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SMALLPOX ERADICATION PROGRAMME [1]

[A19/P&B/2 — 28 March 1966]

REPORT BY THE DIRECTOR-GENERAL

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1. INTRODUCTION

The urgency and desirability of a global programme for smallpox eradication was unanimously affirmed by the Eleventh World Health Assembly in 1958, in its resolution WHA11.54. Intensified vaccination programmes followed in many of the countries with endemic smallpox. Technical assistance and support in the conduct of many programmes and in the establishment of vaccine production facilities was provided by the Organization, on request, within the resources available to the Director-General. However, as noted in resolution WHA18.38 adopted by the Eighteenth World Health Assembly, progress has been slow and major endemic foci remain in Asia, Africa and the Americas. It is now apparent that without a greatly intensified, well co-ordinated global effort, with substantial additional resources, global eradication is not a realizable goal in the foreseeable future.

It is abundantly clear from the results of successful programmes in Central and South America, South-East Asia, the Middle Eastern countries and North Africa, that intensified systematic vaccination programmes using potent vaccines can rapidly eradicate the disease. No insurmountable technical problems have been evident. Failure on the part of individual countries to develop programmes and difficulties experienced by others in achieving eradication have resulted principally from the lack of necessary funds for personnel, vaccine and supplies or from failures in the conduct of the vaccination campaigns or in the establishment of competent surveillance or maintenance vaccination activities.

Costs of vaccination programmes in the non-endemic countries are high. Czechoslovakia has estimated that it expends annually over US $1 million (US $0.073 per person) in maintenance vaccination, and the United States of America US $20 million annually (US $0.112 per person). The United Kingdom has estimated that the average cost in a normal year is US $0.65 million (US $0.01 per person), but when a smallpox outbreak occurred in 1961 and 1962 additional expenditure incurred during the outbreak was

[1] See resolution WHA19.16.

estimated to be US $3.8 million. Despite recognition of the fact that countries would realize a substantial long-term saving after smallpox has been eradicated, a request for voluntary contributions to enable the Organization to provide needed assistance has met with only a limited response.

If the goal of global smallpox eradication is to be realized in a reasonable period, there is an immediate need to establish a soundly based, adequately staffed and financed global programme capable of providing a continuing impetus and co-ordination and technical and material assistance throughout the smallpox endemic regions of the world.

In its resolution WHA18.38 the Eighteenth World Health Assembly, declaring the world-wide eradication of smallpox to be one of the major objectives of the Organization, requested countries having smallpox but no eradication programmes to initiate them and the countries with programmes to intensify them, and requested the Director-General to make available the increased amount of technical guidance and advisory services necessary to accelerate the programme as well as to assist the countries in obtaining the necessary vaccine, transport and other equipment.

At the thirty-seventh session of the Executive Board financial and technical aspects of the smallpox eradication programme were reviewed and in its resolution EB37.R16 the Board recommended the Nineteenth World Health Assembly to decide that "the participation of the Organization in the smallpox eradication programme should be financed from the regular budget of the Organization", and to request "the Director-General, in co-operation with all Members, to initiate action to carry out a world-wide smallpox eradication programme". In accordance with the resolution of the thirty-seventh session of the Executive Board, the following proposal for the eradication of smallpox is presented.

2. TECHNICAL CONSIDERATIONS

2.1 General Considerations

Of all the infectious diseases, smallpox, in its epidemiological behaviour, lends itself uniquely to an eradication effort. Directly transmitted from person to person, without known insect or animal reservoirs, rarely occurring in sub-clinical form, smallpox may quickly be detected in any area. The victim of the disease is generally incapable of transmitting the virus for more than two weeks and is rendered essentially permanently immune against a subsequent attack. Since the disease has a two-week incubation period, prompt identification of a case permits the initiation of effective containment measures.

Eradication can be accomplished in a comparatively simple and straightforward manner by rendering immune, through vaccination, a sufficiently large proportion of the population so that transmission is interrupted. In a highly endemic area this requires almost 100 per cent. coverage of the population.

Measurement of the proportion of a population vaccinated may be useful as a guide with respect to the conduct of a programme. However, it must be kept in mind that such measurement represents a guide only and the actual success of the programme must be appraised in terms of the disappearance of the disease. Although a certain high proportion of the population may have been vaccinated in principle, it must be recognized that substantially less are actually successfully vaccinated. Further, an overall indication of coverage rate says nothing regarding the distribution of vaccination. The Expert Committee on Smallpox [1] stated that follow-up assessments have shown that although the number of vaccinations made represented 80 per cent. or more of a country's estimated population, there were often sections of the population where the proportion vaccinated was only 30 per cent.

In densely crowded areas where infected individuals may contact a large number of persons, a very high proportion of the population should be successfully vaccinated to interrupt transmission. In sparsely settled areas with comparatively little crowding the disease may, in fact, spontaneously disappear until imported subsequently from more distant infected areas. More definitive studies of this phenomenon are required.

Cities, towns and villages, although reasonably accessible geographically for vaccination, appear to represent the most important reservoirs of the disease and sites of transmission. In large urban areas particularly, crowding is greatest and infected individuals normally come into contact with the largest numbers of persons. A fertile soil for the propagation of the disease is provided especially in the lowest socio-economic sectors, where response to vaccination campaigns is normally poor, where unprotected individuals from unvaccinated rural areas commonly migrate, where maintenance vaccination programmes are difficult to carry out, and where birth rates are high.

[1] *Wld Hlth Org. techn. Rep. Ser.*, 1964, **283**.

From limited evidence it would seem probable that intensive vaccination programmes in cities, towns and villages throughout a country with the establishment of active maintenance vaccination programmes, particularly for the new-born and migrants in the lowest socio-economic strata, could effectively terminate transmission.

2.2 Vaccine

The infinitely greater stability of freeze-dried smallpox vaccine unqualifiedly recommends this preparation over the glycerinated form in field vaccination programmes, especially in tropical areas. Although under some circumstances the glycerinated vaccine is preferred because of lower cost and its availability in single-dose containers, it is well recognized that even with the best managed medical facilities storage procedures are frequently inadequate.

Supplies of freeze-dried vaccine for the global eradication programme have been inadequate to date to meet immediate needs. Further, the quality, particularly the potency, of the vaccine has not infrequently failed to meet recommended standards. As pointed out in past reports to the World Health Assembly, the production of freeze-dried vaccine demands high standards of skill and responsibility in the professional and technical staff employed. Routine assessment of each lot of vaccine produced must be systematically carried out.

The costs and difficulties involved in establishing effective vaccine production facilities are considerable. Further, the consultant staff available from established facilities to render necessary assistance is limited.

These considerations dictate the necessity of limiting the number of vaccine production facilities to a few comparatively large, efficient institutions capable of supplying several countries, rather than having many small facilities the efficiency of which would be dubious.

Because of the urgent and continuing need for large quantities of vaccine of known high potency, a substantial supply of vaccine from the non-endemic countries by donation or on a bilateral assistance basis is required on a yearly basis for the next three years at least.

2.3 Surveillance

It is necessary for the eradication programmes to develop a systematic plan for the detection of possible cases and concurrent investigation regarding the source and site of acquisition of the disease, the establishment of vaccination status and the prompt instigation of containment measures. Detailed epidemiological investigation of all cases to establish the reasons for their occurrence and the means by which they are being spread can be one of the most effective instruments to provide continuing guidance and direction in the vaccination programme. In the simplest terms, each case which occurs suggests the possibility of flaws in the programme. An outbreak, however small, demands a full critical review with appropriate revisions of the programme.

The ultimate measure of any eradication programme is its success in reducing the number of cases to zero. So long as the disease is endemically transmitted, an eradication programme has failed to achieve its goal whatever the proportion of the population apparently successfully vaccinated.

Even in countries with a limited local health structure, a systematic surveillance plan can and must be developed as an essential component of the eradication programme. The simplest type of approach might consist of a weekly report from each hospital and dispensary noting whether suspect cases of smallpox had or had not been seen. Simple basic information should be requested for each suspect case, consisting of name, age, sex, residence of patient and date of onset of illness. Hospitals or dispensaries failing to submit a report should be contacted promptly to ascertain specifically whether or not cases have been observed.

This portion of the surveillance activity should be initiated concomitantly with the development of any systematic vaccination programme. Even where cases are comparatively few at the inception of the programme, detailed investigative and containment efforts should be initiated promptly. The discovery of apparent indigenous transmission should be accompanied by a two- or three-day intensive mass programme of vaccination in the immediate area. In highly endemic countries, such detailed field appraisal may not be practical until a vaccination campaign in the immediate areas has been completed. It should not, however, be delayed until a country-wide programme has been completed.

Accurate diagnosis of individual cases may prove difficult in some instances. Not uncommonly, smallpox cases are confused with varicella (chickenpox) or disseminated herpes simplex, for example. To facilitate accurate diagnosis, it is desirable that simple pictorial field manuals pertaining to clinical diagnosis be developed. Provision must be made for the establishment of a number of virus diagnostic laboratories and the training of competent technical staff. Since facilities and competence in virological diagnosis are limited in many parts of the world, consideration must be given to centralized facilities. The stability of smallpox virus lends itself well to the utilization of such centralized facilities. Specimens from lesions

can be shipped without refrigeration with a high expectation of recovering virus for indentification even though many days have elapsed.

A regional surveillance programme is an important component part of the eradication scheme. Increasing facilities for travel plus continuing major population migrations across national borders permit ready dissemination of infection from country to country. Strengthening of the advisory staff at regional and national level to assist individual countries in the development of adequate surveillance programmes, able to render assistance promptly both in the field investigation phases and in direct containment operations and serving to integrate information obtained from the separate countries, would ensure greater success of the over-all programme.

It should be realized that the surveillance system thus being developed will be utilized not only for smallpox services but also to provide epidemiological services for other communicable diseases.

2.4 Approaches to Intensive Country-wide Vaccination Programmes

Several approaches to intensive vaccination programmes have been employed, namely: vaccination conducted in established local health service dispensaries, etc.; vaccination on a systematic house-to-house basis; and vaccination of large groups collected at a series of different locations. Their relative merits and demerits must be carefully weighed.

2.4.1 *Vaccination conducted in Established Local Health Service Dispensaries, etc.*

Experience has shown that, although this system is useful in providing protection to those willing or able to avail themselves of existing facilities, only limited coverage of the population can normally be achieved by this approach, even in countries where local health services are comparatively numerous. The least well educated in the most densely crowded areas normally respond poorly although, as previously noted, it is in this group specifically that the highest levels of immunity are required. Intensive utilization of this approach should be explored and well organized because the participation of the local health services is essential to develop the systematic programme in the most efficient way.

2.4.2 *Vaccination on a Systematic House-to-house Basis*

Many campaigns have been and are being carried out on a house-to-house basis. If done competently, the over-all coverage which can be achieved is highest by this method. A substantial number of personnel is required, however, since experience shows that the individual vaccinator normally can vaccinate by this house-to-house method an average of only 50 to 70 persons per day in rural areas. It should be noted that one of the main difficulties so far recognized in the present projects is a serious shortage of field personnel. If household rosters are obtained, they should be simple and practical. Also, recording of the field work should include the minimum items necessary for the systematic operation. The maintenance of detailed family rosters, although excellent in principle, has proved difficult in practice, especially in the areas where population movement is quite rapid.

In brief, this system can provide more effective total coverage if a large staff can be mobilized and carefully supervised.

2.4.3 *Vaccination of Large Groups collected at a Series of Different Locations*

Mass vaccination employing intensive publicity and the establishment of vaccination sites on a village-by-village basis, on street corners, in markets and other places of congregation in major cities permits a more efficient utilization of personnel. Simple recording procedures, together with a concurrent assessment scheme should be all that are necessary for this campaign. One of the methods used is a sample survey of the population seven days following the campaign at which time those selected for survey are asked whether they have been vaccinated and, if so, their reactions are read.

In contrast with the house-to-house type campaign, a more detailed planning scheme, including intensive health education adapted to the individual area, is required if the programme is to be fully effective. This is particularly true in major population centres with less cohesive social structures. Thus, somewhat higher quality personnel are required. The operational complexities arising from the large numbers of personnel necessary for the house-to-house type campaign would be vastly simplified in this method. If fewer vaccinators are needed higher quality staff may be hired, thus ensuring a higher proportion of successful vaccinations and more rigid adherence to procedures required for vaccine preservation.

This type of campaign permits utilization of mechanical jet injectors which have the capacity of vaccinating as many as 500 to 1000 persons per hour. Adequate studies of two devices have been reported. Successful vaccination rates with these have consistently been 10 per cent. higher than those achieved by trained vaccinators in the same area. Pilot mass vaccination programmes in Brazil conducted in a series of villages and towns with populations ranging

up to 35 000 have demonstrated that population coverage as measured by successful vaccination has been approximately equivalent to that achieved by trained vaccinators in a house-to-house systematic programme. The costs, personnel and transport required were less than 25 per cent. of those for the house-to-house systematic programme.

2.4.4 *Combined Programme*

The combination of smallpox vaccination with another programme employing systematic coverage of a population in a vaccination programme or other disease control activity has proved effective in some intensified campaigns. Since the costs of personnel and transport are normally major expenses in a mass vaccination programme, the combination of several activities has a great deal of merit. If, however, the completeness of coverage must be compromised, the economy of the procedure could well prove to be a false saving necessitating a repeat programme.

2.4.5 *Summary*

It is apparent that each of the approaches outlined has advantages and disadvantages suggesting that, for most programmes, they should be combined in an appropriate manner. Careful advance planning is necessary, but it must be recognized that for a fully effective programme continuing adaptation is important. In addition, it should be stressed that the development of general health services can provide a valuable basis for the campaign and smallpox services will be carried out as far as possible within the framework of the general health services, which would be strengthened where necessary.

Provision must be made for continuing assessment of the completeness of vaccination coverage at appropriate local or national levels by individuals who are not themselves members of vaccination teams. The assessment aspect is an integral part of the programme and should serve to redirect operational plans. As previously pointed out, epidemiological investigations pertaining to the occurrence of smallpox cases represent another form of assessment, and similarly should serve to provide programme guidance.

2.5 Maintenance Programmes

Until all endemic countries have completed valid eradication programmes and until at least a three-year period has elapsed without cases being recorded anywhere in the world, maintenance programmes of vaccination will be required in all of these countries. Methods for the conduct of maintenance programmes are expected to vary widely from country to country. Certain specific groups, however, will require particular emphasis:

(1) urban populations, especially those in densely crowded lower socio-economic areas;

(2) migrants who might be expected to transmit the disease widely and those recently entering urban areas from less well vaccinated rural districts;

(3) schoolchildren, among whom disease may pass quickly and thence to the community at large;

(4) new-born babies: if they are not adequately vaccinated, a large proportion of fully susceptible individuals can accumulate in a community within a comparatively short time;

(5) dispensary and hospital staffs, including laundry personnel: the high risk of disease spreading to these groups has been repeatedly demonstrated.

Some countries may elect to carry out intensified programmes augmented by continuing vaccination programmes in health centres and elsewhere; others may incorporate vaccination into other types of immunization and disease control programmes. Whatever the approach, it is most important to reach specifically the groups noted above and achieve as near total coverage of the population as possible. Finally, it should be noted that the development of the general health services is of the utmost importance to carry out an effective maintenance programme.

3. THE SMALLPOX ERADICATION PROGRAMME AT PRESENT

During 1959, when the global eradication programme was initiated, 81 444 cases of smallpox were reported (see Table 1). The number of cases reported annually since 1959 has fluctuated, reaching a maximum of 99 599 cases in 1963, but declining to half this number in 1964 and in 1965, according to provisional figures. Eradication and control measures have been partly responsible for this decline. However, incomplete reporting in certain areas and delayed reports of cases are known to have influenced these figures. Further, a natural, long-term cyclical variation in the incidence of smallpox is well recognized.

Eradication of the disease appears to have been achieved in North and Central America, Europe, North Africa, the Middle East and the Pacific countries, as well as in some countries in South America.

TABLE 1. SMALLPOX CASES REPORTED, BY CONTINENT, 1959-1965

Continent	1959	1960	1961	1962	1963	1964	1965
Africa	15 781	16 127	24 182	24 837	16 723	12 362	15 882
The Americas	4 899	5 531	8 168	7 860	7 126	3 051	1 529
Asia	60 749	39 251	53 217	49 579	75 621	34 543	33 145
Europe	15	47	27	137	129	—	1
WORLD TOTALS	81 444	60 956	85 594	82 413	99 599	49 956	50 557

— Nil.

Endemic areas now include six countries in Asia (Afghanistan, Burma, India, Indonesia, Nepal and Pakistan), essentially all African countries south of the Sahara and three countries in South America (Brazil, Colombia and Peru). Although the great majority of cases are reported from the far more populous Asian countries, the incidence of disease is probably at least as high or higher in many areas of Africa and South America.

Transmission of disease from the endemic countries to smallpox-free areas remains a problem. Colombia and Peru, for example, both previously freed from endemic smallpox, have experienced the reintroduction of the disease and the establishment of endemic foci. Many imported cases continue to be reported annually to WHO from various countries throughout the world.

At the present time, eradication and control programmes are at various stages of development in Asia, Africa and South America with problems of differing character in each of the areas.

Africa

In Table 2 is shown smallpox incidence in individual countries. Smallpox control programmes of a more or less intensive nature are now being conducted in all of the endemic African countries.

WHO-assisted eradication or control projects have been, or are being, carried out in eight African countries. Two of these countries report having completed systematic mass vaccination campaigns.

In the Ivory Coast and Upper Volta, systematic coverage of the total population has been achieved by mobile teams. Reported cases in both countries have shown a marked decrease. In the Ivory Coast, 4656 cases were recorded in 1961 and 8 cases in 1965; in Upper Volta, 2360 cases were reported in 1961, 14 in 1965. To maintain immunity levels, repeat mass vaccination campaigns every three to four years are being considered. Population movement from adjacent endemic countries is a significant problem. The surveillance systems in both countries need strengthening.

TABLE 2. SMALLPOX INCIDENCE IN THE CONTINENT OF AFRICA, 1961-1965

	1961	1962	1963	1964	1965
Algeria	8	1	—	—	—
Angola	—	23	38	1	—
Basutoland	83	52	—	—	—
Bechuanaland	16	4	—	174	—
Burundi		26	3	—	1 209
Cameroon	1 345	792	133	81	—
Central African Republic	—	57	3	—	—
Chad	273	1 157	10	5	73
Congo (Brazzaville)	22	1 313	1 515	196	89
Congo, Democratic Republic of	2 251	3 785	5 496	2 302	3 643
Dahomey	119	124	228	703	167
Ethiopia	761	360	232	103	58
Gabon	—	1	111	49	1
Gambia	12	4	52	6	6
Ghana	75	135	23	9	7
Guinea	96	2 948	224	300	69
Ivory Coast	4 656	2 066	219	11	8
Kenya	289	96	254	266	271
Liberia	1 119	323	57	128	40
Malawi	1 465	634	455	704	228
Mali	1 706	1 668	1 096	321	615
Mauritania	12	40	1	—	—
Mozambique	51	67	85	250	111
Niger	1 740	1 038	445	29	509
Nigeria	3 538	3 863	1 774	1 416	4 566
Portuguese Guinea	7	2	—	—	—
Ruanda Urundi [1]	18				
Rwanda		30	—	—	5
Senegal	201	231	87	2	—
Sierra Leone	6	78	14	89	60
South Africa	8	112	163	329	62
Southern Rhodesia	3	15	44	200	40
Sudan	104	70	26	—	70
Swaziland	—	—	182	517	89
Togo	281	572	274	21	13
Uganda	398	628	419	523	1 315
United Arab Republic	1	4	2	—	—
United Republic of Tanzania	925	973	837	1 405	2 016
Upper Volta	2 360	1 335	339	8	14
Zambia	233	210	1 882	2 214	528
TOTALS	24 182	24 837	16 723	12 362	15 882

— Nil.

[1] Since July 1962 the independent States of Burundi and Rwanda.

The projects in the remaining six countries have encountered a variety of problems which have prevented their effective development. In Liberia, the WHO-assisted project was started in 1962 but so far less than 20 per cent. of the population has been covered. Shortages of field personnel and transport are the main obstacles hampering the project.

In Mali the WHO-assisted eradication project was agreed upon in 1962. Serious shortages of transport and field equipment, adverse weather conditions and inadequate numbers of supervisory staff and field personnel have permitted coverage of only one-third of the population so far.

In Nigeria, Sierra Leone and Togo combined projects of yaws control and smallpox vaccination are now under way. However, with the possible exception of the Togo project, the programmes are not expected to effect eradication because of the considerable time necessary to reach the entire population. In Nigeria and Sierra Leone intensive mass smallpox vaccination campaigns would be preferable, but shortages of personnel, transport, vaccine and field equipment have precluded this possibility.

In Sudan, the WHO-assisted project was started late in 1962; half of the population has been vaccinated so far. However, very few provinces included in the campaign have shown satisfactory results and the immunity level is decreasing rapidly. Planning, supervisory staff and field personnel are required to intensify the project.

In Zambia the smallpox programme is being intensified. The Union of Soviet Socialist Republics provided 2.5 million doses of freeze-dried vaccine for the programme in the first quarter of 1966.

Freeze-dried smallpox vaccine production facilities in Nigeria are partially operative but will require additional direct and advisory technical assistance. UNICEF/WHO assistance is being provided to Kenya in the development of vaccine production.

In brief, lack of adequate technical assistance, personnel, vaccine, equipment and supplies has hampered most of the African programmes initiated to date. Co-ordination of the programmes on a regional basis has not yet been achieved; efficient surveillance systems have not yet been developed. It is felt, however, that the principal difficulties can be remedied if the countries concerned place a greater emphasis on the programme and if additional assistance is provided in the form of WHO technical staff at the country and regional level in addition to adequate vehicles and supplies. If mass campaign techniques employing mechanical equipment (jet injectors) can be employed, a major difficulty—the lack of sufficient local personnel—could largely be surmounted in some of the programmes.

The Americas

In Table 3 is shown smallpox incidence in individual countries. In the Americas, a regional eradication effort was started in 1950 and eradication was achieved in many countries. Recently, however, the disease has become re-established in Colombia and Peru. Notably, smallpox became endemic again in Peru eight years following an effective eradication programme.

TABLE 3. SMALLPOX INCIDENCE IN THE AMERICAS, 1961-1965

	1961	1962	1963	1964	1965
Argentina	4	2	—	12	15
Bolivia	—	—	—	4	—
Brazil	7 656	7 589	6 211	2 505	1 318
Canada	—	1	—	—	—
Colombia	16	41	4	24	146
Ecuador	491	205	45	42	—
Paraguay	—	—	—	7	32
Peru	—	—	865	454	18
Uruguay	1	11	1	3	—
Venezuela	—	11	—	—	—
TOTALS	8 168	7 860	7 126	3 051	1 529

— Nil.

In Argentina, a national vaccination campaign started in 1961 when 4.4 million vaccinations were performed; 1.3 million, 0.6 million and 0.3 million vaccinations were carried out in 1962, 1963 and 1964 respectively. Twelve cases occurred in 1964, and there was an outbreak in the province near the border with Paraguay in the latter half of 1965. Another national vaccination campaign is planned and the surveillance system will be strengthened.

Although reporting is incomplete in Brazil, it would appear that smallpox is at present endemic throughout the country. An eradication programme was initiated in 1962 and more than 40 million persons have been vaccinated during 1963, 1964 and 1965. However, the programme has been hampered by the topographical conditions of the country and by the lack of communications and qualified staff. Three laboratories in Brazil equipped by PAHO are producing good quality freeze-dried smallpox vaccine in quantities adequate for the programme. National authorities are at present engaged in revising plans for the programme and developing a more effective administrative structure.

Colombia completed a well-organized eradication programme in 1961 but experienced a reintroduction of the disease, apparently from Brazil, in 1965. The disease has once again become moderately widespread. The Government is now considering a repeat programme of mass vaccination to be completed over a three-year period. External assistance will be required.

Peru, free of endemic smallpox since 1955, reported 865 cases in 1963, a result of reintroduction of the

disease in north-eastern areas bordering Brazil. A mass vaccination programme has again been initiated, and in 1964 more than three million vaccinations were performed.

Bolivia and Paraguay, neither of which is at present believed to be harbouring endemic smallpox, are at great risk of reintroduction of the disease because of their proximity to Brazil and relatively inadequate vaccination status and surveillance programmes. A vaccination programme in Bolivia is in progress with assistance from a WHO health inspector, but a variety of administrative, economic and political factors have hampered the programme.

The need for a regional eradication scheme is only too apparent in South America. The persistence of endemic smallpox in Brazil has necessitated the recommencement of national campaigns in adjacent countries. Failure to establish adequate surveillance schemes prevented Peru and Colombia from detecting imported cases sufficiently early to permit containment; maintenance immunization programmes were ineffective and widespread transmission soon resulted.

Of the principal endemic areas of the world, South America could most easily achieve smallpox eradication. The key to the problem is Brazil. Some assistance in the form of technical aid and equipment will be required in several countries; and a vastly more effective programme of surveillance, nationally and regionally, will be required throughout the Americas.

Asia

In Table 4 is shown smallpox incidence in individual countries. The status of smallpox eradication in Asia is intermediate between the relatively advanced situation in the Americas and the developing stages in Africa. Most of the endemic countries in this continent started mass vaccination campaigns between 1960 and 1962. However, progress has been irregular. Between 1959 and 1964 several countries, including Ceylon, Malaysia, the Republic of Viet-Nam, Singapore and Thailand, became free of smallpox. Six countries remain endemic: Afghanistan, Burma, India, Indonesia, Nepal and Pakistan.

In Afghanistan, although WHO-assisted projects were started in 1962, a systematic programme has not yet been developed. Only 20 per cent. of the total population has been vaccinated. Principal difficulties include the lack of national funds to provide sufficient supervisory and field personnel and transport for the project, difficult terrain, and problems in vaccinating the comparatively secluded female population in many areas. WHO and the Union of Soviet Socialist Republics have supplied sufficient freeze-dried vaccine for the project so far.

TABLE 4. SMALLPOX INCIDENCE IN ASIA, 1961-1965

	1961	1962	1963	1964	1965
Aden and Protectorate of South Arabia	1	—	—	—	—
Afghanistan	174	303	571	157	72
Burma	88	21	193	28	8
Cambodia	1	—	—	—	—
Ceylon	34	12	1	—	1
India [a]	45 195	42 231	60 901	31 587	27 658
Indonesia	4 677	3 340	7 966	1 874	3 985
Iran	123	29	6	12	—
Iraq	—	—	—	—	—
Kuwait	—	1	—	—	—
Muscat and Oman	—	8	—	—	—
Nepal	5	...	779	99	84
Pakistan:					
East Pakistan	421	523	3 724	43	259
West Pakistan	2 321	3 091	1 475	738	1 078
Portuguese India	124				
Qatar	1	—	—	—	—
Republic of Korea	1	—	—	—	—
Saudi Arabia	17	1	—	—	—
Singapore	—	—	—	—	—
Thailand	33	2	—	—	—
Trucial Oman	—	17	—	—	—
Union of Soviet Socialist Republics (Asian region)	1	—	—	—	—
Yemen	...	...	5	5	—
TOTALS	53 217	49 579	75 621	34 543	33 145

a Based on the provisional figures in the *Weekly Epidemiological Record*. Recently the Indian Smallpox Campaign Office stated that the number of smallpox cases reported to them were: 45 380 in 1961; 55 579 in 1962; 83 423 in 1963; 39 886 in 1964; and 26 817 in 1965.

— Nil.

... Data not available.

Burma has conducted a successful campaign and is expected to complete the mass campaign phase by 1966. The project is based mainly on existing basic health services with a plan for coverage of the total population once every three years. Twenty-eight cases were reported in 1964 and eight cases in 1965. Vaccine production is in the developing stage, with assistance from UNICEF and WHO, and most of the vaccine is still being supplied by the Union of Soviet Socialist Republics and WHO.

India started a campaign in 1962 and hopes to complete it by the middle of 1966. So far, 420 million vaccinations have been performed. There has been a downward trend in smallpox incidence during the past few years. In November 1965, the Indian Advisory Committee of the National Smallpox Eradication Programme met and reviewed the pro-

gramme in terms of progress of the campaign to date, steps necessary to improve the regular coverage, epidemiological criteria to permit the programme to enter the maintenance phase, and the progress of freeze-dried vaccine production. The committee recommended a further study on the methods of implementing the maintenance programme in relation to the basic health services. The Union of Soviet Socialist Republics has provided a large amount of freeze-dried vaccine (over 400 million doses) for this project on a bilateral basis and, in addition, vaccine has been donated by other countries through WHO. Four vaccine production plants were started in 1962 and 1963 with the assistance of UNICEF and WHO and serious consideration is now being given to developing production capacity sufficiently to meet annual demands of the national programme (170 million doses).

In Indonesia an eradication plan has been drawn up but the nation-wide programme has not yet been implemented. Adequate freeze-dried vaccine is produced locally.

In Nepal, a WHO-assisted programme was started in 1961 but the project was limited mainly to the Kathmandu Valley. The project has been suffering from a serious shortage of field personnel, lack of transport under extremely difficult geographical conditions, and some resistance on the part of the people against vaccination. An intensive effort, supported by substantial external assistance, employing mobile teams with adequate transport, could probably achieve proper coverage within a three-year period. At present, the Government is considering intensifying the project by vaccinating a population of two to three million each year. Vaccine must be supplied from outside sources.

East Pakistan completed a mass vaccination programme in 1964, providing coverage to over 80 per cent. of the population, and entered the maintenance phase; 20 million and 15 million vaccinations were carried out in 1964 and 1965 (up to September) respectively. Reports of cases decreased substantially from 3724 in 1963 to 43 in 1964. In 1965, however, 259 cases were reported. A repeat mass programme may be necessary in some particular areas; at the very least, an intensified maintenance and surveillance programme must be developed. Adequate vaccine can be produced locally. In West Pakistan, 12 million and 10 million vaccinations were performed in 1964 and 1965 (up to September) respectively. The programme is being intensified, but still a substantial number of cases—1078—were reported in 1965.

In Asia, vaccine must be supplied to all countries for mass campaigns except Indonesia and Pakistan. Within one or two years, however, local vaccine production in India and Burma is expected to meet national demands for maintenance vaccination programmes. Moderately substantial quantities of transport and equipment will be required for all programmes. Supplementary technical personnel for assessment, planning, supervision and the development of surveillance are required to a greater or lesser extent for all countries. Effective maintenance programmes and surveillance on a regional basis are needed. Methods of achieving coverage of groups resistant to vaccination in Afghanistan and Nepal must be explored.

Europe

In Table 5 is shown smallpox incidence in Europe. Several countries have reported imported or secondary cases during recent years, but there were no imported cases in 1964 and only one case in 1965.

TABLE 5. SMALLPOX INCIDENCE IN EUROPE, 1961-1965

	1961	1962	1963	1964	1965
Belgium	1	—	—	—	—
Eastern Germany	—	—	1	—	—
Federal Republic of Germany	5	38	—	—	1
Hungary	—	—	1	—	—
Poland	—	32	99	—	—
Spain	17	—	—	—	—
Sweden	—	—	27	—	—
Switzerland	—	1	1	—	—
Union of Soviet Socialist Republics (Moscow)	1	—	—	—	—
United Kingdom of Great Britain and Northern Ireland	3	66	—	—	—
TOTALS	27	137	129	—	1

— Nil.

4. PROPOSED PROGRAMME FOR THE GLOBAL ERADICATION OF SMALLPOX

4.1 General Considerations

Of the utmost importance and urgency is the development of eradication programmes in all endemic countries at the earliest possible date. In some countries, eradication programmes have been or are being completed, and maintenance programmes are in

progress. Maintenance programmes, however, are reasonably difficult to carry out effectively; each year that they must be continued only serves to augment the over-all costs of the global programme. At all times during this period, of course, the possibility of reintroduction and re-establishment of endemic smallpox is real.

To initiate and execute the programme calls for a maximum effort on the part of the individual endemic countries, aided appropriately by technical assistance, equipment, vaccine and other supplies. Of major importance is the evolution of maximally effective programmes for surveillance, field investigation and disease containment.

To provide the necessary impetus, direction, coordination and supervision requisite for a unified global effort, strengthening of the headquarters and regional staff is proposed. In addition, technical advisers at the country level are considered necessary.

It is expected that early action will be necessary to obtain the large amounts of freeze-dried vaccine requisite for this major undertaking.

For purposes of over-all planning, it is necessary to assume that support for an intensified global eradication effort will be forthcoming from each of the endemic countries. A simultaneous intensified global effort would be technically desirable although logistically impracticable. It is proposed, therefore, that eradication efforts be developed or continued in selected countries during 1967, with the extension of the programme to all endemic countries from 1968 onwards. Although in the smaller countries nationwide campaigns can sometimes be achieved in a single year, it is believed that most countries, from the standpoint of transport and personnel, will find it more convenient to extend the intensified phase of the programme over a three- to four-year period. Assuming this phase to be successful, maintenance programmes covering the new-born, migrants, specific age-groups, etc., should follow each year thereafter.

Also, in the planning it is desirable to outline a long-term programme over the next ten years in order to envisage future development of the global eradication activities.

It is believed that in the Americas, Africa and perhaps some countries in Asia intensified vaccination campaigns will partly rely upon the jet injectors for vaccination, supplemented appropriately by the multiple pressure method, varying the extent of its use according to the operation areas.

Since each country necessarily poses particular problems regarding transport and resources of operational and field personnel, it is possible to estimate only approximately the over-all costs required to supplement the maximum effort in each country.

4.2 Proposed Programme for 1967

For the WHO assistance programme in 1967, as mentioned above, attention has been directed to those countries with programmes fully or partially operative, those already prepared to embark on eradication programmes, and selected countries strategically located geographically. Proposed for assistance in 1967 are continuing programmes in Asia (Afghanistan, Burma, India, Nepal and Pakistan); Africa (Ivory Coast, Liberia, Mali, Sudan, Togo and Upper Volta); and South America (Bolivia and Peru). In addition, in South America, Brazil has indicated that it is planning to embark on a more vigorous programme; for geographical reasons, programmes in Colombia and Paraguay should parallel the Brazilian effort; in Argentina re-establishment of the programme is being considered. In Africa, Nigeria and Sierra Leone have expressed interest in embarking on eradication programmes at an early date. A geographically continuous programme should be initiated in Africa and all countries in that area should participate.

4.2.1 *Vaccine Required*

The three main sources of supply of freeze-dried vaccine for the programme are local production, donations through WHO, and contributions to countries on a bilateral basis. Vaccine is available in ample quantity in all South American countries and in Pakistan. It is hoped that the Union of Soviet Socialist Republics will be able to continue its bilateral assistance by providing requisite supplies of vaccine to Afghanistan, Burma and India. Burma needs 7 million doses for the 1967 programme, India 170 million doses, and Afghanistan 3 million doses.

The needs of the remaining countries should be estimated by taking into consideration the target population coverage of individual projects, vaccination for a maintenance programme, an additional stock of vaccine for emergency use (epidemics and gaps between regular supply), wastage of vaccine, etc. It is assumed that approximately 55 million doses of vaccine will be necessary during 1967 to supply other countries from outside sources either through WHO or on a bilateral basis, presuming that the existing bilateral arrangements for vaccine supply will continue in the future.

Freeze-dried smallpox vaccine for the eradication programme should conform with the WHO requirements for biological substances. The requirements were newly revised in 1965. In the new requirements [1] the potency of the freeze-dried vaccine should exceed 1×10^8 pock-forming units using chick embryo

[1] *Wld Hlth Org. techn. Rep. Ser.*, 1966, **323**.

(5×10^7 in the old requirements [1]) and the total bacterial content should not exceed 500 per ml of reconstituted vaccine (1000 in the old requirements). The new requirements for the vaccine will take effect from 1967.

Part of the vaccine supply may be used in jet injectors. Freeze-dried vaccine prepared for multiple pressure use and that proposed for use in the jet injectors differs in that the latter is supplied in quantities in vials and, when reconstituted, results in a tenfold more dilute suspension than that for multiple pressure application. The bacterial content per ml should be almost nil for the purpose of intradermal injection. The rationale of a more dilute material for the injectors is based on the fact that essentially all of the virus particles are inoculated as contrasted to multiple pressure or similar methods in which comparatively few particles are actually inoculated with most of the vaccine remaining on the skin surface. Experimental studies have validated this assumption.

It is believed that this approach with a jet injector is to be preferred for use generally in South America, partly supplemented by multiple pressure vaccination for " mopping-up " operations and for vaccination in remote areas. In African countries, where programmes have been severely hindered by a lack of personnel, it is likely that jet injectors are also to be preferred, especially in densely populated areas. The experience to date in mass measles vaccine programmes in West Africa tends to substantiate this belief. In Asian countries, variable use may be made of this tool, depending on the results of evaluation studies.

4.2.2 *Other Supplies and Equipment Needed*

Requirements have been estimated on the basis of information from a number of countries. They include transport, refrigerators, jet guns, camping equipment, vaccine kits, etc.

4.2.3 *WHO Staff*

Integrated, well co-ordinated programmes require the formation of an adequately staffed headquarters unit and regional offices. Three medical officers are proposed for headquarters. Headquarters will be expected to assume principal responsibility which will include planning and continuous assessment of the world-wide programme as a whole; co-ordination of regional activities towards global eradication; development of operational assessment, surveillance and diagnostic standards for field use; and planning, development and co-ordination of research programmes of interest to the continuing programmes.

It is planned to provide a regional adviser for each region (Africa, the Americas, the Eastern Mediterranean and South-East Asia). In addition, it is proposed to provide WHO technical personnel in the field. Regional offices will take the responsibility for providing close co-ordination, consultation, supervision and impetus for the separate programmes. As mentioned above in chapter 2, since the method of operation should be flexible enough to develop reasonably efficient programmes in the different epidemiological situations and health service structures in each country or area, regional offices will assist in the planning, implementation and assessment of eradication programmes. The regional offices will also assist in the establishment of a surveillance system on a regional basis.

4.2.4 *Consultant Services*

Since particular difficulties have arisen in the provision of adequate supplies of freeze-dried vaccine of high quality—an essential key to the global programme—it is proposed to provide substantial consultant services to the several production facilities in the endemic countries and a regular testing service for vaccines produced.

Additional consultant services regarding the development of virus diagnostic facilities, assessment methods, surveillance procedures and planning will also be required.

4.2.5 *Training Courses*

It is proposed to hold inter-regional training courses in methods of operation, assessment, surveillance and laboratory procedures for national and international staff.

4.2.6 *Research Projects*

A number of important technical areas demand intensive study, the results of which should serve further to guide the programme in the years immediately ahead. These should include epidemiological studies to assess the circumstances and factors necessary for the continued endemic propagation of the disease and the duration of immunity conferred by vaccination under circumstances of natural challenge; comparative studies of strains from different areas, and evaluation of chemoprophylactic agents. It is hoped that total or partial financial support for many of these projects will be provided directly to the responsible investigators from national funds.

4.2.7 *Fellowships*

The principal training in operational and surveillance procedures will be provided by WHO staff and consultants at regional and national levels. Several fellowships, however, will be required for the training of

[3] *Wld Hlth Org. techn. Rep. Ser.*, 1959, **180**.

national personnel in vaccine production and virus diagnostic work.

4.3 Assistance from the World Food Program

The World Food Program has expressed its interest in collaboration with WHO health programmes, especially in support of the smallpox eradication programme. As the smallpox programme in endemic countries is hampered by the shortage of field personnel and inadequate financial provision for expanding such personnel, it would be a great advantage if countries could provide partial payment of salaries with food made available by the World Food Program. The possibility of using this assistance for the smallpox eradication programme might be further explored.

4.4 Bilateral Assistance

In a number of West African countries the development of a large-scale smallpox eradication programme with bilateral assistance from the United States of America is being proposed. The assistance to the countries will include technical personnel, vaccine, transport and other equipment. A country in East Africa has similarly been assisted through bilateral aid from the Union of Soviet Socialist Republics.

In accordance with its normal role, WHO will assist the endemic countries in the planning of national eradication programmes taking into account all available resources within the country and from outside and in the co-ordination and promotion of inter-country collaboration on a regional basis. To the extent that substantial bilateral assistance becomes available for the endemic countries, acceleration of the proposed global eradication programme could be envisaged. Suitable adjustments in individual country plans can be effected in accordance with available resources to quicken the pace of implementation.

5. LONG-TERM PROGRAMME

A plan has been prepared for the development of the smallpox eradication programme during the next ten years, from 1967 to 1976.

There are several factors involved in this planning: the continuation in the endemic countries of synchronization of eradication activities over large areas, the future assistance from non-endemic countries, the development of an efficient surveillance system on a regional basis, the development of basic health services in individual countries, the progress of technology to increase the efficiency of the programmes, the possibility of sudden severe epidemics in large areas which may require modification of the plan for the countries concerned, etc.

Obviously, many of these factors cannot be forecast at present. Therefore, this plan only gives the tentative phasing of the programmes in individual countries, broad estimates of the population to be vaccinated with assistance from outside sources, and general cost estimates of the programme each year in the world as a whole. It is hoped that the plan may supply Member States with information on how to prepare and proceed with the programme towards the ultimate goal of eradication of the disease.

5.1 The Phasing of the Programme

A plan for phasing has been prepared mainly on the basis of a reassessment of the material received from the regional offices up to November 1965. It is proposed that the campaign should start with the three- to four-years' attack phase, followed by the maintenance vaccination programme. The maintenance phase should continue until the disease has been eradicated. However, in this plan international assistance for the maintenance phase is estimated to last four years, because at the latter stage of the programme the incidence of smallpox will be considerably reduced and it is expected that the programme will be carried out by the countries without substantial material assistance from outside sources.

African Region

For the purposes of the programme the African Region is divided into West Africa and East Africa.

West African countries

In Table 6 is shown the phasing of the programmes proposed for West African countries. Dahomey, Ivory Coast, Liberia, Mali, Nigeria, Sierra Leone, Togo and Upper Volta are included with the countries where the campaign will start with WHO assistance in or before 1967. In these countries smallpox control or eradication programmes are already under way or are at preparatory stages at present. The duration of the programme in individual countries will vary depending upon the progress which has been made so far.

TABLE 6. PHASING OF THE PROGRAMMES : WEST AFRICAN COUNTRIES [a]

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Cameroon	*	**	**	**	***	***	***	***		
Central African Republic	*	**	**	**	***	***	***	***		
Chad	*	**	**	**	***	***	***	***		
Congo (Brazzaville)	*	**	**	**	***	***	***	***		
Congo, Democratic Republic of	*	**	**	**	**	***	***	***	***	
Dahomey	**	**	**	***	***	***	***			
Gabon	*	**	**	**	***	***	***	***		
Gambia	*	**	**	**	***	***	***	***		
Ghana	*	**	**	**	***	***	***	***		
Guinea	*	**	***	***	***	***				
Ivory Coast	***	***	***	***						
Liberia	**	**	**	***	***	***	***			
Mali	**	**	***	***	***	***				
Mauritania	*	**	**	**	***	***	***	***		
Niger	*	**	**	**	***	***	***	***		
Nigeria	**	**	**	***	***	***	***			
Senegal	*	**	**	**	***	***	***	***		
Sierra Leone	**	**	**	***	***	***	***			
Togo	**	***	***	***	***					
Upper Volta	***	***	***	***						

[a] Excluding Angola, Portuguese Guinea and Equatorial Guinea, where it is anticipated that eradication programmes can be carried out with national financing only.

* Preparatory stage or national control programme in operation.

** Attack phase.

*** Maintenance phase with international assistance.

Relatively intensive smallpox control programmes have been carried out, mainly by the Services des grandes Endémies, in French-speaking countries, including Cameroon, Central African Republic, Chad, Gabon, Guinea, Mauritania and Niger in recent years. Some of these countries—for example, the Central African Republic and Guinea—have already proposed starting an eradication programme in 1966 or 1967. In the Democratic Republic of the Congo it was proposed that the pilot project should be carried out in 1966 and the campaign should start in 1967 in provinces where the situation is appropriate for commencement of the programme. Little information is available from Congo (Brazzaville), Gambia, Ghana and Senegal.

TABLE 7. PHASING OF THE PROGRAMMES: EAST AFRICAN COUNTRIES [a]

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Burundi	*	**	**	**	***	***	***	***		
Kenya	*	**	**	**	***	***	***	***		
Malawi	*	**	**	**	***	***	***	***		
Rwanda	*	**	**	**	***	***	***	***		
Uganda	*	**	**	**	***	***	***	***		
United Republic of Tanzania	*	**	**	**	***	***	***	***		
Zambia	*	**	**	**	***	***	***	***		

[a] Excluding Basutoland, Bechuanaland, Mozambique, Southern Rhodesia, Swaziland and South Africa, where it is anticipated that eradication programmes can be carried out with national financing only.

* Preparatory stage or national vaccination programme in operation.

** Attack phase.

*** Maintenance phase with international assistance.

TABLE 8. PHASING OF THE PROGRAMMES : REGION OF THE AMERICAS

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Argentina	**	**	***							
Bolivia	**	**	**							
Brazil	**	**	**	***	***	***	***			
Colombia	**	**	**							
Paraguay	**	**	**							
Peru	**	**	***							

** Attack phase.
*** Maintenance phase with international assistance.

Assistance is proposed for all these countries from 1968 onwards, although some of them will start or continue the programmes in 1966 or 1967.

East African countries

In Table 7 is shown the phasing of the programmes proposed for seven East African countries: Burundi, Kenya, Malawi, Rwanda, Uganda, the United Republic of Tanzania, and Zambia. Uganda and Zambia are preparing to intensify the programmes. The projects are being discussed between governments and WHO in Burundi, Kenya and the United Republic of Tanzania. In this plan, assistance is proposed for all these seven countries from 1968 onwards.

Region of the Americas

In Table 8 is shown the phasing of the programmes planned for the Americas. Argentina and Peru are expected to carry out a two-year mass vaccination programme covering especially the population in the border areas where there is a risk of introduction of smallpox cases. In both these countries, after the campaign a one-year programme for " mopping-up " operations is proposed. In Bolivia, Colombia and Paraguay a three-year attack phase programme is proposed, starting in 1967. In Brazil a three-year attack phase is planned to start in 1967 and the project will be continued as a maintenance programme, as Brazil is the principal endemic country in the Americas.

South-East Asia Region

In Table 9 is shown the phasing of the programmes proposed for South-East Asia. WHO-assisted projects started in Afghanistan in 1962 and in Nepal in 1961. Since the period of the programme has been prolonged, effective herd immunity has not yet been established in the population. Therefore, it is proposed that the attack phase should start in both countries in 1967 with three years' duration in Afghanistan and four years in Nepal. Burma is expected to complete the attack phase in 1966 and to start the maintenance programme from 1967 onwards. In India, the attack phase had been expected to be completed in 1966 but it is assumed that the programme will have to be continued in 1967 in the form of " mopping-up "

TABLE 9. PHASING OF THE PROGRAMMES : SOUTH-EAST ASIA REGION

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Afghanistan	**	**	**	***	***	***	***			
Burma	***	***	***	***						
India	**	***	***	***	***					
Indonesia	*	**	**	**	***	***	***	***		
Nepal	**	**	**	**	***	***	***	***		

* Preparatory stage.
** Attack phase.
*** Maintenance phase with international assistance.

TABLE 10. PHASING OF THE PROGRAMMES: EASTERN MEDITERRANEAN REGION [a]

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
Ethiopia	*	**	**	**	***	***	***	***		
Pakistan:										
East Pakistan	***	***	***	***						
West Pakistan	**	**	***	***	***	***				
Sudan	**	**	**	***	***	***	***			

[a] Smallpox vaccination programmes are in progress in Saudi Arabia, Somalia and Yemen. However, detailed information is not available at present.

* Preparatory stage.

** Attack phase.

*** Maintenance phase with international assistance.

operations. In 1968 India is expected to start the maintenance vaccination programme. In Indonesia the programme would be at a preparatory stage in 1967 and it is expected that Indonesia will start a campaign in 1968 and complete the attack phase within a three-year period in the framework of the relatively developed health services. The maintenance phase will follow.

Eastern Mediterranean Region

In Table 10 is shown the phasing of the programmes proposed for the Eastern Mediterranean Region. In Ethiopia the project is being discussed with the Government. A pilot project is proposed for 1966 and the campaign may start in 1967, but the main assistance is proposed from 1968 onwards. Sudan has been carrying out a vaccination campaign in recent years. However, it is considered that a three-year attack phase should be carried out, starting in 1967. In both countries maintenance programmes will follow. In East Pakistan a smallpox eradication programme is in progress. In West Pakistan the attack phase was initiated in 1964 and is gradually being extended.

The phasing of the programmes in Ethiopia and Sudan should be considered on the same basis as the African programmes and the programme in Pakistan on the same basis as the South-East Asia programmes.

5.2 Broad Estimate of the Population to be Vaccinated

In Table 11 are shown broad estimates of the population in the various regions to be vaccinated with international assistance during the next ten years, based on the phasing of the programmes in individual countries.

The population in endemic countries is estimated as 1100 million in 1966, 1210 million in 1970 and 1350 million in 1974. It is planned to vaccinate approximately 220 million people in 1967 with international assistance. The number of vaccinations proposed will reach approximately 310 million in 1968. The programme is phased to develop to its height in 1969, when 350 million vaccinations are expected. From

TABLE 11. ESTIMATED POPULATION TO BE VACCINATED WITH INTERNATIONAL ASSISTANCE

(Population in millions)

WHO Region	Total population			Estimated population to be vaccinated with international assistance										
	1966	1970	1974	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Total
Africa	170	190	220	20	60	80	60	50	50	50	30	10	—	410
The Americas	140	160	180	40	60	60	30	30	30	30	—	—	—	280
South-East Asia	650	710	780	130	150	170	170	150	40	40	30	—	—	880
Eastern Mediterranean	140	150	170	30	40	40	50	20	20	10	10	—	—	220
TOTALS	1 100	1 210	1 350	220	310	350	310	250	140	130	70	10	—	1 790

TABLE 12. GENERAL COST ESTIMATES

(Expressed in US $ millions)

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	Total
Total estimated cost	22.0	31.0	35.0	31.0	25.0	14.0	13.0	7.0	1.5	0.5	180.0
Share of international assistance.	6.6	7.7	8.9	7.7	5.9	4.1	3.8	2.5	0.8	0.5	48.5

1970 the number of vaccinations will gradually decrease since the programme will be completing the attack phase and entering the maintenance phase. In the latter stages of this ten-year period, the figures for vaccination with international assistance would be 250 million in 1971, 130 million in 1973 and 10 million in 1975.

5.3 General Cost of the Programme

Several attempts have been made to obtain specific information on the cost of the programme. This includes theoretical assumption of the cost in African countries, revised information regarding the support proposed from the present programme in such countries as Afghanistan, Burma, India and Nepal, and also a review of the past experience of the programmes of several countries in Latin America and parts of Africa. It is reaffirmed that the cost of the campaign should be broadly estimated on the basis of US $0.10 per vaccination; 70 per cent. of the general cost for each campaign would be covered from national sources and 30 per cent. from external technical assistance (vaccine, transport, supplies and equipment). Past experience indicates that a 30 per cent. share of the general cost from outside sources would enable the endemic countries to establish and implement successful vaccination programmes. In addition it is proposed that, although international assistance will cease after a four-year maintenance programme, surveillance activities and urgent containment measures during possible outbreaks should be supported by international assistance on a global basis. For this purpose, a certain amount of funds should be provided each year from 1972 to 1976. The yearly cost from outside sources could be reduced by taking into consideration the fact that Burma, India, Kenya and Nigeria may be able to produce the necessary amount of vaccine for the campaign from 1968 onward.

The cost of the programme each year has been estimated as shown in Table 12. During the ten years it is expected that 1790 million vaccinations will be carried out, covering the entire population of endemic countries from the attack to the maintenance phase of the campaign. The cost is estimated at US $180 million, of which $22 million in 1967, $31 million in 1968 and $35 million in 1969. From 1970, along with the decrease of the number of vaccinations, the cost will decrease as indicated: $25 million in 1971, $13 million in 1973 and $1.5 million in 1975. International assistance, including that of WHO, is estimated altogether as $48.5 million during the ten-year period, consisting principally of 30 per cent. of the general cost and costs for surveillance activities in the latter stage. This $48.5 million will be distributed as $6.6 million in 1967, $7.7 million in 1968 and $8.9 million (maximum) in 1969. From 1970 the cost will decrease to $5.9 million in 1971, $3.8 million in 1973 and $0.8 million in 1975.

With regard to the $6.6 million from outside sources in 1967, an amount of $2.4 million has been included under the Special Account for Smallpox Eradication to meet the first year's costs, as presented in Annex 3 of *Official Records* No. 146 (pages 521-527); and a further amount of approximately $0.2 million is expected to be provided from other funds administered directly or indirectly by the World Health Organization; the balance of $4 million is expected to be covered on a bilateral basis or by other international agencies.

Finally, it can be stated that if the implementation of the programme is delayed or prolonged a further increase of the over-all cost of the programmes will result, since a greater number of the population than here estimated would need to be vaccinated.