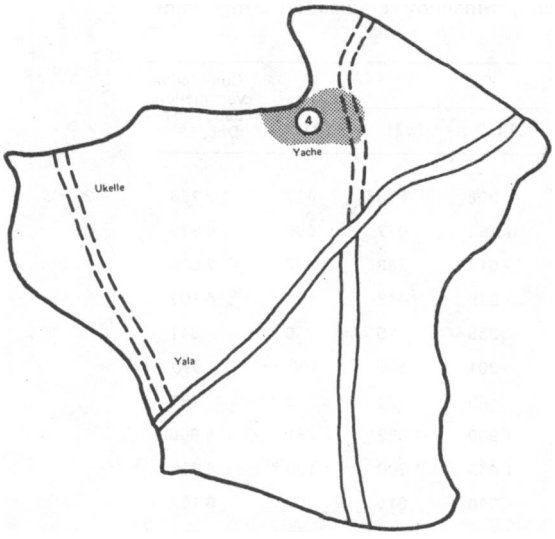

Fig. 5. Ogoja smallpox outbreak, 4–10 December 1966. In this and the next two figures, the numbers indicate the onset of new cases; stippled areas show the areas vaccinated.

observations in Africa indicated that although the spread of smallpox may be tenacious, it is also slow. In one instance, 4 incubation periods were required in a single compound before smallpox involved all 4 susceptible contacts in the compound (Table 5). Of susceptible individuals living in a compound with a

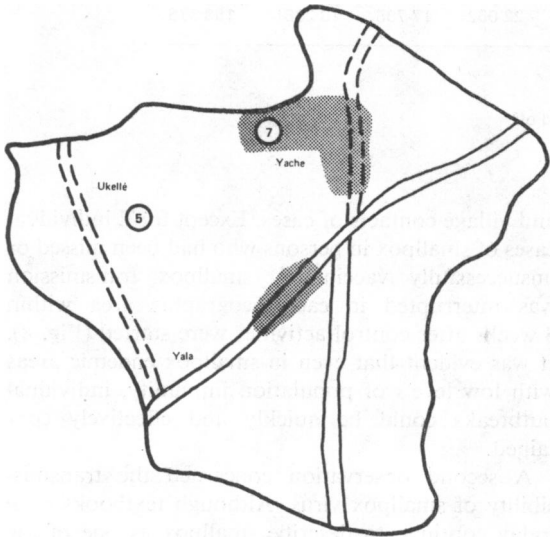

Fig. 6. Ogoja outbreak, 11-17 December.

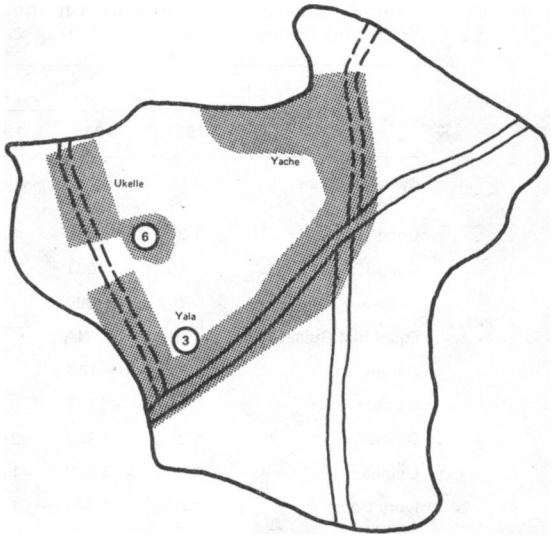

Fig. 7. Ogoja outbreak, 18-24 December.

smallpox case, it appeared that only 25–45% developed smallpox within 1 incubation period after initial exposure (Table 6). These findings agreed with those of Rao (15) in Madras, India, who found that less than half of the unvaccinated household contacts of smallpox cases developed the disease, and that vaccination of contacts even after exposure offered significant protection.

Third, it became evident that smallpox was not widespread throughout smallpox endemic areas. Only a small proportion of villages were found to be involved with smallpox at any one time. Histories taken in a smallpox-infected village often revealed

Table 5. Examples of slow smallpox transmission within a single compound

Source	Contacts in addition to index case	Contacts without history of vaccination	Interval between onset of symptoms in index case and onset of symptoms in last compound case
Nigeria (Abakaliki)	21	4	31 days
Nigeria (Abakaliki)	32	14	47 days
Nigeria (Abakaliki)	14	5	51 days
United Rep. of Cameroon (N'Game)	?	4	approx. 53 days
Nigeria (Adepe-Ipiga)	30	27	approx. 60 days
Nigeria (Gerere)	24	15	approx. 80 days

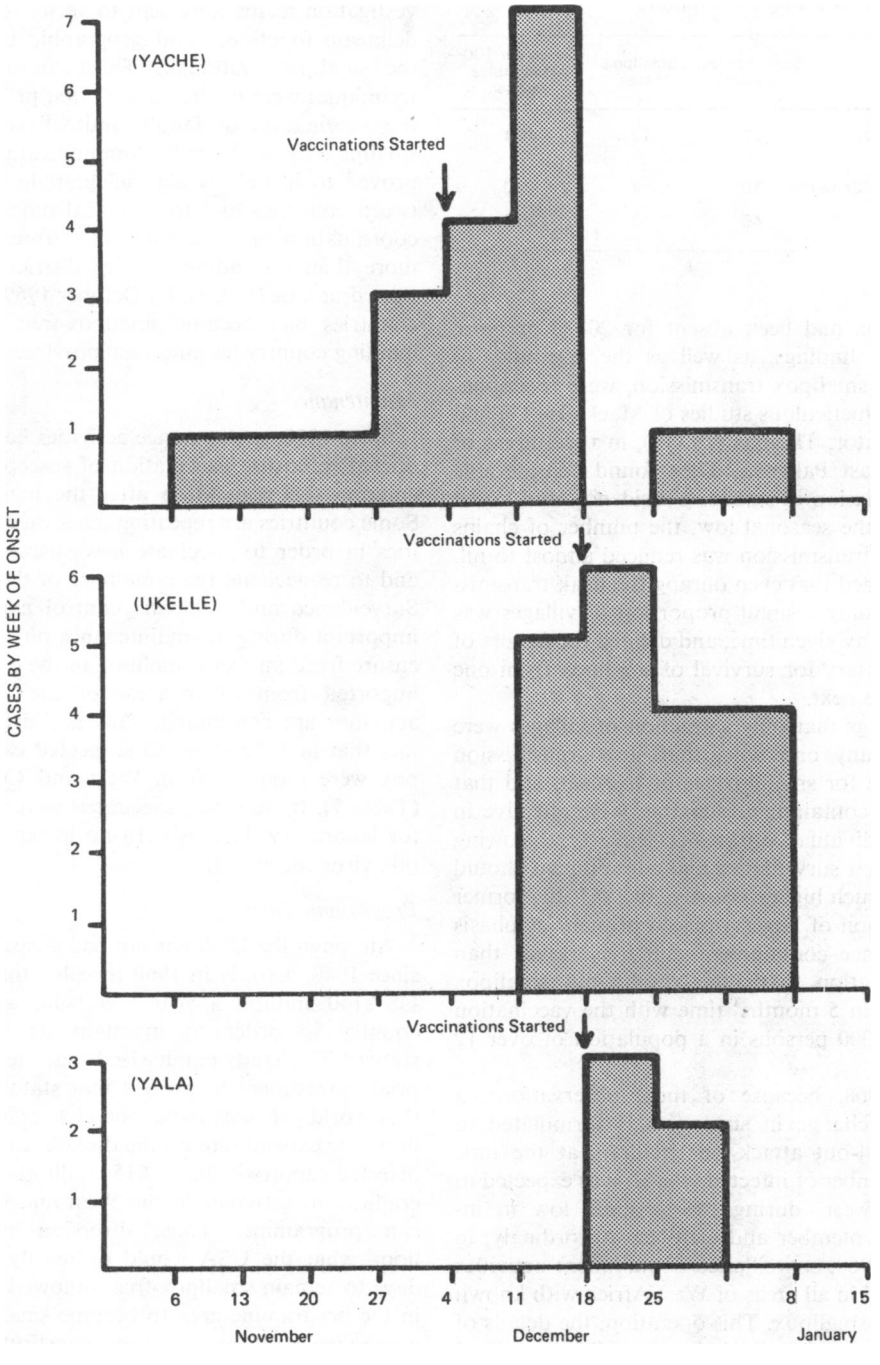

Fig. 8. Ogoja county, smallpox cases by week of onset and geographic area.

Table 6. Smallpox cases as related to susceptible exposures within a single compound

Source	Susceptibles exposed	Smallpox cases	Cases per 100 susceptibles exposed
Nigeria (Abakaliki)	27	12	44.4
United Rep. of Cameroon (N'Game)	10	4	40.0
Nigeria (Gerere)	45	12	26.2

that smallpox had been absent for 20–30 or more years. These findings, as well as the feasibility of interrupting smallpox transmission, were re-emphasized by the meticulous studies of Mack (16, 17) and his collaborator, Thomas (18, 19), in rural areas of West and East Pakistan. They found considerable seasonal variation in smallpox incidence, and noted that during the seasonal low, the number of chains of smallpox transmission was reduced almost to nil. They confirmed that even durang the peak transmission season only a small proportion of villages was involved at any given time, and defined the factors of chance necessary for survival of smallpox from one season to the next.

The findings that only a fraction of villages were infected at any one time, that slow transmission allowed time for smallpox teams to react, and that surveillance–containment activities were effective in stopping individual outbreaks led to a growing awareness that surveillance and containment should be given a much higher priority. In 1967, the former Eastern Region of Nigeria placed primary emphasis on surveillance–containment activities rather than mass vaccination, with the result that smallpox disappeared in 5 months' time with the vaccination of only 750 000 persons in a population of over 12 million.

In mid-1968, because of these observations, a region-wide change in strategy was formulated to permit an all-out attack on smallpox at the time when the number of infected villages was expected to be at its lowest—during the seasonal low in incidence in September and October. Accordingly, in September 1968, surveillance–containment activities were initiated in all areas of West Africa with known or suspected smallpox. This operation, the details of which have been described elsewhere (20), consisted essentially of 4 parts. First, surveillance activities were increased through formal and informal reporting and case detection methods in an effort to locate all outbreaks of smallpox. Second, outbreak investigation teams were sent to verify reports and to delineate functional and geographic boundaries of the smallpox outbreak. Third, outbreak control techniques were instituted with first priority given to the vaccination of family and village contacts of smallpox cases. Fourth, communications were improved to include weekly telegraphic reporting between countries and to a central office to facilitate coordination in the control of outbreaks involving more than one administrative district. The results were dramatic (Fig. 9). By October 1969, 19 of the 20 countries had become smallpox-free, and the remaining country became smallpox-free in May 1970.

Maintenance

Since 1970, maintenance activities have been conducted to ensure vaccination of susceptible persons entering the population after the mass campaign. Some countries are repeating mass vaccination activities in order to vaccinate new susceptible persons and to revaccinate the remainder of the population. Surveillance and epidemic control capabilities are important during the maintenance phase in order to ensure freedom from smallpox in the event that it is imported from other areas of the world. These activities are continuing. This is illustrated by the fact that in 1972 alone 53 suspected cases of smallpox were reported from West and Central Africa (Table 7). In 46 cases, specimens were sent to CDC for laboratory diagnosis. In no instance was smallpox virus recovered.

Programme costs

Although the USA has not had a case of smallpox since 1949, a study in 1968 revealed that more than US $140 million a year was being spent in that country in order to maintain its smallpox-free status.[a] This study emphasized that the most appropriate investment to protect that status was to free the world of smallpox, thereby reducing future domestic expenditure on the disease. In all, the USA invested approximately $15 million in smallpox eradication activities in the West and Central African programme. Thus, diversion of $15 million—what the USA would ordinarily spend in 39 days to remain smallpox-free—allowed 20 countries in the programme area to become smallpox-free. In consequence, these countries constitute no future

[a] AXNICK, N. W. & LANE, J. M. Costs associated with the protection of the United States against smallpox. Geneva, 1972 (WHO offset document WHO/SE/72.45).

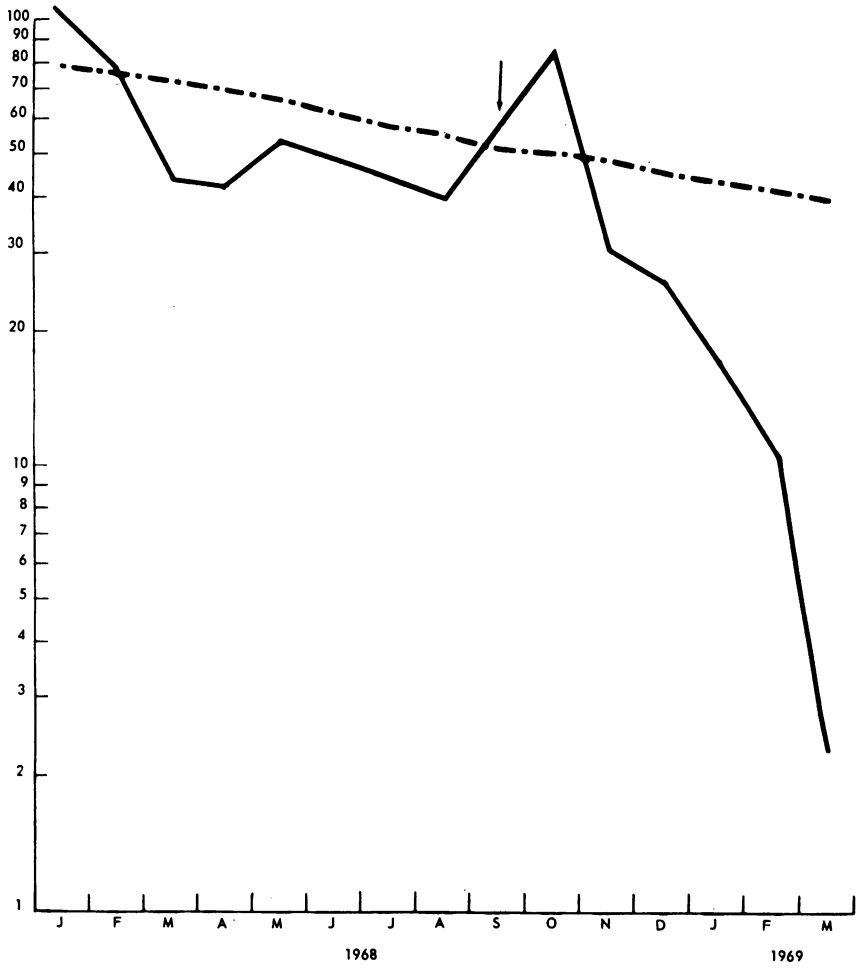

Fig. 9. The percentage of the population not vaccinated in the smallpox eradication programme area (broken line) compared with the ratio (%) of reported smallpox cases to cases expected from the 1960–67 monthly average (solid line). The arrow marks the start of surveillance–containment activities.

risk as exporters of smallpox. Estimated per capita costs of smallpox eradication in West and Central Africa are shown in Table 8.

Monkeypox

In the past 3 years, 17 cases of human monkeypox have been reported from West and Central Africa (21). Clinically, the disease is indistinguishable from smallpox and it can be diagnosed only by laboratory examination. It appears to be a disease of very low incidence, probably mistaken for smallpox in the past, most likely the result of chance spread from animal to man and with limited potential for human-to-human spread. Most important, studies to date indicate that it poses no threat to the achievement of smallpox eradication.

In addition to its scientific interest (the disease is a zoonotic curiosity), the discovery of monkeypox has broader ramifications in the setting of smallpox-free Africa. That monkeypox cases have been repeatedly identified and investigated as suspected smallpox is strong evidence of the existence of a surveillance system adequate to identify smallpox resulting from importation.

Table 7. Suspected smallpox cases, West and Central Africa, 1972

Country	No. of suspected cases reported to CDC	No. of cases with specimens sent to CDC	Laboratory results		
			Herpes	Vaccinia	Negative
Central African Republic	3	3	1	—	2
Congo	2	2	—	—	2
Dahomey	1	—	—	—	—
Ghana	7	7	4	—	3
Ivory Coast	1	1	1	—	—
Liberia	3	3	1	—	2
Mali	1	—	—	—	—
Niger	3	3	2	—	1
Nigeria	23	22	6	7	14
United Rep. of Cameroon	8	4	3	—	1
Upper Volta	1	1	1	—	—
Total	53	46	19	2	25

Table 8. Per capita costs of smallpox eradication in West and Central Africa

Item	Amount (US $)
Commodities, administrative and delivery costs	0.097
Local salaries and local indirect costs (estimated)	0.018
Smallpox vaccine	0.016
Jet injectors (purchase and spare parts)	0.007
Total costs per person	0.138

DISCUSSION

To the countries of West Africa, the importance of having achieved smallpox eradication cannot be overestimated. Smallpox has been a scourge for untold generations, exacting a fearsome economic, social, and human cost. The success of the programme in interrupting smallpox transmission not only provides present and future benefits to Africa, but has also served as a catalyst in many other areas of the world by demonstrating that smallpox eradication is an achievable goal. In addition, the cooperation of French-, English-, and Spanish-speaking countries in a single unified and coordinated programme was a landmark that pointed the way to future coordination in other African programmes.

The smallpox eradication programme also enabled ministries of health to pursue 2 important medical objectives. First, it allowed emphasis on preventive rather than curative approaches and, second, it permitted a departure from an all too prevalent tendency in many countries to provide elaborate medical facilities for the few with little or no medical attention for the many.

The change in the strategy of the programme to emphasize surveillance–containment activities had far-reaching ramifications. For 175 years, the approach to smallpox control had emphasized a defensive strategy, i.e., protection of the population against future exposure by means of mass vaccination. To be sure, the surveillance–containment approach was advocated by a Royal Commission as long ago as 1896 (22). More than a decade ago, Dixon wrote: " If more study was given to the foci of smallpox, it might be possible to eradicate the disease from an area by vaccinating a far smaller proportion of the total population " (23). However, this idea, embracing an offensive strategy, was slow to mature as an operational concept. The development of surveillance–containment activities in West and Central Africa made widespread use of this approach in seeking to find smallpox outbreaks,

using vaccination as a specific technique to protect persons at immediate risk. The strategy worked well in the programme area and has subsequently been used with similarly excellent results throughout the rest of the smallpox-endemic countries. The use of these techniques in the last remaining endemic countries—Bangladesh, Ethiopia, India, and Pakistan—could well bring about the worldwide eradication of smallpox within the period of the 10-year plan considered by the Nineteenth World Health Assembly in 1966.

Finally, in most of the West African countries the smallpox eradication programme is being used as the foundation for immunization programmes using additional antigens. Countries have developed the necessary expertise and have recognized that immunization programmes are among the most economical approaches to health improvement in Africa. By giving several antigens to each child at a single visit, costs can be reduced even further. Studies in Africa and elsewhere have shown this procedure to be safe and effective. The simultaneous delivery of 5–10 antigens has been shown to be feasible both administratively and logistically (24).

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RÉSUMÉ

ÉRADICATION DE LA VARIOLE EN AFRIQUE OCCIDENTALE ET CENTRALE

En 1966, un programme visant à éradiquer la variole et à lutter contre la rougeole a été lancé en Afrique occidentale et centrale. Dans chaque pays, l'exécution du projet a été placée sous la responsabilité du Ministère de la Santé publique. Le Gouvernement des Etats-Unis d'Amérique et l'OMS ont fourni une assistance financière et technique.

La région est caractérisée par une gamme étendue de conditions écologiques, par une grande variété des aspects sociaux (nomadisme, transhumance, abondance d'idiomes locaux, mœurs et traditions) et par de profondes différences d'organisation des services de santé selon les pays. Les 20 pays intéressés ont mis sur pied une campagne coordonnée qui a débuté en janvier 1967 et qui comportait des activités de vaccinations de masse, d'évaluation, de surveillance ainsi que des vaccinations d'entretien. En décembre 1969, plus de 100 millions de personnes avaient été vaccinées contre la variole.

La stratégie du programme a été modifiée en 1967 et 1968: au lieu de mettre l'accent sur les vaccinations de masse, on a concentré les efforts sur les activités de surveillance-endiguement orientées par des critères épidémiologiques. En octobre 1969, 19 des 20 pays étaient exempts de variole, et depuis mai 1970 aucun cas de variole n'a été signalé dans la région. La mise en œuvre des mesures de surveillance-endiguement a amené l'interruption de la transmission de la variole bien plus tôt que prévu. De 1966 à 1972, plus de 28 millions d'enfants ont été vaccinés simultanément contre la rougeole et contre la variole.

Le programme régional a permis d'établir ou de renforcer les structures des services de soins préventifs dans les différents pays et ses succès remarquables ont fourni l'élément moteur de leur expansion.

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NOTE ADDED IN PROOF. Since this article was prepared, Bangladesh, India and Pakistan have become smallpox-free. Dahomey was re-named the People's Republic of Benin in 1975.